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Leena Hiltunen

Enhancing Web Course Design Using Action Research

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ABSTRACT

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This research focuses on web course design and training university teachers to design their own web courses. The aim was to help busy university teachers to learn an easy and supportive way to design online courses. The objective was to enhance a specially developed topic-case driven web course design methodology and a variety of training modes using action research.

Based on existing action research findings the web course design methodology employed works well in different design and training situations for heterogeneous groups. The incremental and iterative nature of the process model allows confusions to be clarified as this research shows. A web course design process can be supported with different kinds of training sessions and guided by different kind of pedagogical scripts.

In training either large groups or single teachers, we can use different (kinds of) training modes in different settings. In this research project we tested the following six different training modes: short-term introductory workshop, short-term participatory workshop, middle-term learning network workshop, learning-by-doing workshop, long-term training course, and self-oriented online course. The results were positive and encouraging. Therefore, we shall continue with the blended development of the design process and tailored collaborative learning and production approaches.

Keywords: online education, web course, design, action research

Author's address Leena Hiltunen
Department of Mathematical Information Technology
University of Jyväskylä, Finland
P.O. Box 35 (Agora), 40014 University of Jyväskylä
Leena.r.k.Hiltunen@jyu.fi

Supervisors Professor Tommi Kärkkäinen
Department of Mathematical Information Technology
University of Jyväskylä, Finland

Antti Auer, Head of Development Services
Information Management Centre
University of Jyväskylä, Finland

Reviewers Professor Stephen Kemmis
School of Education
Charles Sturt University, Australia

Associate Professor Ulf-Daniel Ehlers
Institute for Computer Science and Business Information Systems
University Duisburg-Essen, Germany

Opponent Professor M. Pilar Lacasa Díaz
Psycho Pedagogical Department
Aulario Maria de Guzmán
University Alcalá, Spain

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Jyväskylä, November 11, 2010

Leena Hiltunen

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1 INTRODUCTION

The increase in the use of individualized curricula and personal study plans for learners, and the emphasis on lifelong learning in today's world entails a need for more flexible forms for learning. The diverse study circumstances of learners, e.g., work and family duties, also affect teaching arrangements (Koivisto, Kylämä, Listenmaa and Vainio 2002; Dzakiria, Razak and Mohammed 2004; Ruhalahti 2006; Manninen and Luukannel 2002). Furthermore, learner groups today are more heterogeneous, in many cases multicultural, with different studying abilities (Koivisto et al. 2002; Dzakiria et al. 2004). In such an environment, teachers are expected to have wider variety of knowledge and skills than ever before, especially, in the context of online education (Yang and Cornelious 2005; Koivisto et al. 2002; Zheng and Smaldino 2003; Tella, Nurminen, Oksanen and Vahtivuori 2001; O'Connell, Benson and Samarawickrema 2006, 599).

In this research online education is defined as formal educational courses or training delivered primarily via the Internet to learners regardless of their physical locations. Online courses may be delivered synchronously or asynchronously. Online education may also include some occasional or periodical face-to-face meetings by learners and teachers in a physical setting, e.g., lectures, tutoring, or exams, as long as it takes only a small proportion of the total course hours. In online education the teacher's role is changing as the learning process moves further from the teacher and learners take more responsibility for their own learning (Nokelainen and Sointu 2003; Mäki-Komsi 1999; Canada 2000; Harasim, Hiltz, Teles and Turoff 1995, 14-15). While learners are seen as active knowledge constructers (Bonk and Cunningham 1998), teachers are more like moderators, instructional designers, facilitators, motivators, or mentors (Mason 1991; Paulsen 1995; Berge 1995; Anderson, Rourke, Garrison and Archer 2001; Zheng and Smaldino 2003; Wu and Hiltz 2004; Yang and Cornelious 2005).

1.1 Context for the Inquiry

Traditionally, content knowledge has been the most important competence for teachers in higher education; pedagogical knowledge has been less valued while research and the creation of new knowledge have been emphasized (e.g., Kember and McKay 1996, 528). Most of the teachers in higher education model their teaching on someone who they considered to be "a good teacher" (Gerrard 2002) and in online teaching they are simply replicating traditional, instructivist pedagogies (Bonk and Dennen 1999a). However, that is not enough to be a "good" online teacher.

Online education adds to the amount and intensiveness of a teacher's work, fetters teachers right next to the computer, requires a lot of writing, and takes more time than traditional teaching and guidance. This has an effect on the characteristics of teaching and learning duties, ands on the design, and realization as well as implementation of the whole teaching-studying-learning process and scheduling. (Uljens 1997; Kansanen 1999; Kansanen and Meri 1999; Tella, Nurminen, Oksanen and Vahtivuori 2001, 233, 237; Tella, Vahtivuori, Vuorento, Wager and Oksanen 2001, 36; Vahtivuori-Hänninen 2004, 28-29) As Bob Blomeyer in the article by Wood (2005, 36) states, "a good classroom teacher is not necessarily a good online teacher". According to Gerrard (2002), "teaching online requires a different set of skills and a different pedagogy to that of the classroom, none of which can be developed quickly or easily". Similar to distance education, online education requires "special techniques of course design, special instructional techniques, special methods of communication by electronic and other technology, as well as special organizational and administrative arrangements" (Moore and Kearsley 1996, 2). Therefore, in many cases, making the transition to online education requires changes in a teacher's pedagogical paradigm and training for their online role, not just training in how to use new technologies (Tella, Vahtivuori, Vuorento, Wager and Oksanen 2001, 17; Salmon 2001; Bonk and Dennen 1999b, 7).

Teachers need to become aware of pedagogical views and models that they can or should use, in online education as well as the pedagogical approach they select (Manninen and Pesonen 2001, 63; Harasim 2000). Teachers have to consider what kind of learning they want to promote, what the learning goals and contents are, what learners already know about the subject, and how learners will achieve the knowledge or skills that they are seeking to acquire (Kiviniemi 2000, 23; Manninen and Pesonen 2001, 76; Koli and Silander 2003, 34). Because their own pedagogical paradigm has an essential influence on the success of online education (Koivisto et al. 2002), teachers are often, for the first time, forced to reflect on how they teach and why they should adopt information and communication technology (ICT) when they start to teach online (Pirttimäki 2004; Nevgi, Lindblom-Ylänne and Kurhila 2003, 404). It is also essential that teachers take a positive attitude towards the new educational environment of online teaching and learning (Vahtivuori, Wager and Passi 1999, 273-274;

Vahtivuori 2001, 107). As a result of their own online learning experiences teachers are better able to understand learners' points of view about online learning (Pirttimäki 2004, 23).

In online education we utilize new kinds of tools and techniques that require novel competences from teachers. The implementation of ICT presumes that teachers are confident enough about their technical skills to be able to use the new methods in their teaching and to guide their learners (Koivisto et al. 2002). Nowadays ICT provides a lot of new possibilities, but far too many online courses are still based on learners themselves reading and writing answers to assignments (Hakkarainen 2001).

While the course materials may contain most of what the learners are to learn, it is the teacher who has the responsibility to evaluate whether the learners are actually advancing in their knowledge of the subject (Gerrard 2002). As Thorpe (2000, 71) states, "such evaluation will be achieved by learners and tutors speaking, arguing, presenting their views, etc, hence the ability of tutors to stimulate learners towards an active rather than passive learning process is vital". It is this interaction between learners and their teachers that makes learning a dynamic process (Gerrard 2002). The need for individual guidance in online education varies a lot among learners, and consequently, recognition of learning disabilities sets new requirements for teachers' pedagogical competence (Koivisto et al. 2002). Moreover, the extent to which learners interact within this new online learning environment will be dependent on the ability of the teacher to make his or her learners feel 'comfortable' and encourage them to participate (Gerrard 2002).

However, technology itself doesn't automatically bring with it high quality education or provide learning (Koli and Silander 2003, 28; Nevgi, Lindblom-Ylänne and Kurhila 2003, 403-404). The design of online learning processes, creation of learning assignments, and guidance of the learning process online has important implications for learning outcomes (Koli and Silander 2003, 28). Teachers have to design learners' learning processes carefully in advance, because learning online is usually self-oriented, the teacher is not physically present, and guiding the learning process is not as situation-related as in face-to-face learning (Kiviniemi 2001; Lehtinen 1997). Most of all, it is essential to decide how the learning process is phased, what kind of interaction is supported, and what kind of learning assignments are required during the online course (Nevgi, Kurhila and Lindblom-Ylänne 2003, 387). Face-to-face periods, if there are any, have to be tied closely together with online periods to generate a complete learning process (Koli 2003, 154).

To achieve its goals, online education requires commitment, high motivation, and shared effort in the learning process from both teachers and learners (Tella, Nurminen, Oksanen and Vahtivuori 2001, 237). According to Pirttimäki (2004), university teachers experience their work as challenging, because of the continuously increasing demands made on them at a time when there is no concomitant increase in resources. This leads them to constant feelings of being too busy, and also creates problems of motivation. In this light, it seems that the

biggest threat to realizing online education of good quality is the relationship between lack of teachers' time or other resources, and the demands set by online education (Pirttimäki 2004, 25; Bonk and Dennen 1999b, 8). Moreover, according to Walls-Carpelan (2005), stress related to teacher's work and other health problems have increased during the past few years at least among teachers in Finland. However, similar results have also been obtained in other countries; e.g., according to Austin, Shan and Muncer (2005) in UK and US, "more than 40% teachers have experienced serious symptoms of stress due to the pressure of excessive workload" (p. 64).

The question that arises here is: Is there anything that we can do to support online teachers in their work?

1.2 The Problem

Nowadays the biggest challenge teachers and instructors confront in their teaching is transiting to online teaching. This is an increasingly new demand on teachers while more and more learners are distance learners, and more teachers are working in multi-national research networks. Supporting flexible learning and learners' individual needs are new goals (e.g., Opetushallitus 2005). Contentual and pedagogical issues are at the centre of the curriculum design process, at least in Finland, because teachers are allowed to interpret national and local curricula on every educational level from their own perspective and to use such pedagogical solutions as they wish.

The content and the nature of teaching have changed, both quantitatively and qualitatively (Fullan 1995; Niikko 1996; Helakorpi 2001). The trend toward using ICT in teaching involves changes in teachers' actions, organizational roles, the meaning of technology, and teaching methods (Mäki-Komsi 1999; Koivisto and Ilomäki 2001; Salmon 2001). The implementation of new communication and teaching methods causes anxiety among teachers, while there is not enough time to learn new technical, as well as, pedagogical issues, and to deal with the growing amount of work, especially at the beginning of transition to online (Mäki-Komsi 1999). A major challenge for teachers is to get to know and learn how to utilize online environments, online learning and individual tutoring, and new working methods in online education. Besides pedagogical knowledge, teachers need practical skills in online pedagogy (Koivisto and Ilomäki 2001).

On the other hand, teachers are willing to learn how to design their own web courses, but their own knowledge, skills, and time resources are limited. They need training and support in online learning environments, content production, online pedagogies, and written articulacy (Koivisto and Ilomäki 2001; Pirttimäki 2004). Although teachers don't need to know everything, online education sets so many new requirements that a single teacher is often unable to cope with them alone. However, in many areas collaboration with colleagues seems to be almost impossible, because most study modules are organized by

one teacher or instructor only (at least in Finland). All this creates a need for a unified process for web course design that can help teachers in this situation. It should also support teamwork where different specialists work together (Koivisto et al. 2002).

On the other hand, teachers are too overloaded with other teaching and research duties and thus have limited lime and energy to adopt new practices; they don't have enough time to design contents and learning assignments properly. According to Pirttimäki (2004), web course design takes up one-half of the total time allocated for providing online education. Most teachers in higher education carry out online education as an additional "hobby" during their own free time (Pirttimäki 2004). However, according to Moses (1985, 86), "most staff want practical advice, prescriptive guidelines, dos and don'ts". Similarly, according to Pirttimäki (2004), teachers need more guidance, especially at the beginning of transition to online, and both professional support and peer support throughout the design process.

1.3 Purpose of the Study

This study employs an action research framework to investigate how so-called topic-case driven web course design methodology (Hiltunen 2005) could help teachers in higher education to design their web courses collaboratively, and in this way enable their professional development. As Hord (1994) states, the purpose of professional development is "change in individuals' knowledge, understanding, behaviour, skills, and in values and beliefs". Action research is particularly applicable to professional development because it supports critically reflective thinking about one's own practice, is grounded in the principles of teamwork and collaboration to forge new meanings from experience, and offers a clear framework for acting on these (Brookfield 1995; Carr and Kemmis 1997; Kemmis and McTaggart 1990).

The methodology presented here was first tested with a group of computer science graduate learners. The methodology was then introduced to the staff of the local university, and, finally, to the educators at different Finnish universities. The main goal was to find, through case studies, the best practices for web course design training by testing and modifying educational methods, roles, scheduling, and grouping. The starting point was individual side-by-side guidance, which, however, can be too time-consuming and requires a lot of guiding resources.

The design methodology is a development process for web course design that allows well-managed integration and incorporation of structural and multigranular digital material along pedagogical knowledge, such as communication and cognitive tools. It also supports the utilization of a large, possibly distributed team of domain experts for creating the key contents. It is possible that approaching web course design through case studies may lead to the emergence of new requirements or ways to run the design process; hence the goal in

the research reported here was also to assess and improve the methodology itself.

The three specific areas of investigation were (1) participants opinions on using the design methodology, (2) possibilities to adapt pedagogical scripts into the web course design training, (3) ways of training professionals to follow the design methodology in heterogeneous groups. The data were collected from interviews and questionnaire with participants, informal classroom observations, teachers' notes, and collections of participants' work and related artefacts. The results revealed that while the methodology required some further development, in principle it worked well in all three areas.

1.4 Significance of the Study

The significance of this research is based on three main considerations. First of all, we use action research as a research methodology that focuses particularly on combining theory and practice (Greenwood and Levin 1998). This kind of research was chosen because it was thought likely to inform and change teachers' practices in the future (Ferrance 2000). Moreover, action research seeks to be of practical value to teachers while simultaneously contributing to the acquisition of new theoretical knowledge.

Secondly, a topic-case driven web course design methodology helps teachers in higher education to adapt and design online education. By participating in appropriate training sessions, as in the present research, teachers can learn to take into account both content as well as pedagogical and technical issues during the design process, and receive sufficient guidance.

Finally, as they are extremely busy, teachers need productive and efficient methods to support their own design process, and training in appropriate approaches to web course design can meet this need. As a result of this research the methodology employed in study has been enhanced based on findings of this research.

1.5 Limitations

This research is limited to learners, and especially teachers, at the higher education. Participating university teachers were willing to participate in the case studies voluntarily on the basis of their own interest. Their main goal was to learn how to design web courses. None of them knew beforehand that they were also actually participating in action research. According to several studies (e.g., Huxham and Vangen 2003, 385; Marshak and Heracleous 2005, 74), in action research the participants do not need to be fully aware of all aspects of the research, especially when, as in this case, the focus is on developing the target

design methodology itself, as well as modes of training, rather than directly on learners' or on teachers' personal design practices.

1.6 Definitions

Action research is a qualitative research method that is characterized by a spiral of cycles of five steps (1) planning, (2) acting, (3) observing, (4) reflecting, and (5) re-planning (Kemmis and McTaggart 1990).

ICT is an abbreviation of information and communication technology used to support online education.

Online education is defined as formal educational courses or educational training delivered primarily via the Internet to learners regardless of their physical locations. Online courses may be delivered synchronously or asynchronously. Online education may also include some occasional or periodic face-to-face meetings by learners and teachers in a physical setting, e.g., lectures, tutoring, or exams, as long as it takes only a minor proportion of the total course hours.

Virtual learning environment (VLE) is defined as a set of online tools and resources that facilitate various aspects of the online education experience, including communication, assessments, and content sharing.

Hypertext is a piece of digital content where one can navigate through links that connect different contents and concepts together.

Web course is an instructional or training course delivered via web pages and sites accessible via the Internet or some course management system, e.g., Blackboard or Moodle; it is a synonym for 'online course'.

Web course design refers to the design and implementation of a web course that has some content and pedagogical foundation; it is a synonym for 'authoring'.

Topic-case is a short but structured description of the basic outline of a single course topic.

Topic-case diagram is a display that defines the basic contentual hierarchy of the web course, serving as a more precise content map showing what knowledge is required before learners encounters a certain topic (topic-case), and what knowledge it would be useful to have available, but which is not compulsory for the following topic (topic-case).

Topic-case driven methodology is a web course design and implementation model that is based on software engineering metaphors for capturing the necessary steps for creating web courses using a content-based development method.

1.7 The Structure of the Thesis

This research is organized into eight chapters. Chapter 1 includes a description of the context, purpose, and significance of the research along with its limitations and definitions. To gain a better perspective on the domain of the study, preliminary concepts related to the field of research, e.g., online learning and web course design, are presented in Chapter 2. Chapter 3 outlines the topic-case driven methodology employed in this study for the purpose of web course design. Chapter 4 outlines the research methodology used, i.e., action research. The research design, including the context of the case studies, participants, research questions, data collection procedures, and data analysis procedures are outlined in Chapter 5. Chapter 6 describes actions taken during the action research cycles and data collection procedures used in each case study. The data analysis and the results of the study are described in Chapter 7. Chapter 8 provides a summary, conclusions, possible implementations, and recommendations for further research as well as an evaluation of the study.

2 DOMAIN OF THE STUDY

In research, traditional classroom learning has often been compared to online learning, with findings such as there is "no significant difference" in learning effectiveness between the two modes (e.g., Russell, 2001). Joy and Garcia (2000) criticize this research which assumes that the delivery medium alone influence the learning outcome. They state: "learning effectiveness is a function of effective pedagogical practices" (Joy and Garcia 2000, 33). So, the basic goals of online education are the same as those in traditional classroom education, but the ways of learning and teaching, and the format of the content are different. There are also different ways of planning and realizing online learning.

In this chapter, the differences between "traditional" education and online education, the changes taking place in teaching, the teachers' role, and the assessment of learning outcomes are reviewed to see how far teaching is changing in the process of adapting online education and what kind of difficulties might arise in the course of doing this.

2.1 Differences in Learning

When we move from the traditional classroom environment into the virtual learning environment, learning remains basically the same; learning continues to mean changes in one's level of ability or knowledge, and to be measured by the amount of change in an individual's level of performance or behaviour (Uusikylä and Atjonen 2000, 124; Mayer 1982, 1040; Driscoll 1994, 8-9; Inglis, Ling and Joosten 1999, 104; Shuell 1986, 412). Learning should still be meaningful (Jonassen 1995; Ruokamo and Pohjolainen 1999) while the whole learning process is based on the learner's own motivation (Engeström 1988).

Learning to learn and recognition of one's own learning style are even more important in the virtual learning environment than in the traditional classroom, because courses in the future need to be more learner-centred (Ertmer and Newby 1993). Learners are expected to be responsible for their own

learning, self-motivated and disciplined, and independent seekers of knowledge (Mäki-Komsi 1999; Canada 2000). Different learning styles can quite easily be supported with virtual learning environments, since learning materials can be presented in different forms: video, animation, picture, audio, charts, text, rehearsals, drills, assignments, etc., and different kinds of teaching methods can be adapted, e.g., experiential learning (Blank, Roy, Sahasrabudhe, Pottenger and Kessler 2003; Pimentel, 1999).

Differences in learning in a virtual learning environment appear in the requirements that are set for the learner. According to Mäki-Komsi (1999), online learning sets up a whole new set of requirements for informational abilities and skills, e.g.

- Abilities to seek, use, adapt, criticize, process, and yield information, and differentiate essential from the unessential knowledge
- Ability to build new mental models based on old ones
- Ability to co-operate and co-learn together with a teacher and other learners
- Ability to accept oneself as a learner
- Ability to choose learning goals and strategies by oneself
- Ability to evaluate one's own learning process
- Aptitude for self-regulation, methodicalness, flexibility, and explicitness

Learners should have internal motivation, and should able to take initiative, and be independent, creative, and reflective (Mäki-Komsi 1999). Moreover, learners have to take more responsibility, adapt to new learning environments, adjust to new contexts, know how to participate, and stimulate their own curiosity (Yang and Cornelious 2005). There is also more diversity among online learners because they are able to take a part in any online learning course they want, and where they want. Learners may differ, e.g., in gender, ethnic and cultural background, learning experience and qualifications, work experience, professional self-concept, family background and commitments, and in age (Dzakiria et al. 2004). On the other hand, disabilities may be hidden in virtual interaction (Blake 2000).

According to Palloff and Pratt (1999), online learning brings up a whole new set of physical, emotional, and psychological issues along with educational issues, e.g., physical problems that can be experienced as the technology becomes intensively used, or possible psychological addiction to the technology. Furthermore, in the traditional classroom a learner may be physically present but psychologically absent, without the teacher even noticing it. In a virtual learning environment absence is noticeable. A learner who suffers from performance anxiety in the face-to-face classroom may be more comfortable online and more active in responding to other learners.

There are also large differences in social aspects of learning. According to Palloff and Pratt (1999), we need to deal with a virtual world in which learners cannot see, hear, or touch the people with whom they are communicating. We

cannot see the facial expressions and body language that help us gauge responses to what is being discussed, and we cannot hear voices or tones of voice to convey emotions, because teachers and learners are represented mostly by text on the screen. We need to use more descriptive and explanatory language, along with clear instructions that tell the learners exactly what they are expected to do, although some emotions can be expressed, e.g., with smileys. Moreover, there are also differences in the sense of "synchronous presence": there is a social distance between all participants (in the sense that a group is working together in real time). This leads us to the need for social connections which are made through the sharing of ideas and thoughts (Palloff and Pratt 1999). If teachers are able to reduce this social distance between learner and teacher, learners' satisfaction will be higher (Arbaugh 2001).

In virtual learning environments learning is mostly carried out without a teacher being physically present. With careful pedagogical design learners can be guided to be more self-reflective and to follow the desired learning process. Possible problems can be predicted during the implementation of such a learning environment by supporting different learning strategies and styles, and with well-defined and unambiguous instructions; the more the learners are required to study independently the better the guidance and instructions should be included in the content itself (Nokelainen and Sointu 2003). Lack of face-to-face communication can be substituted by online discussions in chat rooms and on discussion boards, or via online video conferencing (Blake 2000). In a virtual learning environment tutoring and new kinds of supporting systems became more important.

There are also a lot of requirements for the virtual learning environment itself. Learning environments should spur learners to be active and responsible for their own learning (development of self-instructed learning manner), problem-based, context-based, and integrate different fields of knowledge. Moreover, it should spur learners to collaborate and socially interact, improve dialogue, argumentation, and thinking skills, as well as learners' reflective and metacognitive abilities. (Mäki-Komsi 1999)

However, technology is just a tool; virtual learning environments should be designed in such a way that learning to use the technology does not demand too much attention, and such that the focus should be on learning the content itself. As Jonassen (1995) states, technological solutions "should be used as facilitators of thinking and knowledge construction". Instructors should pay attention to the kind of learning that occurs through the use of the medium itself (Palloff and Pratt 2001). This requires that designers are aware of the basic rules of learning, so that they are able to optimize learning.

2.2 Changes in Teaching

According to Engeström (1988), there are three important basic elements in education: educational goals, educational content and educational methods. All

of these include both external and internal factors. External factors consist of resorts that are used for controlling the observable behaviour of learners and learning about the situation itself, and the internal factors of resorts that are used for guiding the mental process of learners. By concentrating on the external factors only, education becomes fragmented and the learning results are not as good. Of course, external factors are also important, but by using internal factors it is possible to achieve better learning results (Engeström 1988).

Engeström's (1988) perfect learning process and its internal factors can also be adapted to the virtual learning environment context. **Educational goals** are at least as important in online learning as in the traditional classroom environment, if not even more important because learners are expected to be more self-directed (Mäki-Komsi 1999; Canada 2000), and the learning environment should be prepared to tackle new issues and concerns, and to develop new approaches and skills in order to create an empowering learning process (Palloff and Pratt 2001). Moreover, as Palloff and Pratt (2001) argue, "when teaching and learning leave the classroom, it is up to the instructor to create a container within which the course proceeds by posting goals, objectives, and the expected outcome for the course, initial guidelines for participation, thoughts and questions to kick off discussions, and assessments to be completed collaboratively".

In the virtual learning environment, **educational content** is mostly in digital form and learners are easily able to find more learning materials by searching the Internet (presuming that learners have the requisite skills for the acquisition of information). Content is easier to divide into must-know and should-know topics, and to extend with nice-to-know topics, because of hypertext (Karjalainen and Jaakkola 1999). Hypertext (as well as simulations, animations and videos) also enables the use of authentic and applied exercises.

Educational methods can also be divided into external and internal factors. External methods include forms of education that can be immediately seen (who is communicating with whom, and who is active) and forms of interaction (how learners are interacting; size of groups). Internal factors include **educational tasks** (function of the teaching) being done, which can be divided into eight categories (Engeström 1988):

- *Preparing for the new and motivating*: explaining the meaning of new topics and their connections to previous knowledge; arousal of motivation and channelling it into the subject under discussion; raising issues of informational conflict with learning assignments
- *Orientation*: identification of learning goals and orientation base
- *Delivery of new information*: fulfilling the orientation base and enriching it with modifications, details and footnotes using various forms of teaching; reorganization and interpretation of knowledge; active discovery of new information based on the orientation base
- *Boning up on the learned topic*: re-examining the learned topic before entering into a new topic

- *Systematization*: clarifying analysis of learned topic; learning to separate essential from unessential knowledge, to recognize unclear issues, and to become aware of mutual connections and relationships between learned issues
- *Rehearse*: transformation of information into knowledge or competence; requires repeated rehearsing
- *Application*: solving new learning assignments based on learned knowledge
- *Control*: assessment of validity and usability of the learned topic and of the new mental model; critical examination of learned knowledge based on authentic assignments; self-evaluation

It seems that these are the educational methods that will change the most as we move from the traditional classroom into the virtual learning environment. Moreover, because there is a need for different methods of interaction to be employed, changes in interpersonal relationships between teacher and learners are also needed (Bower 2001). According to Palloff and Pratt (2001), collaboration in learning results from interactions among the learners themselves and interactions between the teacher and learners. It is though relationships and interactions among people that knowledge is primarily generated. Moreover, learning in the virtual learning environment cannot be passive; learning is an active process in which both the teacher and the learner must take part.

The whole learning process can be based on a specific learning or teaching theory, but the selection of the learning or teaching method used should always be based on an objective evaluation of what is the best or most suitable choice in that particular learning situation (Manninen and Pesonen 2001).

2.3 Educational Methods in the Virtual Learning Environments

Most teachers emphasize constructivism as the basis for online learning (Sahlberg and Leppilampi 1994, 24-27; Tynjälä 1999, 60-67; Koli and Silander 2003, 21; Puolimatka 2002, 41-42). However, it is important to realize that different didactic and pedagogical approaches fit different learning situations and needs. There are many suitable approaches and models for teaching and learning in virtual learning environments. Some of these are briefly introduced below in alphabetical order:

- **Active learning**: learners must "read, write, discuss, or be engaged in solving problems […] engage in such higher-order thinking tasks as analysis, synthesis, and evaluation […] instructional activities involving students in doing things and thinking about what they are doing" (Bonwell and Eison 1991)
- **Anchored learning**: learning where "activities are designed around a realistic situation - or anchor - in which there is a problem to be solved by

the group […] encourages students to view knowledge as tools to be applied to new situations, rather than knowledge as facts to be learnt" (Floodman 2004)

- **Cognitive apprenticeship**: learning through guided experience where experts are present to coach and model the cognitive activity (Barab and Duffy 1998). Knowledge is learned by solving problems and carrying out tasks in an anchored context (Collins, Brown and Newman 1989)
- **Collaborative learning**, cooperative learning or peer learning: learners working in groups or in pairs on the same task simultaneously, searching for understanding, meaning or solution, interacting to learn; learners work in groups to maximize the learning of all individuals in the group (e.g., McKeachie 1999)
- **Discovery learning**: teaching method in which information or evidence is presented to learners in a way which enables them to progress to new levels of understanding; learners learn well when they discover what is to be learned for themselves (e.g., Baldwin 1996)
- **Experiential learning**: learning process of acquiring skills, knowledge, and understanding through experience rather than through formal education or training (e.g., McKeachie 1999)
- **Instructional learning**: focus on teaching and motivation; teacher-centred, predetermined goals, content, teaching, and assessment methods; response to impulses, receiving of knowledge (Manninen and Pesonen 2001)
- **Learning through design**: learning occurs while designing artefacts such as games, textile patterns, robots, and interactive devices; design activities can provide personally meaningful contexts for learning (e.g., Haury 2002)
- **Problem-based learning**: a widely used instructional technique that involves learners solving real-world problems through a series of steps, while working in groups (e.g., Boud and Feletti 1991)
- **Reciprocal teaching**: a teaching strategy in which "learners are involved in summarizing, question-generating, clarifying, and predicting as they read texts and observe phenomena [...and] both teacher and students share the responsibility for the conduct of the discussion" (e.g., Palincsar and Brown 1984; Palincsar 1986)

As in teaching in general, there is no single unified way to teach, and new technologies enable new kinds of educational methods as well as new ways to utilize these (Manninen and Pesonen, 2001). However, a few approaches are used more than others, e.g., constructivistic methods such as *active learning* (McConnell, J. 1996), *learning by doing* (e.g., Reid and Wilson 2005), *discovery learning* (e.g., Baldwin 1996), *peer learning* (e.g., Wills, Finkel, Gennert and Ward 1994), or *collaborative learning* (e.g., Rodger 1995). Furthermore, learning is usually situated in authentic learning environments (e.g., Herrmann and Popyack 1995).

2.4 Changing Role of the Teacher

Transferring education to an online environment from a traditional classroom environment does not radically change the nature of teachers' duties or problems (Vahtivuori et al. 1999; Kiviniemi 2000, 14, 21-22). However some requirements for teachers will change: teachers will have to know how to use ICT to support teaching from both the technical and pedagogical point of views (Pirttimäki 2004, 10). Moreover, teachers will need to think about familiar issues and problems from a new perspective: teachers' pedagogical thinking and attitudes towards the new learning environment will need to change (Vahtivuori et al 1999, 273-273).

When moving from the traditional classroom into the Internet, the teacher's role is no longer just to deliver information; instead the teacher becomes more of a facilitator than a traditional lecturer (Yang and Cornelious 2005). The teacher is now helping learners to deal with new information and the management of knowledge; the teacher selects and filters the information for the learner's consideration, provides thought-provoking questions, and facilitates well-considered discussion (Kettner-Polley 1999). Responsibility for learning is transferred from teacher to learner; however, the teacher still has an important role as an instructor; the teacher serves as a facilitator while the learners develop their personal understanding of course content by collaborating with each other (Yang and Cornelious 2005).

Besides acting as a facilitator, the teacher should be an instructional designer (Zheng and Smaldino 2003). It is also important for the teacher to motivate learners to adjust their role when they become online learners (Yang and Cornelious 2005). The teacher plays an important role in motivating effective online discussions as well (Wu and Hiltz 2004). Tella, Vahtivuori, Vuorento, Wager and Oksanen (2001) conclude their discussion of the role of the teacher by listing the following five key online roles:

- **Motivator**: keeps learners' motivation and activity at a high level by focusing attention on learners, by offering proper learning materials, and by maintaining collaboration and co-operation. The teacher asks, demands, inspires, and persuades learners to participate. The teacher speaks out and responds to learners' activities, pays attention to the learners, creates learning opportunities, and motivates learners by his or her own actions. Personalized feedback is also essentialin online learning.
- **Networker**: establishes networked relations to different experts and specialists, and also makes these resources available for the use of learners.
- **Organizer**: organizes teaching and learning environments that drive learners into collaborative learning by making choices between different tools, applications, and media. The teacher organizes structures and sets the rhythm for the course, sets goals, conducts the course on the basis of

a flexible study plan, poses stimulating questions, and comments on and guides discussion.
- **Signaler**: creates nets of communication, informs and guides learners during the learning process by putting specific instructions and guiding questions on the Internet. The teacher creates the rules for communication and ensures that all learners understand them.
- **Instructor** or **tutor**: makes it possible for learners to learn better, but without controlling too much. The teacher helps the learners to understand, guides them towards active learning, and enables the process where the learner internalizes the external knowledge and transforms it into his or her own knowledge.

According to Tella, Vahtivuori, Vuorento, Wager and Oksanen (2001), there are other additional roles for teachers, such as **assessor**, **supporter**, **expert** or **storyteller**. However, for these, while the teacher needs the same kind of didactic and pedagogical skills as in the traditional classroom, the mode of teaching and the teaching environment are different. Furthermore, teachers, as well as learners, need new computing and communication skills.

Teachers need to create deep and durable learning in the virtual learning environment. Hacker and Niederhauser (2000) offer five principles to help teachers to accomplish this goal:

1. *Active participation* in learning by changing the role of learners from passive recipients of knowledge to active constructors of their own knowledge. It is the teacher's job to promote this change. Learners become meaningful makers who actively select, organize, and integrate their experiences with existing knowledge. Learners are required to construct deep explanations, justifications, and reasons for what they think and do.
2. *Effective use of examples* because it has been shown that case-based instruction suits computer-based technology. By using examples that are anchored in contextualized and authentic cases, we can improve educational outcomes.
3. *Collaborative problem solving* that can increase specific problem-solving abilities and general metacognitive understanding of how, when, and why to use problem solving strategies.
4. *Effective use of feedback* means that feedback is commensurate with performance - too much feedback may prevent learners from learning how to regulate their performance on their own.
5. *Motivational components* that enhance self-efficacy and perceived challenges. All the four previous principles of instruction also enhance the motivation to learn.

In conclusion, it is important for the teacher to master and design delivery strategies, techniques and methods for teaching online courses (Yang and Cornelious 2005).

2.5 Assessment of Learning Outcomes

Educational assessment is difficult to define (Payne 1974). The educational literature is replete with different definitions of assessment, while during the past few decades the area of achievement assessment has undergone major changes. Since the mid 1980s the assessment literature has been enriched with many new terms, such as performance assessment, authentic assessment, direct assessment, constructive assessment, incidental assessment, informal assessment, balanced assessment, curriculum-embedded assessment, and curriculum-based assessment (Birenbaum 1996). However, a few important questions arise above all the others: what to assess, how to assess it, and why?

Assessment is a fundamental part of any curriculum (Frye 1999; Korpinen 1982); it is a part of all phases of learning. The same assessment learning cycle, shown in Figure 1, takes place at all educational levels starting from early childhood level all the way to university level. Assessment is the first step in this continual cycle which includes measurement, feedback, reflection, and change (Frye 1999). Moreover, it helps learners and teachers to see how learning improves during the learning process. Assessment is often divided into three types: 1) diagnostic assessment, 2) formative assessment, and 3) summative assessment (Bloom, Hastings and Madaus 1971). Every type gives us different kinds of information that can be used in different phases of the learning process (Korpinen 1982).

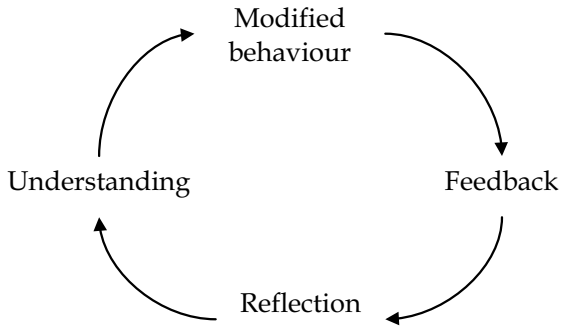

FIGURE 1 Assessment learning cycle (Frye 1999)

Diagnostic assessment concentrates on the learner's qualifications, **formative assessment** on the learning process, and **summative assessment** on the learning outcome (Korpinen 1982). "Learning outcomes […] encompass a wide range of learner attributes and abilities, both cognitive and affective, which are a measure of how their college experiences have supported their development as individuals" (Frye 1999). According to Frye (1999), a cognitive outcome includes "demonstrable acquisition of specific knowledge and skills"; what learners know that they didn't know before, and what they can do that they couldn't do before. An affective outcome is related to the attitudes, values, and beliefs that influence behaviour, and these are not directly measurable (Frye 1999). Assessment can be summarized as in Figure 2.

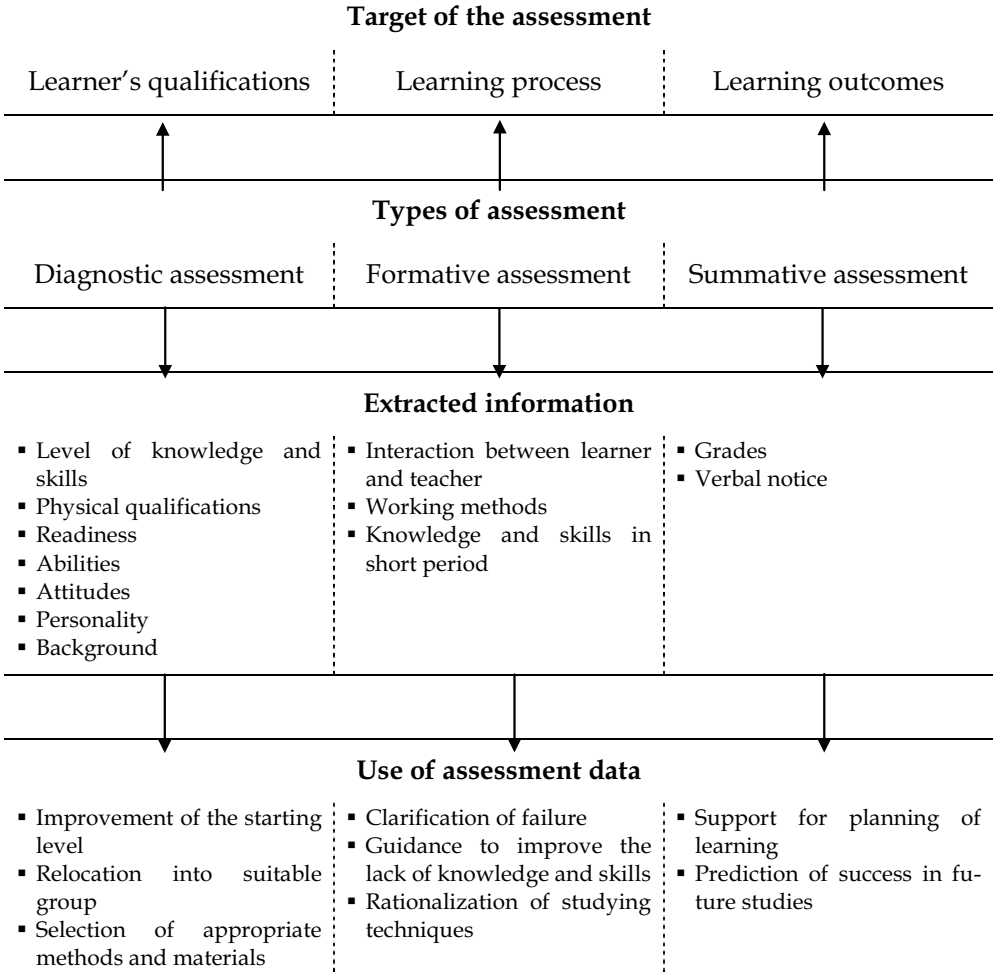

FIGURE 2 Assessment as a whole (Korpinen 1976)

Assessment is not just the measurement of learning, and the purpose of assessment is not merely to gather information. Assessment is seen as a vehicle of improvement that should foster learning, guide, encourage, and motivate learners (Koli and Silander 2003, 61). Analysis of the learning outcome enables the rationalization of learning that helps the learner to learn and the development of education that helps the teacher to instruct (Frye 1999; Koppinen, Korpinen and Pollari 1999; Wiggins 1997). Frequent assessment of learners helps to refine the concepts learned and deepen their understanding; it also conveys high expectations, which further stimulate learning (Dempster 1991).

Assessment comprises two important processes: 1) measurement, which includes gathering evidence or important information related to assessment, and 2) evaluation, which refers to the interpretation made on the basis of the measurement (Kauchak and Eggen 1998). An effective teacher gathers information from different sources, including conventional tests, homework, involvement in the class or online, and authentic assessment, such as mind maps made during a brainstorming session, or crib sheets made as an assignment for the final exam (Kauchak and Eggen 1998). According to Koli and Silander (2003, 61-63), "evaluation can be declarative, motivating, guiding, instructive, controlling, elective, or predictive".

Traditionally a final teacher-made exam or standardized test has been the most used method of assessment during higher education courses, although many have argued that it is not the best way to assess learning outcomes. For example, Wiggins (1997) states that "conventional tests often prevent learners from fully understanding and meeting their intellectual obligations". Moreover, Kauchak and Eggen (1998) list the following reasons: traditional testing focuses on knowledge and the recall of information, it provides little insight into the way learners think, and it does not assess learners' ability to apply their understanding to real world problems. Boud and his associates (2010) even list a proposition of principles for assessment reform in higher education.

In the virtual learning environment implementation of the traditional final exam is more difficult; for example, you cannot be sure who is taking an exam on the Internet (Yang and Cornelious 2005). During the past few decades teachers and researchers have been developing new, more authentic and alternative ways to assess learning.

2.6 Authentic Assessment

Authentic assessment directly measures a learner's performance through "real life" tasks (Worthen 1993) such as writing a letter or an editorial commentary for the school newspaper, designing a lab activity for science learners, or solving some real-life problem (e.g., Kauchak and Eggen 1998). We could add further examples to this list, such as, learners' own custom-made software projects, and writing a term paper that would be self-evaluated as well as peer evaluated. In self-evaluation an individual or a group evaluate their actions, objec-

tives, preconditions for action, or results of action, whereas in peer evaluation assessment takes place between individuals or within a community (Koli and Silander 2003, 64). Both of these are used at the Department of Mathematical Information Technology, University of Jyväskylä.

There are different forms of authentic assessment. Next we take a closer look at two of them: performance assessment and portfolios. Both of these can easily be adapted for online learning as well.

2.6.1 Performance Assessment

According to Kauchak and Eggen (1998), performance assessment measures skills and understanding by directly measuring a learner's performance in a natural setting. "Evaluation takes place throughout the entire learning process, not only at the end of a study period" (Koli and Silander 2003, 64). Systematic observation, checklists, and rating scales are used as evaluation methods (Kauchak and Eggen 1998):

- *Systematic observation* is based upon a teacher taking notes that describe a learner's performance according to preset evaluation criteria.
- *Checklists* are written descriptions of characteristics that must be present in an acceptable performance. Use of checklists extends systematic observation.
- *Rating scales* are written descriptions of characteristics and scales of values on which each characteristic is rated.

In online learning, performance assessment could include assessment of, e.g., online discussions, different kinds of learning assignments, and questionnaires.

2.6.2 Portfolio Assessment

Portfolios are collections of work that are reviewed against preset evaluation criteria. Portfolios can include essays, journal entries, video clips, photos, discussions, tapes of presentations, term papers, and designed materials. Portfolios should reflect the learning process; products made at different times indicate the changes that have occurred over time. (Kauchak and Eggen 1998; Wolf 1988)

When using portfolios learners should be involved in deciding the evaluation criteria or at least have been told in advance how their work will be evaluated. Based on these criteria learners decide what they want to include in this so-called sample portfolio which is then evaluated (Kauchak and Eggen 1998; Tenhula, Kuure, Koponen and Karjalainen 1996).

In online learning, portfolio assessment is easy to execute, since all the products are in digital format (if they have been saved, e.g. chat discussions). A portfolio could include, e.g., online discussions on a discussion board or in chat rooms, learning assignments, learning diaries, self-evaluations, peer evaluations, opponent reviews, and term papers.

2.7 Summary of Domain Review

Most learners and educators have a long educational history in the class-room environment, so it might be hard suddenly to move into a virtual learning environment with all the changes it entails in learning and teaching. Virtual learning environments have set new requirements for learners, while the recognition of one's own individual learning style becomes even more important. Learners need more internal motivation, and they need to take the initiative more and be more independent, creative, and reflective. Teachers are no longer physically present, and most of the interaction in the learning situation takes place through written text without seeing, hearing, or touching the people with whom the learners are communicating. Teachers are facing so many new educational changes while adopting online education that they need special training.

The role of the teacher is transformed when the responsibility for learning is transferred from teacher to learner. Learning becomes more learner-centred, but the role of the teacher as an instructor remains essential. New technology offers new possibilities to utilize a wide range of educational methods. Assessment of learning outcomes has to be also rethought. Traditional final exams are much harder to execute online, hence new, more authentic methods of assessment are needed. This calls for a more comprehensive educational design.

The key questions for web course design are how to design granular learning material that benefits from using the web and how and when to integrate such a (web-) pedagogy into training so as to enhance learning. Our contribution for this is the so-called topic-case driven web course design methodology that is introduced in Chapter 3.

3 TOPIC-CASE DRIVEN DESIGN METHODOLOGY

The main constructive ingredient of this chapter is to describe a web course design and development process that allows well-managed integration and incorporation of structural and multigranular digital material with pedagogical knowledge as well as, e.g., communication and cognitive tools. This methodology naturally supports the utilization of a large, possibly distributed team of domain experts for creating the key content. Moreover, it supports structural and incremental development and reusability of the resulting materials as suitable learning objects. Finally, it also supports blended learning. This proposed approach, called Topic-case driven methodology for web course design and realization, was internationally introduced in ICNEE 2004 (Hiltunen and Kärkkäinen 2004). Backgrounds and more detailed description of the presented design methodology are presented in licentiate thesis published in 2005 (Hiltunen 2005).

The approach utilizes metaphors from software engineering (following Unified Process, see Jacobson, Booch and Rumbaugh 1999) to describe a unified way to design and realize web courses, but this approach is blended together with educational (especially pedagogical) issues. Unlike the Unified Process, the proposed approach is topic-case driven and content-centric. In general, this web course design and realization process contains five phases: *Background study*, *Content design*, *Pedagogical design*, *Technical design*, and *Realization and assessment* (see Figure 3). The proposed approach allows incremental and iterative development of the web course (again following Unified Process). Moreover, it can be utilized as a content development mini-project within other similar methods (e.g., Montilva 2000; White 2000; or Baloian, Fuller and Ochoa 2001).

In the following sections each phase is depicted in more detail using general activity and phase product descriptions. Exact tasks, management responsibilities and precise roles in each activity are not defined, as there all depend on organizational issues and the target environment for carrying out the development project. Moreover, for the same reason, all metadata that could and should be documented as a part of the development are also left aside.

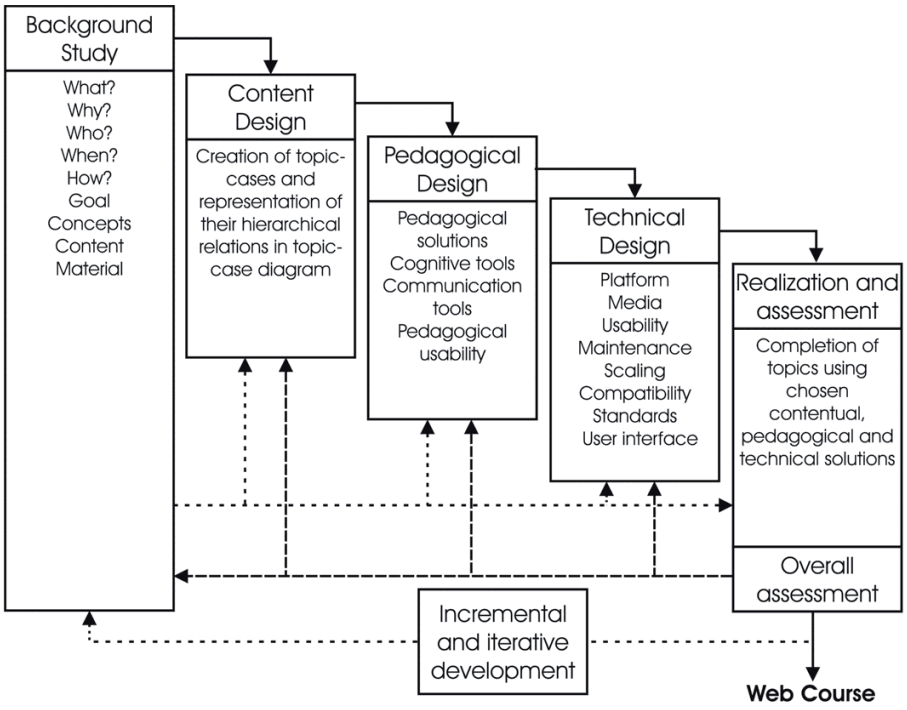

FIGURE 3 Phases of the topic-case driven web course design and realization process

3.1 Background Study

The first phase in our web course design and realization process is the Background study that corresponds to the feasibility study in software engineering processes (e.g., Jaaksi, Aalto, Aalto and Vättö 1999; McConnell, S. 1998). During the background study several issues has to be considered before starting the construction of a web course. The central task in the background study is to define and consider all the issues that affect the feasibility of the planned web course (Table 1).

All information about organizational design principles, copyright regulations and design standards should also be considered and documented for further use. As a result of this phase one should have a project plan with a timetable, resource allocation, financing plan, possible limitations and the baselines of the course. During the background study a useful technique for creating a general view of the content of a course is concept mapping (e.g., Novak 1998; see Figure 4).

TABLE 1 Questions to consider during the background study

- Why are you designing a web course? What are the benefits compared to a traditional classroom course? (In our approach a web course is not a must but an option and/or a possible enhancement of the traditional classroom course.)
- How are you using the Internet? What is the role of the Internet? Is the course (or actually parts of it) going to be an output (static) or a process (dynamic)? (Hein, Ihanainen and Nieminen 2000) How highly structured is the course (actually parts of it) to be and will there be dialogue or not? (Moore 1983)
- What is the target group? Who are the learners? What kinds of learning strategies and learning styles do they use?
- How much time and resources do we have?
- What kind of technical infrastructure do we have at our disposal?
- What are the basic ideas, focus, and goals of the course?
- How do you handle copyrights and agreements, e.g., concerning content creation?
- Are there organizational regulations that might affect the design process, e.g., support for certain learning platforms only?

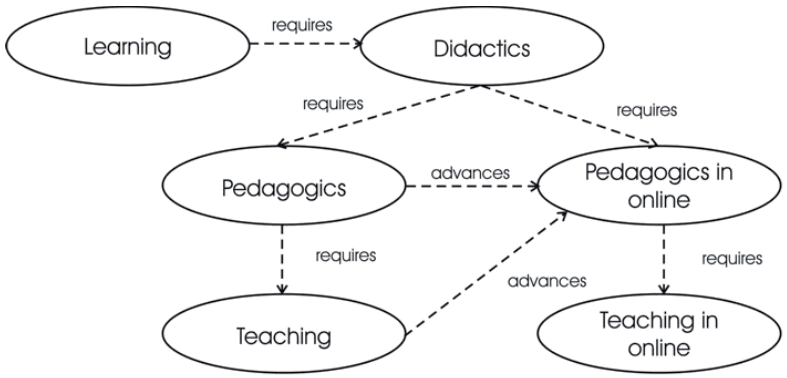

FIGURE 4 A part of the concept map in Virtual Learning Environments

3.2 Content Design

The question of how the content is constructed in an institutionalized setting is important (Menck 1987, 1995). During the content design phase basic content of the web course is designed and documented. During content design the goal should be to design high quality learning materials that are able to achieve a good learning outcome; "a learning outcome is clearly only as good as the content will allow" (Flagler 2002). The phase is divided into two activities: describing topics of a web course in as much detail as possible, and finding relationships between individual topics.

3.2.1 Description of Topics

Creation and documentation of topics is obtained through the following basic steps:

1. Generation of the basic set of topics with basic attributes
2. Selection, modification and possible combination of the basic topics to create a non-overlapping structured description of contents

The method used to describe the contents of a web course at a general level is the topic-case method. **Topic-case** is a short but structured description of the single course topic (or the course itself in the beginning). With topic-cases the necessary issues that should be treated during the course are described first. Hence, topic-cases form the skeleton of contents of the course (cf. software architecture). Later more features are added to them, such as pedagogical ideas concerning the realization of the topic-cases.

Topic-cases can be documented using suitable forms capturing the necessary attributes during the cumulative development process. The initial topic-case descriptions (see Figure 5) can be formed during the early planning stage (central ones already during the background study). First, separate topic-cases (using independent and possibly distributed team of content experts if desired) are created from single issues and then linked according to preliminary knowledge and the target learning.

Name of the course
Topic-case number: #
Date / Name of the developer

Topic-case:	Name of the topic-case
Summary:	Brief description of the topic-case
Preliminary knowledge:	Knowledge which is required before entering the topic-case
Material(s):	Material(s) concerning the topic-case
Learning:	Sort of post-conditions, learning that is pursued after completing the topic-case

FIGURE 5 Form for basic description of topic-case

Topic-cases are authenticated with numbers (and names) that also describe the amount of topic-cases, help to evaluate the timetable of the course, and can be used for defining the order of presentation of the topic-cases. Naturally, the names and creators of topic-cases should also be documented. Materials engaged with topic-cases can be in any form e.g., books, articles, video clips, re-

cordings. Humphrey (1998) uses similar course descriptions in connection with software engineering courses: *Objectives*, *Prerequisites*, *Course structure*, and *Course support*. Formally, the definition of a set of attributes defines the interface of a topic-case (cf. component and class signatures in software engineering).

3.2.2 Relations Between Individual Topics

After finishing with the first set of individual topics possible relationships between them are identified to decide which one of these should be developed further during the current iteration. The creation of these relations is based on the prerequisite knowledge and target learning for each topic-case as documented in the basic form. Firstly, sub-groups of highly similar topics are merged and joined together to form a single topic-case.

The topic-case relations are represented in the **topic-case diagram**, which defines the basic contentual hierarchy of the web course, serving as a more precise content map (see Figure 6). To describe the relationships between different topic-cases new stereotypes are introduced: *«requires»* and *«advances»*. **«requires»** indicates what knowledge is required before a certain topic-case can be accomplished properly, and **«advances»** indicates the knowledge that it would be usefully to have available, but is not compulsory for the succeeding topic-case.

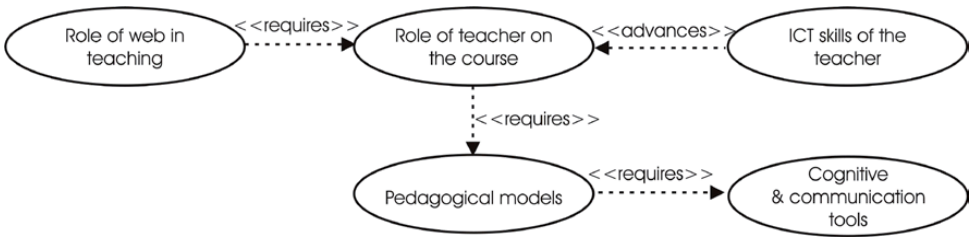

FIGURE 6 An example of a topic-case diagram with five topic-cases

Using the given stereotypes, the topic-case diagram reveals which topic-cases are essential to the main concepts in the concept map of the course and which are prerequisites for other topics. This yields a natural way to select the topic-cases that must be implemented first (under the given time and resource limitations). The remaining topic-cases that extend the basic knowledge can be implemented during the later iterations or can be used as a subject of term papers or exercises.

This activity should result in a topic-case diagram that describes realizable topics (also actual content) and the relationships between them (cf. learning path). After the content design phase all the topic-case descriptions and the

topic-case diagram present the detailed content of the web course. For example, the course syllabus is then just (one) transformation of the content to lessons in the (virtual) classroom, e.g., in weekly units.

3.3 Pedagogical Design

Pedagogical design is often neglected in a content-oriented web course design. By stipulating a separate phase for pedagogical design, we aim to ensure that this issue, which should underlie all the activities facilitating teaching and learning processes, has its special role within the development process.

Pedagogical design includes both teaching and learning processes. The goal in pedagogical design is to find the best ways to facilitate both these processes, and to help learners to reach or develop specific knowledge or competences (Uljens 1997, 16). The biggest difference between this and other existing design models is that each topic-case can include more than one alternative pedagogical solution.

3.3.1 Questions Behind Pedagogical Design

During this phase the participants size up all the selected topic-cases and seek an appropriate pedagogical solution for each case separately. They answer questions like: what kind of learning do we support in our web course: instrumental, communicative or emancipatory? What is a suitable pedagogical approach for each topic: instructional, cognitive, constructive, humanistic, critical humanistic learning or something else? What forms of activity do we use? What kinds of media do we utilize in our course?

Pedagogical problems are usually related to the roles of teachers and learners, ways of teaching and learning and actions in those situations, learning tasks with different characteristics, guidance and control in learning, assessment, and feedback. In addition, pedagogical design includes the integration of communication and cognitive tools into the web course and consideration of pedagogical usability. All of these pedagogical issues should be considered and written down during the pedagogical design phase. Some of these issues have been brought up already during the background study, but at this point each topic is connected to its pedagogical solution.

3.3.2 Pedagogical Solutions for Each Topic

After the content design phase selected topics for the current iteration have been selected that should be augmented with advisable pedagogical activities to support and to describe the teaching and learning of that topic. In this phase educators augment these topics with advisable pedagogical activities.

To document the decisions made, the approach extends the topic-case descriptions by adding a few more attributes that describe in more detail what

teachers and learners should do and what kinds of teaching and learning activities are recommended. Hence, new attributes – actor(s), description, pedagogical solution(s), and relations – are added into each topic-case. Moreover, each topic-case may have more than one possible pedagogical solution. In some cases it might be better for (different) learners to be able to see a topic from different perspectives to support their individual learning styles. Pedagogical solutions contain both teaching and learning activities, and recommended assignments for the learning session.

Relations to other topic-cases are important. These relations identify links between different topics for the technical design. They are also useful if the contents have to be updated later on.

After this phase the content of the web course and pedagogical activities for each topic should have been documented; these are represented in the extended topic-case descriptions (Figure 7; extensions are marked with bold).

These approaches also conform with the need of pedagogical design; pedagogical issues should and can be taken into account at the beginning of the process or during the pedagogical design.

3.3.3 Pedagogy Driven Variation

If there is some strong overall pedagogical approach guiding the teaching and learning processes, like problem-based learning (Boud and Feletti 1991), the order of content design and pedagogical design can be changed to better fit the content into the pedagogical ideas, which may be the ultimate drivers for the whole design process (see Figure 8). While respect to the extended topic-cases in Figure 7, this means that the necessary attributes are filled out in a different order.

3.4 Detailed Technical Design

The approach separates the technical design from the pedagogical design, because the pedagogical issues deserve special attention in their own right. During the technical design phase decisions need to be made concerning technical issues, like the use of a platform, media in use, maintenance, scaling, compatibility, user interface, etc. During this phase, we should also keep usability issues and different standards, e.g., LOM (2002) and ISO 13407:1999 in mind.

At this point, we do not want to commit ourselves to certain technical decisions, because there are again many ways to implement a web course. It is possible to implement the web course based on, e.g., databases, simple HTML web pages, XML or a combination of all of these. There might also be limited tools and software available in different projects. So, how the web course is actually implemented is based on resources, technical infrastructure, and knowledge in use. In the following sections we say a few words about different tasks concerning technical issues.

Name of the course
Topic-case number: #
Date / Name of the developer

Topic-case:	Name of the topic-case
Summary:	Brief description of the topic-case
Actor(s):	**Actor(s) involved in the topic-case (teacher, students, …)**
Preliminary knowledge:	Knowledge which is required before entering the topic-case
Description:	**Detailed description of the activity in the topic-case**
Pedagogical solution(s):	**Pedagogical solution(s) in the topic-case, e.g., learning and teaching methods and activities used**
Teaching:	**Advisable teaching actions in the topic-case**
Learning:	**Advisable learning actions in the topic-case**
Assignments:	**Advisable learning assignments with this topic-case**
Material(s):	Material(s) concerning the topic-case
Learning:	Sort of post-conditions, learning that is pursued after completing the topic-case
Relations:	Relations to other topic-cases

FIGURE 7 Form of the extended topic-case

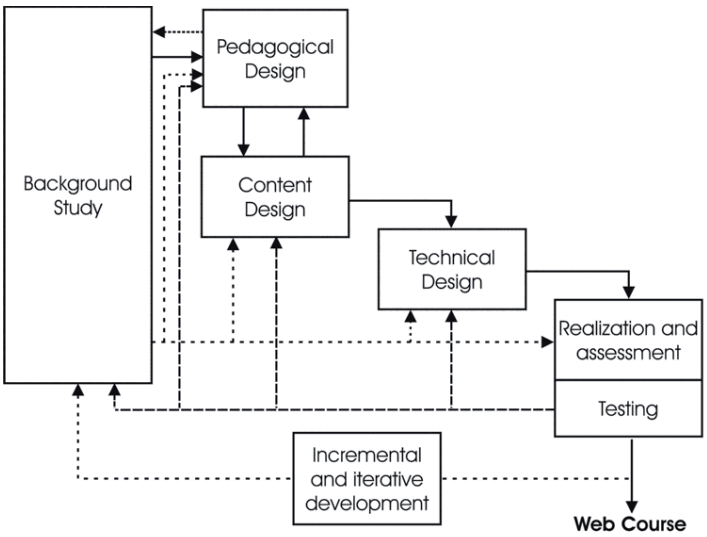

FIGURE 8 Modified design process where strong pedagogical models are driving the whole topic-case driven design process (cf. Figure 3)

3.4.1 Use of Platform

Web courses can be implemented as open web pages or using a specific platform, social media or virtual worlds to create virtual learning environment (VLE). Nowadays there are plenty of different kinds of platforms and tools in use all around the world. The most commonly used platforms are perhaps Blackboard[1], Moodle[2], and Discendum Optima[3]. The social media provide wikis (like Wikispaces[4] or Confluence wiki[5]), blogs (like Blogspot[6]), and virtual communities (like Ning[7]) along with virtual world instances (like Wiziq's[8] or Second Life[9]). All these platforms have different features and different basic rules. They all enable material delivery and communication between individuals, and some of them even support and promote learning.

More precisely, there are usually some tools or functions that support cognitive processes and communication in VLE. VLE also offer certain ways to transmit learning materials, but too often only in the platform's or tool's own format. Comparison of existing online course delivery software products is difficult, but many reported comparisons have been made and are available on the Internet[10].

At the University of Jyväskylä most educators now use either Optima or Moodle, both of which support web course design through:

- A simple and explicit interface
- Ease of use for both learners and teachers
- Easy maintenance
- Reusable objects
- Use of external resources (e.g., HTML, Word, PDF)
- Transferable objects in HTML format

Both Optima and Moodle also support SCORM (Shared Content Object Reference Model; ADL 2005), which makes it easier to move web courses from one platform into another.

3.4.2 Media in Use

Depending on the kinds of content and topics on one's own web course it is possible to use different kinds of media for presentations. The typical medium

[1] See http://www.blackboard.com/
[2] See http://www.moodle.org
[3] See http://www.discendum.com/english/tuotteet_eng/index.html
[4] See http://www.wikispaces.com/
[5] See http://www.atlassian.com/software/confluence/
[6] See https://www.blogger.com/
[7] See http://www.ning.com/
[8] See http://www.wiziq.com/
[9] See http://secondlife.com/
[10] See, e.g., http://www.edutools.info/landonline/

is written text, but often it would be more illustrative to use photos, graphs, tables, animation, videos or even simulations to present current information. Video conference can also be used. This other medium is often more informative, but can be much more expensive to produce and maintain. It also has higher technical requirements that might be beyond the reach of a non-expert in the field. It should be noticed that there are also guidelines for writing for the Internet, e.g., in Morkes and Nielsen (1997).

3.4.3 Maintenance, Scaling and Compatibility

In technical design there are three essential issues that should be considered in order to create web courses with lasting life cycles. These issues are maintenance, scaling, and compatibility. **Maintenance** includes:

- Updating date-sensitive materials such as timetables and schedules
- Modernizing the layout of the course
- Keeping contact information current
- Adding new information or features
- Updating user information

A web course should be easy to maintain: files that need to be updated often or continually could be in the same folder, files should be organized with some systematic regulation, files and web pages should be named in a recognizable way, etc. All of these issues rely on well-structured contentual organization of the material.

Scaling means that the learning system is capable of presenting multiple courses with hundreds of topic-cases for thousands or even tens of thousands of learners concurrently and simultaneously. Solutions for this purpose are beyond the scope of the present study, but basically they are always based on needed improvements in the organization of hardware or software platforms and their features.

The contents of the web course should also feature **compatibility** with different platforms and other systems in use. Often, it is necessary to convert parts of the web course, or even the whole course, to fit into a new environment (or platform). For this reason, it would be better, e.g., to avoid special, platform-dependent formats in the production of material.

3.4.4 User Interface

Jacob Nielsen has written many books about web usability (e.g., Nielsen 2000). His advice is also useful in web course design. The user interface is the most immediately visible part of web course and users are usually looking at a single page at a time. Especially, when we design a web course "web pages should be dominated by content" not by layout (Nielsen 2000). According to Nielsen (2000), "navigation is a necessary evil that is not a goal in itself and should be minimized". However, users should always know where they are, where they

are coming from and where they can go. It is also important for users to know if they have definitely logged out from a system where they logged in with personal user identification.

Here user interface design is part of the technical design, but it could already start during the background study phase (especially if one has decided to use a specific learning platform) or after the content design phase, when the content is set. Even if a virtual learning platform is used, there are always user interface issues to be considered, like the placing and functionality of navigation (cf. blocks in Moodle), order of content folders (cf. left-hand content-tree in Optima), or layout of actual content sheets.

3.5 Realization and Assessment

The final realization or implementation consists of completing the individual topic-cases using the chosen pedagogical and technical solutions. This means that the content is enlarged to the final length and teaching and learning actions are described in detail in connection with the final contents and the media in use.

Assessment is an activity that should be an essential part of the whole development process (and the maintenance phase as well). In the presented approach, the overall assessment (see Figure 9) is divided into three parts:

- Reviews during the development phase
- Assessment of topics and contents after realization
- Assessment of the user's required technical, pedagogical and contentual skills

3.5.1 Reviews

Reviews are carried out at the end of each step by developers to ensure that everything has been done as required and to locate as many errors and unresolved problems as possible before proceeding to the next step. For instance, derivation of the topic-case diagram is reviewed by comparing it to the output of the prior step (the creation of topic-cases), and feeding back any mistakes discovered.

3.5.2 Planning and Performing of Assessment

An assessment plan is made after the realization of the topics. The assessment plan should cover both the assessment of single topics and the assessment of the whole content of a web course. It should also assess the technical, pedagogical and contentual skills required of the user. Assessment is performed by users (learners, teachers and technical staff) with real learning, teaching and maintenance assignments.

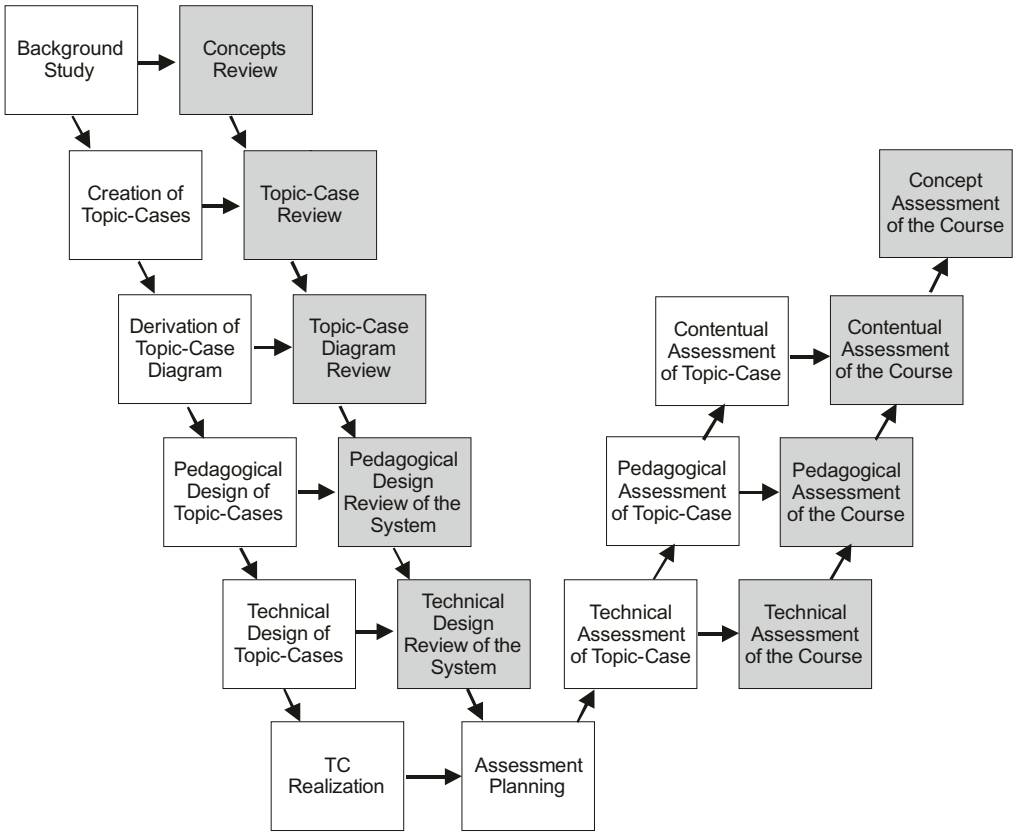

FIGURE 9 Assessment of the web course in accordance with the modified V-model of testing

Assessment of single topics and assessment of the content as a whole are both divided into three steps: technical assessment, pedagogical assessment and contentual assessment.

Technical Assessment. In the technical assessment, the technical realization of a single topic is assessed first and then the technical functionality of the whole system is considered. Technical assessment is based on five questions:

- Is the use of the web course easy to learn?
- Is the web course efficient to use?
- Is the use of the web course easy to remember?
- Does the web course have a low error rate and is it easy to recover from those errors?
- Is the web course congenial to use?

Pedagogical Assessment. Pedagogical assessment is based on the meaningfulness of learning and pedagogical usability, including the following questions:

- Does the web course support significant thinking and knowledge presentation?
- Does the web course support communication with others?
- Does the web course offer accessibility to information and construction of personal representations?
- Does the web course support social negotiation and the formation of learning communities?
- Does the web course offer a proper articulation of goals, wilful achievements and meaningful effort?
- Does the web course support the formation of knowledge building communities?
- Does the web course support the solving of real-world tasks, meaningful and complex problems, constructing situation-specific schemas and defining/interacting with problem space?
- Does the web course support the articulation of and reflection on new knowledge?

The pedagogical assessment also includes checking that all the topic-cases have a pedagogical solution that is consistent with the pedagogical models underlying the particular web course.

Contentual Assessment. The main issues for contentual assessment are:

- Does the web course contain all the topics that were planned at the beginning?
- Are all topics linked properly (logically) together?

In the approach employed this means that all the selected topic-cases have been implemented properly and relationships between topic-cases in the topic-case diagram are consistent with the corresponding plans.

3.6 Quality of the Design Methodology

Quality is often used to signify "excellence" of a product or service – how useful it is in its management (Oakland 1993). This leads us to recognition of the true requirements – the needs and expectations – of the "customer". Quality is simply meeting the customer's requirements (Oakland 1993). Quality is important nowadays, as is quantity in the public sector as well as in the education (Ehlers, Goertz, Hildebrandt and Pawlowski 2005). To help resolve most of the quality problems in the educational sector, a quality standard ISO/IEC 19796-1 for learning, education, and training was published in 2005.

ISO/IEC 19796-1:2005 is "a framework to describe, compare, analyze, and implement quality management and quality assurance approaches" (ISO/IEC 19796-1:2005). ISO/IEC 19796-1 identifies seven categories that should be assessed as a process model in the case of learning products including following issues:

- *Needs analysis:* Identification and description of requirements, demands, and constraints of an educational project including initiations, stakeholder identification, definition of objectives, and demand analysis
- *Framework analysis:* Identification of the framework and the context of an educational process including analysis of the external context, analysis of staff resources, analysis of target groups, analysis of the institutional and organizational context, time and budget planning, and environment analysis
- *Conception/design:* Conception and design of an educational process including learning objectives, concept for contents, didactical concept/methods, roles and activities, organizational concept, technical concept, concept for media and interaction design, media concept, communication concept, concept for tests and evaluation, and concept for maintenance
- *Development/production:* Realization of concepts including content realization, design realization, media realization, technical realization, and maintenance
- *Implementation:* Description of the implementation of technological components, like testing of learning resources, adaptation of learning resources, activation of learning resources, organization of use, and technical infrastructure
- *Learning process:* Realization and use of the learning process including administration, activities, and review of competency levels
- *Evaluation/optimization:* Description of the evaluation methods, principles, and procedures including planning, realization, analysis, and optimization/improvement

Presented web course design methodology can be assessed based on this quality framework.

3.7 Summary of Topic-Case Driven Methodology

The proposed web course design methodology follows the Unified Process and adapts metaphors from the software design process. The methodology is user-centred, following the basic principles of human-centred design (ISO 13407:1999). Although every learning environment design process should follow these basic ideas of user-centred design, we consider that these basic principles are not enough. The Unified Process can be joined with the instructional

design (e.g., Gagné, Briggs and Wager 1988) to ensure that all general principles of learning and instruction are considered during the design process. The Unified Process also includes features of co-operative design (Bødker, Grønbæk and Kyng 1993) and participatory design (Kensing and Blomberg 1998), although in educational design it is not always possible to have users (learners) involved in the design process, even where it is user-centred.

4 ACTION RESEARCH

The main purpose of this chapter is to present a review of the central research method applied in this study. First of all, action research as a research paradigm is introduced. We then discuss how to do action research, and what are the advantages and disadvantages of action research. Finally, we set some guidelines for when to do action research. Such a review is an essential component of a research study of the present kind, because action research is not as well understood as are the most traditional research methodologies (Herr and Anderson 2005, 5). Defining action research clarifies the research setting and also helps us to understand the comprehensiveness of the research paradigm used.

4.1 Introduction to Action Research

Various terms related to action research have been used as synonyms. Different researchers use terms like action inquiry (Torbert 1999), action research (Lewin 1946; Kemmis 1985), action learning (Revans 1997), action science (Argyris, Putnam and McLain Smith 1985), and participatory action research (Whyte 1991). Ellis and Kiely (2000) clarify these terms comprehensively. According to them, **action inquiry** is "a cyclical process whereby knowledge is created in and for action" (p. 83). It includes four distinctive approaches: action research, action learning, action science, and participatory action research. Thus action inquiry is an umbrella term for the deliberate use of any kind of a plan-act-describe-review cycle for inquiry into action in a field of practice.

The idea of **action research** was developed by Kurt Lewin (Lewin 1946; Hopkins 1985, 33). He was not the first to use it, but "he was the first to develop a theory of action research that made it a respectable form of research in the social sciences" (Herr and Anderson 2005, 11). Action research is a phased spiral process that combines theory and practice through change and reflection in an immediate problematic situation. It is also called practitioner research, practitioner-led research, and practitioner-based research, because "action research is

conducted by practitioners who regard themselves as researchers" (McNiff, Lomax and Whitehead 2003, 12).

Action learning, defined by Reg Revans (1997, 5), is a social process of learning through action. The basic idea is to share knowledge, but action learning is at its best, when a learning group "discover[s] that no one knows the answer but all are obligated to find it" (Revans 1997, 5). Action learning usually starts with a question identified by the leaders. Experts then draw up a plan for how to solve the question, and find the answers by using knowledge and other available resources.

Action science is largely associated with the work of Chris Argyris (Argyris et al. 1985). He "wishes to return to action research its scientific dimension" and argues that "the problem-solving focus in action research has moved it too far away from the tasks of theory building and testing" (Herr and Anderson 2005, 14). Argyris et al. (1985) defined action science as "inquiry into how human beings design and implement action in relation to one other" (p. 4).

Participatory action research was originally defined by Paulo Freire (1970), but it was publicized first by Gaventa and Horton (1981), and later by Whyte (1991), Kemmis and McTaggart (2000), and Lewis (2001). Participatory action research emphasizes the importance of participation and group dynamics during the research process; research is seen as a form of social action (Freire 1970). Most of the participatory action research studies have been done by true collaboration between practitioners and researchers (Herr and Anderson 2005, 30).

In the present study we concentrate on a mode of action research that is "particularly appropriate where problem-solving and improvement are on the agenda" (Hart and Bond 1995, 3). In this study we use the term action research regardless of all the approaches that have emerged from different traditions. Some of these different traditions are also briefly reviewed to see what action research is about.

4.2 Theoretical Background of Action Research

Action research is often defined as "an interactive process involving researchers and practitioners acting together on a particular cycle of activities, including problem diagnosis, action intervention, and reflective learning" (Avison, Lau, Myers and Nielsen 1999, 94). It is directed towards an individual, a group, an institution, or a larger community in a certain situation (Syrjälä and Numminen 1988). Common to all action research traditions and methodologies is some kind of collaboration with actors in the field of study (Pålshaugen 2006, 149). Usually the researcher is a participant in the implementation of a system, but simultaneously he or she wants to evaluate a certain intervention technique. Usually the action researcher is not just an independent observer; (s)he becomes a participant, and the process of change becomes the subject of research. Action research has been used, especially, in the social sciences and education. In the

educational field action research has been used "as an individual route to professional development and as a collaborative route to professional and institutional change" (Herr and Anderson 2005, 17) – as in the present study.

The focus in an action research study is on the opinions and experiences of the participants' involved in certain actions, functions, or phenomena (Syrjälä and Numminen 1988). The main goal of action research is to develop a new theory, compare or test a theoretical model against empirical results from action research (Yin 1989, 35-40), and to improve target practices as well as understanding the actions of participants. Action research can be simultaneously beneficial for problem-solving, theory expansion, and competence enhancement (Hult and Lennung 1980, 243). Researchers either improve practices and develop individuals, or transform practices and participants (Herr and Anderson 2005, 9). Action research "involves identifying the reasons for the action which are related to the researcher's values, and gathering and interpreting data to show that the reasons and values were justified and fulfilled" (McNiff et al. 2003, 13). The environment gives meaning for actions taken toward finding a solution to the problem (Hult and Lennung 1980, 245). The results can be confirmed with repetition research or by multi-case study (Syrjälä and Numminen 1988). Hence, altogether action research seems to establish a well-formed framework, especially for collaborative pedagogical development and qualitative assessment. Typically action research is used in the social and educational sciences, but according to Baskerville and Wood-Harper (1996, 235), the discipline of information systems also seems to be very appropriate field for the use of action research methods.

Action research is a phased spiral process[11] that is based on continuous reflection. It proceeds from planning to observations of actions and possible changes in actions based on reflection. During the process interpretation of an action in certain situation is formed through retrospection (Kemmis 1985). The analysis of possible changes in actions is based on participants' self-evaluations and self-reflections.

Overall, action research is a research paradigm which involves a variety of research traditions. Within the paradigm there are several established methodologies. Each of these methodologies draws on a number of methods for information collection and interpretation, for example interviewing and content analysis. Figure 10 summarizes these three levels of the action research paradigm.

The concepts used to describe the action research paradigm vary. Different re-searchers discuss about modes, types, approaches, typologies, or perspectives of action research, but they all define three distinctive action research paradigmatic traditions rather similarly. Grundy (1990, 353) discusses the modes of action research: technical, practical, and emancipatory. Holter and Schwartz-Barcott (1993, 301-303) write about types of action research: a technical collaborative approach, a mutual collaborative approach, and an enhancement approach. McKernan (1991, 15-27) lists the typologies of action research as

[11] Cf. Boehm's Spiral model of software development (Boehm 1988, 64)

follows: the scientific-technical view of problem solving, practical-deliberative action research, and critical-emancipatory action research. McCutcheon and Jung (1990, 145-147) discuss the perspectives of action research: a positivist perspective, an interpretivist perspective, and a critical science perspective.

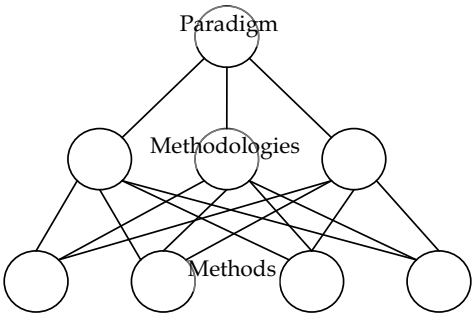

FIGURE 10 The three levels of the action research paradigm

Different approaches or perspectives are typically used in different contexts (Hart and Bond 1995). However, in the literature all three research traditions are described in a similar way. Therefore, in this study these three research traditions are grouped as follows: technical, practical, and emancipatory action research. These three paradigmatic traditions will now be briefly summarized.

4.2.1 Technical Action Research

Technical action research is a scientific research tradition for solving social and practical problems, and testing theories in action (Grundy 1990; Holter and Schwartz-Barcott 1993). Research problems are defined in advance, and the goal is to improve practice through improving the practical skills of the participants (Grundy 1990) as well as to test a particular intervention or change based on a pre-specified theoretical framework (Holter and Schwartz-Barcott 1993, 301).

The behaviour of the participants is taken to be objective and testable, and it can be generalisable and predictable. The researcher identifies the problem and proposes a specific intervention, after which practitioners are involved who agree to collaborate with the research by implementing the intervention and assisting with data collection. Researcher bias can be minimized or even eliminated through the use of appropriate methodologies that are independent of the researcher (McCutcheon and Jung 1990).

In educational settings technical action research cases are characterized by teachers' identifying discrete variables and positive hypotheses relevant to a problem, conducting a small experiment, and reporting the results (Taba and Noel 1990; McCutcheon and Jung 1990). A technical action research project is usually instigated by a person or a group of people who, because of their

greater experience or qualifications, would be regarded as experts or authority figures. Action is then designed to "produce", "make", or "create" something; therefore technical action research promotes more efficient and effective practices, systems, products, or formulation of hypotheses (McCutcheon and Jung 1990; Grundy 1990).

Technical action research promotes participation by practitioners in the process of improvement as well as the professional development of the participating practitioners (Grundy 1990). This tradition of action research results in the accumulation of predictive knowledge, the major thrust being on the validation and refinement of existing theories, essentially deductively (Holter and Schwartz-Barcott 1993). A "field experiment" in which scientists use an experimental design to test a hypothesis in a real-world situation, rather than a laboratory, is one example of technical action research (Holter and Schwartz-Barcott 1993).

4.2.2 Practical Action Research

The practical action research tradition is used to improve practice by developing and applying the personal knowledge and wisdom of the participants (Grundy 1990, 357). In a practical action research project research problems are defined in the situation while "researchers and practitioners come together to identify potential problems, their underlying causes, and possible interventions" (Holter and Schwartz-Barcott 1993, 301-302). The main goals are to understand practices, to reach mutual understanding, and to solve immediate problems that are connected with the process or tasks of education rather than the achievements or the end products of the inquiry (McKernan 1991, 20-21). Moreover, the goal is also to make some differences to how the participants feel, think, and behave.

In practical action research differences are introduced by individuals who gain a new understanding of their practice. Changes implemented by individuals tend to have a more lasting character, although they tend to be closely connected to the individuals who are directly involved in the change process; interventions are often lost when individuals leave the organization, group, or community. (Holter and Schwartz-Barcott 1993, 301)

4.2.3 Emancipatory Action Research

Emancipatory action research tradition involves the full involvement of all the important stakeholders in the social or educational system, including researchers, practitioners, policymakers, clients or learners, and community members (Holter and Schwartz-Barcott 1993, 302; Grundy 1990, 358). The purpose of emancipatory action research is to emancipate participants in the action from the dictates of compulsions of tradition, precedent, habit, coercion, and self-deception. It focuses upon particular practices, theoretical and organizational structures, and the social relations which support it. (Grundy 1990, 358; Holter and Schwartz-Barcott 1993, 302) Emancipatory action research underlines the

importance of participation from the organization's members as a condition for successful results (Pålshaugen 2006, 149).

The goal in emancipatory action research is to assist practitioners in identifying and explicating fundamental problems, and to achieve mutual emancipation by raising their collective consciousness, underlying assumptions and values, and involving the practitioners in critical reflection on their practices and unwritten laws (Holter and Schwartz-Barcott 1993, 302). Emancipated strategic action follows from disposition of critical intent that motivates action and inquiry at all stages of emancipatory action research. It is important in the development of the theoretical perspective which informs and underpins a research project (Grundy 1990, 358).

According to Grundy (1990, 358), "the dynamic relationship between theory and practice in emancipatory action research […] entails the change and expansion of both [theory and practice] during the course of the project". When a person reflects on theory in the light of practice, the form of knowledge that results is personal or tacit knowledge. This tacit knowledge can be acquired through the process of reflection on action. The interaction of theory and practice through the process of reflection, with participation of key stakeholders, is the core of participative action research.

4.3 Realizing Action Research

There are different ways to do action research. According to Hult and Lennung (1980, 246), there are three traditions of action research spanning different disciplines: 1) a school tradition that focuses on teaching and learning mostly in the field of education; 2) a community of development tradition that helps advance the cause of under-privileged groups; and 3) an organization tradition intended mostly for the effective design and development of organisations. Different methodologies and methods can be used in slightly different ways in each of these traditions.

While doing action research, first, the approach to follow has to be chosen: technical, practical, or emancipatory (see Section 4.2) – or more than just one of them. Each approach involves different methodologies, e.g., technical methodologies such as, Lewin's (1947) original model, Patton's (1990, 150-159) approach to solving a specific problem, or Checkland's (1981) soft systems analysis; practical methodologies such as Elliott's (1991) model; and emancipatory methodologies, such as Deakin model (Grundy and Kemmis 1990; Carr and Kemmis 1997). These different methodologies are briefly introduced in Sections 4.4-4.6. The role of the researcher is essential, and thus it has to be decided what role the researcher will take (see Section 4.7). Finally, appropriate methods need to be found for collecting and analysing data, and reporting the findings (see Sections 4.8-4.9).

Most of the action research methodologies similarly define the five main steps in spiral process model (Figure 11). While the models are different in

various ways, they share the steps of data collection and analysis, and taking action on an identified focus. Although each of the models uses different terms, in essence, they each include the use of data to act or react in relation to a defined problem or area of concern. According to most models, action research can be summarized as a spiral process that facilitates planning, acting, collecting, observing, reflecting, analyzing, reacting and evaluating in a manner that is systematic but flexible in nature.

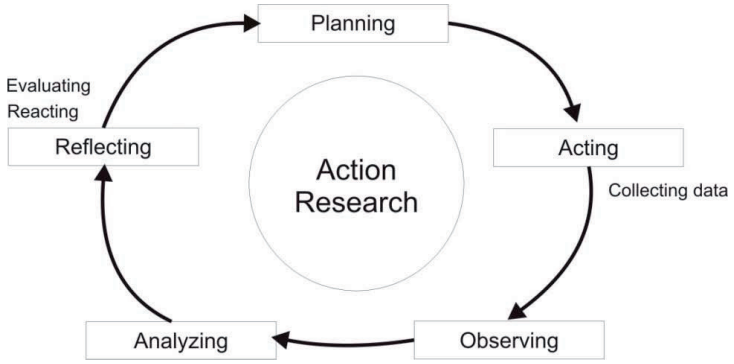

FIGURE 11 The cycle of action research

Because several methodologies exist for planning action research, Hopkins (1985, 41-43) has defined the criteria, especially for teachers, for choosing appropriate methodology in educational settings:

1. The teacher's primary job is to teach, and any research method should not interfere with or disrupt the teaching commitment.
2. The method of data collection must not be too demanding on the teacher's time. The teacher needs to be certain about the data collection technique before using it.
3. The methodology employed must be reliable enough to allow teachers to confidently formulate hypotheses and develop strategies applicable to their teaching situation.
4. The research problem undertaken by the teacher should be one to which he or she is committed.
5. The teacher-researchers need to pay close attention to the ethical issues surrounding their work.

Next we consider action research methodologies by introducing a few examples in the following sections.

4.4 Technical Action Research Methodologies and Procedures

In technical action research methodologies the goal is to solve existing technical or scientific problems (see Section 4.2.1). Some of these methodologies are briefly summarized next.

4.4.1 Lewin's Model

Lewin's (1947) action research model is composed of a series of steps that include 1) planning, 2) fact-finding, 3) execution and 4) analysis. According to Lewin (1947), planning begins with a general idea or a difficult problem requiring a resolution. This is followed by further fact-finding, or "reconnaissance", resulting in an overall plan of how to solve the problem (Figure 12). This planned action is implemented, and then monitored in an attempt to evaluate the effectiveness of the first action step, to plan the next step and to modify the overall plan. The reconnaissance (in Figure 12) shows if the plan and the resultant action performed a expected, while allowing the researcher to learn from the experiment.

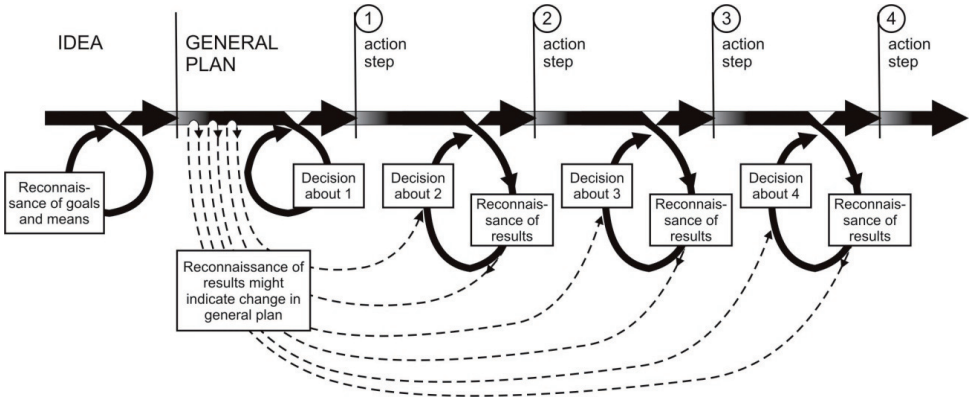

FIGURE 12 Lewin's action research model (Lewin 1947)

4.4.2 Patton's Model

According to Patton (1990, 157), "action research aims at solving specific problems within a program, organization, or community" at specific points in time. Participants solve such specific problems by studying their own problems. They focus on these specific problems only, and there is no intention to generalize the results beyond these specific settings (Patton 1990, 157). The aim is to solve the problems, which are identified in advance, as quickly as possible.

Patton's (1990) process cycle includes design, data collection, analysis, interpretation, and reporting. Usually process is assessed only on the basis of the feelings among the research participants and the feasibility of the solution gen-

erated. Moreover, the results are typically unpublished. According to Patton (1990, 162), a typical example of such research would be a self-study by members of certain group, organization, or community to learn how they can be more supportive of and help each other.

4.4.3 Taba-Noel Model

Taba (1962) applied action research stages to educational curricular problems. The model has a number of stages: 1) identifying problems, 2) analysis of problems, 3) formulating ideas or hypotheses, 4) gathering and interpreting data, 5) formulating action, and 6) evaluating the results of action (Taba and Noel 1990, 67; Taba 1962).

During the first step the concerns of teachers are identified. Problems have to come from the teachers themselves and be important to the teachers in order to involve them more closely in the research process. Often teachers are unable to state their concerns fully enough, so therefore "one task of problem identification is to correct the perspective on the problem and to begin the process of bringing the cause of the difficulty into focus" (Taba and Noel 1990, 67). However, problems need to be manageable to keep motivation sufficient for long-drawn-out research processes.

The first step also serves to obtain a diagnosis of the teacher: skills, perception, attitudes and capacity to accept changes. The process continues with a problem analysis during the second step to discover the possible dimensions of a problem or project, to identify its crucial aspects, and to clarify the focus. Problem analysis therefore involves several types of activities (Taba and Noel 1990, 68):

- An analysis of the causes and consequences of the difficulties mentioned in the problem statements
- An examination of the assumptions about causes made earlier
- A study of the research data available
- Securing some preliminary data in order to clarify the issues or to change teachers' perspective on the problem

Problem analysis can be guided by tentative hypotheses: what might be the causes of or the factors in the difficulties mentioned in the problem statements as well as in whatever was revealed about the teachers themselves. These preliminary investigations help in focusing on the actual problems during the third step, formulating action hypotheses. "It is necessary to develop, invent, borrow and adapt a variety of research techniques" while trying to achieve a result in some action hypotheses (Taba and Noel 1990, 72).

After these hypotheses have been generated, it is possible to set up experiments as the fourth step. During the experimentation and action step, it is necessary to plan an experiment and its steps carefully. Experiments could include, e.g., the reshaping of curriculum content, a method of teaching, a plan for grouping, or a new emphasis in classroom procedures. A part of this step is

to help teachers acquire the new skills they might need for creating a successful learning experience. There is also a need to consider human relations factors to avoid psychological hazards, and guidance to enable teachers to be freed of their fears of making mistakes.

The last step in the Taba-Noel model is evaluation. It is important to keep records of both the changes in participants' responses and the procedures and materials used, because the success of the experiment can only be assessed in terms of its effectiveness in producing the desired effects in the participants (Taba and Noel 1990, 73). There is also a need for teachers to secure objective evidence, such as records of performance, test data, and other tangible data, which can be subjected to careful comparative analysis.

4.4.4 Lippitt-Radke Procedure

Lippitt and Radke (1946, 172-175) developed a procedure for doing action research with the following major points:

1. *A group-need to discover some facts exists or is created*. Besides recognizing a problem, the group needs to be willing to solve it or do something to it. The process of finding solutions by themselves will be educational.
2. *The groups, or their representatives decide 'what do we need to know?'* The research group usually has excellent hunches or ideas about facts that are needed or questions worth asking, and where the answers that should be documented might be found.
3. *Specific research instruments are constructed*. The group will decide what would be the best instrument, or set of instruments, to do research from the methodological point of view.
4. *Making decisions about sampling and learning to use the research tools reliably*. Training should be given in the use of the sampling tools, adequate sampling in research designs etc. Special attention should be paid to challenging and fascinating problems and to refining the mechanics of the data collection and being objective.
5. *Supervision of the data collection will help to ensure success and overcome problems of discouragement.* Data collectors should be trained so as to avoid discouraging interviewed persons and unsuccessful interviewing.
6. *Evidences of attitude change often appear during this phase of participation in fact-gathering*. Adopting an "objectivity role" helps researchers to see things differently and concentrate on looking for facts.
7. *Collaboration in putting the facts together and interpreting the facts requires the special skill of a research technician*. The most successful projects share the workload between researchers and lay persons during the data gathering and analysis.
8. *Sometimes more is needed than a change in the values and social perception of the individual or group*. Often new knowledge is not enough to induce individuals to change their behaviour – there is a need for trying solu-

tions out, co-operative evaluation and perfecting solutions to ensure success.

9. *Disseminating the facts to other groups by oral and written reports can be a final step – and a new first step*. Sharing the results with other research groups stimulates the readiness of others to do similar research.

4.4.5 Checkland's Methodology

Checkland's (1981) 'soft' systems thinking approach is based on Jenkins' (1976) hard systems thinking methodology. The proposition in this model is that "system is the name of a general model or paradigm which can usefully be employed to understand, explain or engineer aspects of the real world" (Checkland 1975, 278). Moreover, 'problem' is conceived in a very general sense: any perceived mismatch between what is seen to exist and what might exist in the same situation. The main idea is to use methodology both to decide what to do and to decide how to do it (Checkland 1975, 282).

Checkland's methodology is presented in the form of a diagram in Figure 13. It represents a chronological sequence that is to be 'read' from 1 to 7. Checkland (1975, 279) assumes that the process will start with a relatively unstructured problem situation, Stage 1, where the goal is to define a problem or a need to be solved. In Stage 2 it is necessary to see the problem situation in a more structured way and to define a choice of objectives, e.g., physical needs and the system within which they must be met (Checkland 1976, 54). Possible and relevant alternative systems are selected in Stage 3 based on formulated and discussed 'root definitions', which express a view as to what is the essential nature of the relevant systems. According to Checkland (1975, 281), "root definitions express the chosen way of viewing the problem situation, and the aim in formulating them".

According to Checkland (1975), with the formulation of root definitions systems thinking proper now begins. In Stage 4 hypothetical systems are analysed in the light of the objectives generated during the systems analysis. The goal is to make conceptual models of systems which meet all the requirements of the root definitions, including their implications. Formal comparison between the problem situation developed in Stage 2 and relevant alternatives constructed in stages 3 and 4 is done, and the selection of the most promising alternative is made during Stage 5. Stage 6 consists of defining changes which are agreed to be both desirable and feasible in the attitudes which exist in the problem situation. This could be done up to the prototype stage, if needed.

Finally during Stage 7, as a result of the work done in stages 2 to 5, one may return to the problem situation itself and make the desirable, feasible changes to the problem situation.

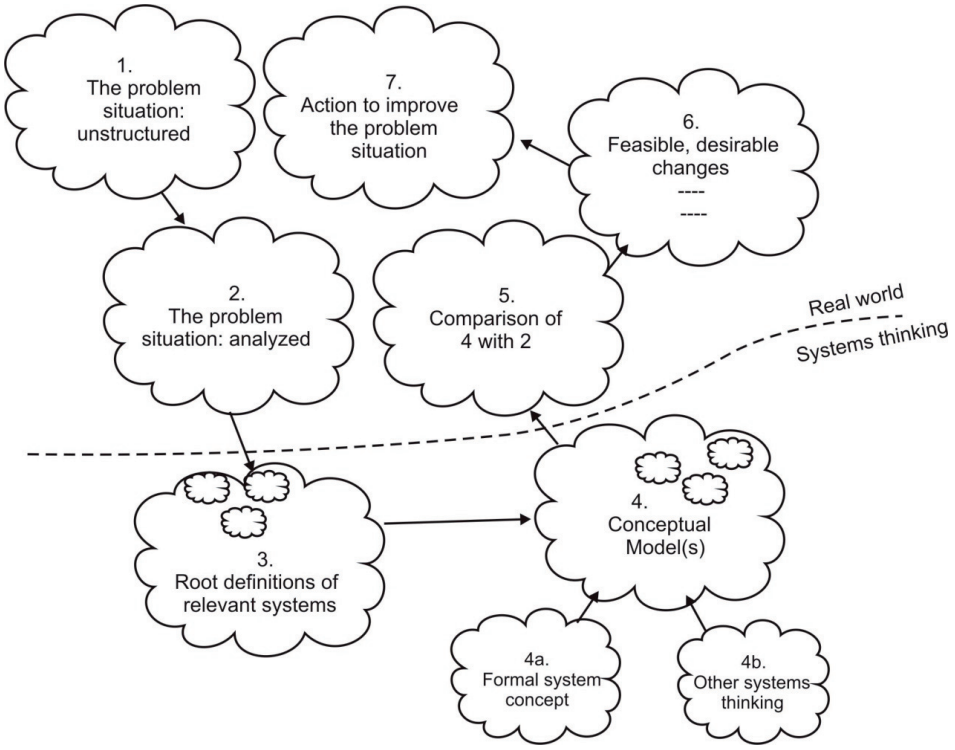

FIGURE 13 Checkland's soft systems thinking methodology (Checkland 1975, 280)

4.5 Practical Action Research Methodologies

The goal of practical action research is to understand practices and to solve immediate problems (McKernan 1991, 20). The different methodologies that could help researchers to achieve this goal are briefly summarized next.

4.5.1 Elliott's Model

For Elliott, action research attempts to improve the quality of life in a social situation (Elliott, 1991). While Elliott's model is based on Lewin's model (see Section 4.4.1.), Elliott argues that the general idea should be allowed to shift, reconnaissance should involve analysis as well as fact-finding, and before evaluating the effects of an action in the implementation phase, the extent to which it has been implemented should be monitored (Elliot 1991, 70).

Elliott's model of the action research process is outlined in Figure 14. Progress happens in cycles as in other models even if it is represented as a flow chart. The general idea is that the action researcher develops a personal interpretive understanding from working on practical problems, and that theoretical

under-standings are constitutive of practical action and discourse (Elliott 1987, 157).

In Elliott's model (1991) the first step is to identify and clarify the general idea, a state of affairs or situation that one wishes to change or improve. During the second step, reconnaissance, the facts of the situation are described and explained on the basis of critical analysis of the context in which those facts arise. Constructing the general plan is the third step. The key concepts here are confidentiality, negotiation, and control. Information gathered from others has to be kept confidential until it is known where and how to use it, usage need to be negotiated and agreed with that person, and if disagreement persists, interviewed persons have control, the final say.

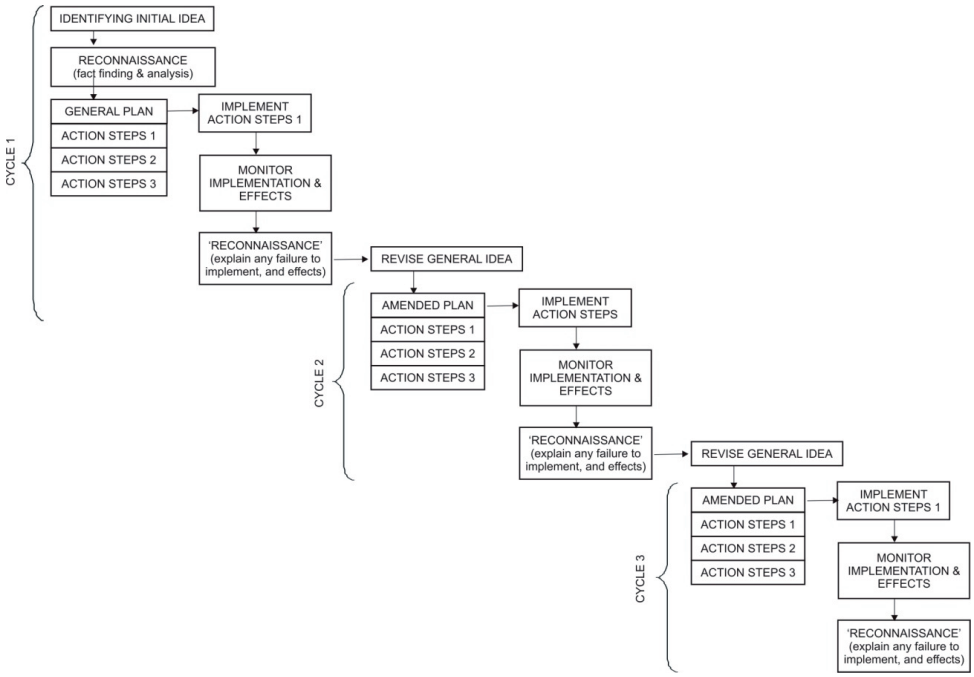

FIGURE 14 Action research model by Elliott (1991, 71)

Developing the next action steps, as the fourth step, includes decisions about the courses of action that are to be implemented next, and how both the process of implementation and its effects are going to be monitored. During the fifth step, the action researcher shifts from monitoring into a period of reconnaissance, and to generating ideas about future possibilities for action in the next cycle.

4.5.2 Ebbutt's Model

Ebbutt (1985, 164) questioned Elliott's model by claiming that the spiral is not the most useful metaphor or image to use to think about the action research process. Ebbutt (1985, 164-166) uses a series of successive cycles (Figure 15) that enable the possibility of providing evaluative feedback within and between the cycles of action.

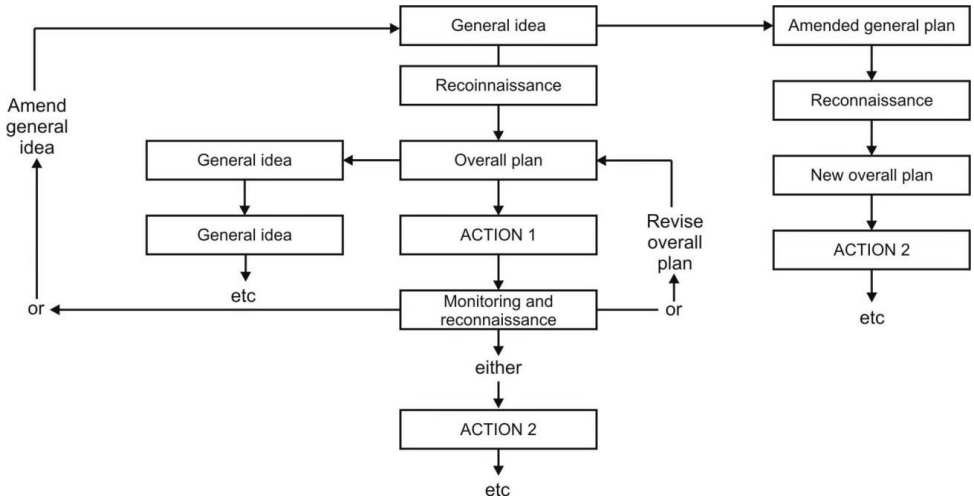

FIGURE 15 Ebbutt's action research model (Ebbutt 1985, 166)

4.5.3 Sagor's Model

Sagor's (1993, 10-11) process of collaborative action research has five sequential steps: 1) problem formulation, 2) data collection, 3) data analysis, 4) reporting of results, and 5) action planning. Researchers identify the issues to be studied, the greatest professional concern, in the first step. During the data collection, the participants involved in the collection process devise a plan for collecting and assembling three sets of different data. This allows the researchers to compare and contrast the independent sets of data. Sagor (1993, 10) believes that data collection is "the heart of the five-step process". It is the data that enables the teacher to look at the issue through different lenses.

Next the data are analyzed. It is during this step that the researchers look for trends or patterns and draw conclusions. During the fourth step, the researchers communicate their results. It is here that the education profession can benefit and learn the most. "Thus, it is imperative that teams of action researchers find as many appropriate forums as possible to share what they are learning about teaching and learning" (Sagor 1993, 11). The last step is action planning. During the last step decisions on how to use the research findings to plan and implement improvements are made.

4.6 Emancipatory Action Research Methodologies

In emancipatory action research the goal is to activate all the important stakeholders in the social or educational system to identify problems, critically reflect on their own practices and attitudes, and achieve mutual understanding by collectively changing their goals, strategies and established practices (Holter and Schwartz-Barcott 1993, 302; Grundy 1990, 358).

4.6.1 The Deakin Model

Deakin model was postulated at Deakin University in Australia by Stephen Kemmis and his colleagues (Grundy and Kemmis 1990; Kemmis 1985; Kemmis and McTaggart 1990; Carr and Kemmis 1997). They developed a four-step spiralling process of educational action research (Figure 16) that included: a) planning, b) acting, c) observing, d) reflecting, and e) re-planning (Kemmis and McTaggart 1990).

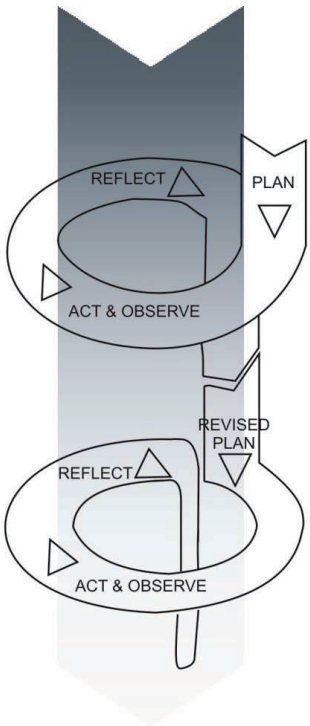

FIGURE 16 Deakin action research model (Kemmis and McTaggart 1990)

During the first step of the Deakin model educational researchers' plan how they will change or how they will address a specific issue of concern. Research

questions are also developed. The researchers implement the second step to take action and experiment with ways that may lead to solutions. The third step, observing, is important for the data collection. During this step the researchers record specific elements for a series of lessons. This allows the researchers to look for trends.

The fourth step, reflecting, is used to reflect on the plan, action, and observations. After this guided reflection, the educational researchers re-plan and revise the original plan according to the data, and then continue through the spiral of acting, observing and reflecting. The process of action research is an intentional, results-aligned investigation that is group or personally owned and directed.

Kemmis and McTaggart (1990) stated that the uniting of the terms action and research signifies the primary features of action research. Action research is a systematic research process for teachers to use to take action on ideas in practice, to broaden knowledge and improve the processes of instruction, teaching, and learning.

4.7 Role of Researchers

Educational action research[12] is usually either *teacher research,* where teachers are researching their own self or practices, or *research on teaching,* where others are researching teacher's practices or behaviour (Cochran-Smith and Lytle 1993, 10-13). Researchers can participate in research in six different roles that are defined by insiders and outsiders. According to Herr and Anderson (2005, 17-19) these roles are 1) insider studying own self or practices, 2) insider in collaboration with other insiders, 3) insider in collaboration with outsiders, 4) reciprocal collaboration, which means insider-outsider teams, 5) outsiders in collaboration with insiders, and 6) outsiders studying insiders.

An insider is defined as a participant who is doing research work or who practices inside their organization (Herr and Anderson, 2005, 17-19). A typical insider is a practitioner whose teaching practices are the object of action research. An outsider is defined as a participant who designs the research that is carried out by teachers (insiders) in their classroom, or persons who are otherwise helping or guiding the research process (Herr and Anderson, 2005, 17-19). A typical outsider is a university researcher who is doing action research with school-based teachers, but is otherwise outside of the day-to-day practices of school-teaching; or a specialist who is relied on for methodological guidance.

There are possibilities and challenges for insider-outsider relations in research. According to Cochran-Smith and Lytle (1993, 10-13), teachers in practice do not seem to highly value results obtained from outsider research, which typically means university researchers doing research on teaching (how teachers teach). This is because in these studies the research questions usually

[12] We focus here on educational action research.

emerge from study of the target discipline or analysis of the relevant theoretical and empirical literatures, and the findings are often generalized and reported outside of the context in which they were developed. In the case of insiders, teachers doing research, the research questions emerge from problems of practice, from the day-to-day experiences of teachers themselves, and are based on the knowledge of professional practice. In these studies the findings are closer to the context in which they were developed, and often useful beyond the immediate context, not just "laws about what works generically in classrooms" (Cochran-Smith and Lytle 1993, 15).

4.8 Methods of Data Collection and Gathering Evidence

Next we take a look at some of the data collection options available to a research team. Elliott (1991, 77-83) lists several methods of data collecting, e.g., diaries, profiles, document analysis, photographic evidence, tape or video recordings and transcripts, using an outside observer, interviewing, the running commentary, the shadow study, checklists, questionnaires, inventories, triangulation, and analytic memos. Hopkins (1985, 58-84) adds field notes, sociometric analysis, documentary evidence (like memos, letters, position papers, examination papers, and newspaper clippings), shadowing (also Sagor 1993, 34), and case studies. Kemmis and McTaggart (1990, 100-105) also list anecdotal records, ecological behavioural descriptions, logs, item sampling cards, and portfolios. Next some of these methods are briefly summarized in alphabetical order.

4.8.1 Case Study

Hopkins (1985, 81) defines a case study as a relatively formal and fairly definitive analysis of a specific aspect of teaching behaviour or research spaced life. A case study usually requires a full case study report that includes a statement of intent, description of procedures and process, results and implementation, and a meta-analysis (Hopkins 1985, 117).

According to Hopkins (1985, 81), the main advantages of using a case study in action research are the simplicity of plotting the progress of a course or a participant's or group's reactions to teaching methods, and a tendency to obtain a more accurate and representative picture of a research situation than the other research methods. The disadvantages are that case studies tend to be time consuming and that feedback is often only available to teacher after a considerable lapse of time.

4.8.2 Diaries

According to Elliott (1991, 77), it is useful for both teacher and participants to keep a diary during the action research project. A diary can contain both unstructured and structured entries including personal observations, feelings, re-

actions, interpretations, reflections, hunches, hypotheses, and explanations (Kemmis and McTaggart 1990, 101). Participant diaries provide an interesting contrast to the field notes kept by the teacher on the same topic.
At its best diaries are excellent ways of obtaining honest feedback on a particular teaching episode, to gain an indication of the general research environment climate, or to assess the progress on an individual participant (Hopkins 1985, 64). Teachers or researcher can also write a diary about contacts, meetings, notices, and observations.

The main advantages of the diary can be listed as follows: provides feedback from the participant's perspective, provides the possibility to focus on either a specific teaching episode or on the general research environment climate, can be part of a lesson, helps to identify individual participant problems, improves the quality of teaching through involvement of the participant, and provides the basis for triangulation (Hopkins 1985, 65). The disadvantages of the diary are lack of established practices in the research environment, difficulties for participants to record their thoughts and feelings, participants' inhibits participants discussing their feelings with the teacher, and the obviously subjective accounts of participants.

4.8.3 Documentary Evidence

Hopkins (1985, 78-79) defines memos, letters, position papers, examination papers, and newspaper clippings as documentary evidence. Elliott (1991, 78) adds syllabuses and schemes of work, curriculum reports, minutes of meetings, work cards and assignment sheets, sections from textbooks, and samples of a participant's written work. Different documents can provide relevant information on the issues and problems under investigation (Elliott 1991, 78). The use of such material might provide background information and understanding of issues that would not otherwise be available (Hopkins 1985, 78).

The main advantages of documentary evidence can be listed as follows: illuminates issues surrounding a curriculum or teaching method, provides context, background and understanding for a particular curriculum or teaching method, and provides an easy way of obtaining other people's perceptions (Hopkins 1985, 79). The disadvantages of documentary evidence are the time needed to obtain documents, difficulties obtaining all or some documents, and the unwillingness of some people to share 'confidential' documents.

4.8.4 Field Notes

According to Hopkins (1985, 59), keeping field notes is a way of reporting observations, reflections, and reactions to research problems. A field note is a written record of observations, interactions, conversations, situational details, and thoughts during the study period. Ideally, the field notes should be written right after a lesson or a session, as this makes it is easier to reconstruct problems and responses accurately and retain conscious awareness of one's original thinking.

Field notes can be of a number of different types, e.g., issue-oriented, when observations focus on a particular aspect of a teacher's teaching or behaviour, general reflections of impressions, or an ongoing description of an individual participant (Hopkins 1985, 59) The main advantages of field notes can be listed as follows: very simple to keep, provide good on-going record, give first-hand information that can be studied conveniently, act as an aide-memoire, help to relate incidents and explore emerging trends, and helps teachers if they intend to write a case study (Hopkins 1985, 60). The disadvantages of field notes are the need to fall back on aids such as question analysis sheets, tapes and transcripts for specific information, impossibility to record conversations, time demands, and conceivable subjectivity.

4.8.5 Interviews

Interviewing is usually used when there is a need to focus on a specific aspect of teaching or a research situation in detail, to improve the research situation climate, or if teacher-participant discussion can better provide general diagnostic information. Interviewing is a good way to find out what the situation looks like from the other interacting participants' points of view (Elliott 1991, 80). According to Hopkins (1985, 66-70), interviewing can take four forms based on between whom it occurs: teacher-participant, observer-participant, participant-participant, or occasionally teacher-observer.

Interviews can be structured, semi-structured, or unstructured (Elliott 1991, 80). In structured interviews, the questions are determined by the interviewer. Typically the aim of this approach is to ensure that each interviewee is presented with exactly the same questions in the same order, usually based on some questionnaire (Hirsjärvi, Remes and Sajavaara 1997, 203). This enables that answers can be reliably aggregated and that comparisons can be made with confidence between sample sub-groups or between different survey periods. In the unstructured interview the initiative for raising the relevant topics and issues is left to the interviewee. The interviewer merely sets the theme or topic, possibly asks the interviewee to expand, explain or clarify some points. In semi-structured interviews there is typically some predetermined topic or issue to discuss, but the form and order of the questions is free (Hirsjärvi et al. 1997, 203).

The main advantages of interviewing are the following: the interviewer is in direct contact with the participant, the interviewer is able to seek the desired information directly, the interview can be done in either lecture time or outside the class, and problems can be followed up immediately when they arise and information obtained while minds are still fresh (Hopkins 1985, 68). The disadvantages of the interviewing are time demands and difficulties getting participants to explain their thoughts and feelings.

4.8.6 Questionnaires

Questionnaires are a good way to elicit other people's observations and interpretations of situations and events (Elliott 1991, 81-82). They are a quick and simple way of obtaining wide-ranging and rich information from participants. Typical questionnaire forms are the postal or internet questionnaires and the controlled questionnaire (Hirsjärvi et al. 1997, 191-192). The postal or internet questionnaire is mailed to participants, and after answering they mail it back to the researcher. The controlled questionnaire is either delivered personally in research situation or gathered personally after a stated period of time.

Typically questionnaires contain open, multiple-choice, or scaled questions (Hirsjärvi et al. 1997, 193-195). An open question includes a question with on empty space or textbox for the answer. A multiple-choice question includes question and preset, numbered responsive alternatives. It is also possible to include an open responsive alternative, where the respondent can add his or her own personal response. A scaled questionnaire presents alternative statements and the respondent chooses the most applicable one. A typical scale is the Likert scale with 5 to 7 points.

The main advantages of the questionnaire in use are ease of administration - quick to fill in and easy to follow up, provides direct comparison of groups and individuals, provides a lot of feedback from different points of view, and the data are quantifiable (Hopkins 1985, 74). The disadvantages of the questionnaire are the time needed for analysis, extensive preparation to get clear and relevant questions, difficulty of creating questions that explore in depth, dependence for effectiveness on reading ability and comprehension of the respondent, respondents' possible reluctance to answer candidly, and attempts to produce 'right' answers.

4.8.7 Portfolios

Kemmis and McTaggart (1990, 102) define portfolios as collections of materials compiled for a purpose. Portfolios might contain any kind of matters and documents relevant to the researched situation, such as minutes of relevant meetings, correspondence related to the progress and behaviour of a participant, or correspondence and documents related to a target issue.

According to several studies (e.g., Niikko 2000, Kankaanranta 1998, Heikkilä 1999), an advantage of the portfolio is the richness of the available documents, but at the same time this can also be an enormous disadvantage, because it enlarges the amount of data for analysis. This requires that someone accurately selects the most relevant documents.

4.8.8 Video Recordings

In classroom settings video recording can be used to record lessons in whole or in part (Elliott 1991, 79). "It allows the teacher to observe many facets of his or her teaching quickly, and provides heuristic and accurate information for diag-

nosis" (Hopkins 1985, 70). Often, interesting and relevant episodes from recordings are later transcribed into written form for analysis, and different methods are used to examine specific aspects of teaching (Elliott 1991, 79; Hopkins 1985, 70).

According to Hopkins (1985, 60), the main advantages of video recordings are the possibility to constantly review all the target teaching situations, to diagnose the origin of problems, to capture the behavioural patterns of teacher and participant, and to chart clearly patterns of progress over long periods.

4.9 Analysis of Action Research Data

The analysis of action research data can be divided into four stages (Becker 1958; McKernan 1991, 227-232; Hopkins 1985, 107; Sagor 1993, 48-57):

1. Selection and definition of problems, concepts, and indices
2. Defining data frequencies
3. Interpretation
4. Reporting results

In the following sections, we take a closer look on each of these stages.

4.9.1 Selection and Definition of Problems, Concepts, and Indices

During the first stage, *Selection and definition of problems, concepts and indices*, the collected evidence is processed, that is, edited, coded and sampled conceptually and theoretically (McKernan 1991, 227). Then themes, issues, or factors that seem to emerge from the data are identified, and problems for further investigation are defined (Sagor 1993, 48; Becker 1958, 654). According to Sagor (1993, 48), these emerging items are generally of two types: (1) items that come up repeatedly or (2) idiosyncratic items that seems particularly noteworthy. Usually, during this stage, the researcher has also established a number of hypotheses that begin to explain what is happening in the research situation (Hopkins 1985, 110).

4.9.2 Defining Data Frequencies

During the second stage, the *Defining data frequencies*, the data is mapped by noting the frequency of recurrence of issues, themes, and units (McKernan 1991, 229). The goal is to find out which of these are worth pursuing during the later research (Becker 1958, 656). It also concerns the validation of the hypotheses: whether the evidence truly supports the researcher's theories or not (Hopkins 1985, 110-111; Sagor 1993, 49). There are a few techniques that can be used to establish the validity of the hypotheses: saturation, triangulation, matrixes, or

grounded theory (Hopkins 1985, 110-113; Sagor 1993, 49-52). These techniques are briefly introduced in Section 3.10.

4.9.3 Interpretation

The third and final stage of the data analysis is *Interpretation* (Hopkins 1985, 113; McKernan 1991, 230-231). The goals are to create meaning out of the observations and constructs, spot relationships among the data, and to draw a larger picture, i.e., build a model of the research data by incorporating the individual findings into a generalized model that best explains the data one has assembled (McKernan 1991, 230-231; Becker 1958, 657), or to elaborate and modify existing theories as incoming data are meticulously played against them (Strauss and Corbin 1994, 273). The model built during this stage gives the teacher information on how to change his or her teaching situation, and serves as a springboard for the next action research cycle (Hopkins 1985, 114).

4.9.4 Reporting Results

Before reporting the results, Becker (1958, 659) recommends the careful rechecking and rebuilding of models to ensure that every item of information is assessable and taken account. According to Sagor (1993, 58), "the reporting of research is not often discussed in action research". In many cases, teachers who engage in action research have no need to present their results to anyone except to themselves, particularly if the research is to be used solely for improving their teaching (Hopkins 1985, 117). However, the results could be replicated on an other occasion, and therefore presenting the results in some form would help to disseminate knowledge of good practices and improve the quality of teaching (Sagor 1993, 58-59, 64).

The form of the report will depend upon the audience of the study (McKernan 1991, 231; Sagor 1993, 62-64). It could be, e.g., a written publication, a presentation, or a discussion in a meeting. Sagor (1993, 60) reminds us that because action research reports are developed by and for practitioners, "the most important consideration should be to choose a methodology that will tell the story accurately and effectively". McKernan (1991, 231) lists a few basic rules for reporting the results:

- Contains clear exposition
- Ensures fair conditions based on careful selection of concepts and indicators
- Reconstructs an adequate explanation of the findings and the process which generated them
- Summarizes first the problem studied and present summary tables of the main findings
- Interprets what the findings mean within the study context and their possible the integration with theoretical perspectives

- Settles whether the actions taken have improved or not improved the problem
- Poses new lines of research or new proposals for inquiry into the teaching situation

The diversity of the evidence and data gathered also has an effect on the form of the action research report, i.e., on how to deal with mixtures of media including videotapes, photographs, charts and figures, written narratives, audiotapes, and oral presentations (Sagor 1993, 60). The basic content of a successful report is generally as follows (Sagor 1993, 60-62; Hopkins 1985, 117):

- *Introduction* to the context of an executed action research project to clarify the purpose of the study, including the site where the research was conducted, the focus of the research, and possible pertinent characteristics of the staff and learners.
- *A description of the research process* explaining clearly and concisely to others what has been done during the research and what kinds of research procedures have been followed by describing the research design, techniques of data collection, verification of concepts, and what has actually occurred.
- *An analysis of the data* to show what has been found during the research: the research outcomes, theoretical implications, actions taken as a result, and the evaluation of those actions. Typically, this includes examples of evidence: segments of interviews, portions of videotaped lessons, or testimonials from teachers and learners.
- *An action plan* stating the importance of the findings and the implications of the study: what is going to be done to improve the observed teaching situation. This reviews the whole process, concludes the utility of the research, and defines things that should be done differently next time.

4.10 Techniques for Establishing Validity of Hypotheses

As stated in Section 4.9.2., there are a few techniques that can be used to establish the validity of the hypotheses: saturation, triangulation, matrices, or grounded theory. Each of these techniques is briefly introduced next.

4.10.1 Saturation

In saturation "the hypothesis or category generated from observation is tested repeatedly against the data in an attempt to modify or falsify it" (Hopkins 1985, 111) as follows:

- If after repeated testing a hypothesis or category is found wanting, it is then discarded.

- The hypothesis or category might have been conceptualized crudely and, through testing, the concept is modified, refined and amplified.
- Although the process of falsification is never complete, there comes a time when repeated observation leads neither to refutation nor amplification and only serves to support the hypothesis.

At the point, as the utility of observation decreases, saturation can be said to have occurred and the hypothesis has been validated.

4.10.2 Triangulation

Triangulation is typically seen as the use of multiple methods in the study of the same phenomenon (Campbell and Fiske 1959). Denzin (1978, 294-304) classified the concept of triangulation into four types, according to the focus:

1. **Data triangulation**: involves the collection of data from multiple sources for the same study, provides an opportunity to examine 1) how an event is experienced by different individuals, groups of people, or communities, 2) at different times, or 3) in different settings (Mitchell 1986, 20); data from one source is used to validate data from another source (Kimchi, Polivka and Stevenson 1991)
2. **Investigator triangulation**: involves multiple observers, two or more investigators with diverse research training backgrounds examine the same phenomenon (Mitchell 1986, 20); removes the potential for bias that might occur in a single-investigator study
3. **Theoretical triangulation**: various theoretical points of view, perspectives or hypotheses are critically examined within the same study (Mitchell 1986, 20); competing hypotheses are developed and tested using the same data set; tests existing theories in the field of study when alternative theories are examined
4. **Methodological triangulation**: two or more research methods or procedures of data collection (such as multiple data collection methods, multiple data analysis techniques, or methods from both qualitative and quantitative research) are used in a single study (Mitchell 1986, 21); used in the examination of complex concepts; the most common type of triangulation (Burns and Grove 1993, 278)

Kimchi et al. (1991) define also a fifth type of triangulation, **analysis triangulation**, where the same data set is analyzed with the use of two ore more differing analytical techniques. The purpose is to evaluate the similarity of the findings. More-over, when researchers combine multiple sources of data, observers, theoretical perspectives, methodologies, and analyses in one study, the research procedure is defined as a **multiple triangulation** (Denzin 1978, 304); that is the use of more than one of the five types of triangulation presented here.

Triangulation is used in qualitative research "to compare all the measures from different sources to determine the validity of the findings" (Burns and

Grove 1993, 350). In action research a special form of data triangulation is the most common type of triangulation. According to Elliott (1982), triangulation is a procedure for organizing different types of evidence into a more coherent frame of reference or relationship so that they can be compared and contrasted.

Triangulation provides access to relevant data about a teaching situation: 1) the learners explain how the teacher's actions influence the way they respond in the situation; 2) a participant observer collects data about the observable features of the interaction between teacher and learners; and 3) the teacher has an opportunity to test and perhaps revise his or her own teaching actions on the basis of more sufficient data.

4.10.3 Matrices

According to Sagor (1993, 49), data can also be sorted by drawing up a matrix (Figure 17). Across the top of the matrix, as column headings, each of the research themes or categories that emerged during the previous stage are written. On the vertical axis, either individual sources of data (different data collection methods) or, if only one data source is used, data from individual respondents are placed.

	Previous experience	**Parent involvement**	**Relationship with teachers**
Surveys			
Interviews			
Archival Evidence			

FIGURE 17 An example of a data matrix with three research categories (horizontal axis) and three sources of data (vertical axis) based on Sagor (1993, 50)

As members of a research team read through the raw data, they look for supporting data for each theme or category, and write it in the appropriate space on the matrix. It is possible to add new themes or categories to the matrix, if needed, during this phase. A completed matrix serves as a visual representation of the data.

4.10.4 Grounded Theory

Originally Glaser and Strauss (1967, 3) defined grounded theory as "a way of arriving at theory suited to its supposed uses", or "an initial, systematic discovery of the theory from the data of (social) research". Moreover, generating a theory from the data means that most hypotheses and concepts not only come

from the data, but are systematically worked out in relation to the data during the course of the research (Glaser and Strauss 1967, 6). They defined the stages of the theory as follows (Glaser and Strauss 1967, 105-113):

1. *Comparison of incidents applicable to each theme or category* is done by coding each incident into as many themes or categories as possible, and comparing it with previous incidents and groups coded in the same theme or category. At some point, stop coding and record a memo on ideas.
2. *Integration of categories and their properties* is done by coding and comparing incidents with properties of the theme or category that resulted from the initial comparisons of incidents during the first stage.
3. *Delimiting the theory* is based on delimiting features of the constant comparative method to prevent it becoming an overwhelming task. Delimiting occurs at two levels: the theory solidifies or the list of categories is reduced.
4. *Writing theory* is based on coded data, a series of memos and a theory formulated during the previous stages.

The main difference between this and other qualitative methods is that the grounded theory combines general approaches, the explicit coding procedure and the style of theory development, to generate theory more systematically (Glaser and Strauss 1967, 101-102).

However, during the past four decades, grounded theory has begun to live its own life and nowadays we have different interpretations of grounded theory: the early version by Glaser and Strauss (1987), and versions according to Glaser (1978), Strauss (1987), or Strauss and Corbin (1990), among others (e.g. Charmaz 1990; Kools, McCarthy, Durham and Robtrecht 1996). According to Dey (2007, 80), in these various interpretations we can distinguish questions and themes that they tend to have in common:

1. Grounded theory is conceived as a way of generating theory through research data rather than testing ideas formulated in advance of the data collection and analysis.
2. The use of grounded theory requires an innovative approach to data selection, where sites and sources are selected flexibly for their theoretical relevance in generating comparisons and extending or refining ideas.
3. Grounded theory relies on qualitative data, mostly observation and unstructured interviews in the initial stages and more structured forms of data collection in later stages when the study becomes more focused.
4. Data analysis is based on 'coding' data into categories for the purpose of comparison as well as identifying and refining properties.

5. In grounded theory, the data collection stops when the categories reach 'theoretical saturation', that is, when further data no longer prompt new distinctions or refinements to the emerging theory.

4.11 Quality of Data Collection and Gathering Evidence

The traditional criteria for judging quality in quantitative research are internal validity, external validity, reliability, and objectivity. Sagor (1993, 28) also highlights these qualities in action research, although he replaces objectivity with generalisability. However, the use of these terms in qualitative work has been questioned by several researchers (e.g. Heikkinen and Syrjälä 2006; Heikkinen, Huttunen and Syrjälä 2007; Stenbacka 2001; Whittemore, Chase and Mandle 2001; Long and Johnson 2000; and Golafshani 2003). Healy and Perry (2000) assert that the quality of a study in each paradigm should be judged on that paradigm's terms. The basis for this criticism is the difference in the purpose of these two mainstream research paradigms: quantitative research seeks to explain something, while qualitative research seeks to generate understanding (Stenbacka 2001, 551). Stenbacka (2001, 551) identifies four quality concepts in qualitative research: validity, reliability, generalisability, and carefulness. Reliability and validity are essential criteria for quality in the quantitative paradigm, but in the qualitative paradigm the terms credibility (cf. internal validity), transferability (cf. external validity), dependability (cf. reliability), and confirmability (cf. objectivity) are essential criteria for quality, and thereby establish the trustworthiness and rigor of the research (Lincoln and Guba 1985, 300). To this end, in the context of narrative action research, Heikkinen et al. (2007) have defined own five principles for validation.

4.11.1 Credibility

According to Trochim (2002), the credibility criterion involves establishing that the results of qualitative research are credible or believable from the perspective of the participant (insiders) in the research. Since from this perspective, the purpose of qualitative research is to describe or understand the phenomena of interest from the participants' viewpoint, the participants are the only ones who can legitimately judge the credibility of the results. If action research is to be viewed as credible, the solution to the problem must actually solve the problem (Mills 2003, 85).

According to Greenwood and Levin (1998, 81-85), the credibility of action research can be assessed in three ways:

1. By assessing workability, that is, whether the actions taken in the action research process result in a solution to the problem.

2. By assessing whether the inquiry is making sense out of the tangible results; the focus is on examining how meaning is constructed through deliberative processes.
3. By assessing the possibility of "transcontextual modelling", that is, meanings created in one context are examined for their credibility in another situation through a conscious reflection on similarities and differences between contextual features and historical factors.

Lincoln and Guba (1985, 301-316) describe a series of techniques that can be used for establishing credibility as follows: prolonged engagement (including persistent observation and triangulation), peer debriefing, negative case analysis, referential adequacy, and member-checking.

4.11.2 Transferability

Transferability refers to the degree to which the results of qualitative research can be generalized or transferred to other contexts or settings (Lincoln and Guba 1985, 290; Erlandson, Harris, Skipper and Allen 1993, 31-32). From a qualitative perspective transferability is primarily the responsibility of the one doing the generalizing. The qualitative researcher can enhance transferability by doing a thorough job of describing the research context and the assumptions that were central to the research. The person who wishes to "transfer" the results to a different context is then responsible judging how sensible the transfer is. Therefore, transferability can be established by using thick descriptions that provides the widest possible range of information, making transferable judgments on the part of potential appliers possible (Lincoln and Guba 1985, 316).

4.11.3 Dependability

The traditional quantitative view of reliability is based on the assumption of replicability or repeatability. Essentially, it is concerned with whether we would obtain the same results if we could observe the same thing twice. But we cannot actually measure the same thing twice. This is because by definition, if we are measuring twice, we are actually measuring two different things. In order to estimate reliability, quantitative researchers construct various hypothetical notions (e.g., true score theory) to try to get around this fact.

The idea of dependability, on the other hand, emphasizes the need for the researcher to account for the ever-changing context within which research occurs. The researcher is responsible for describing the changes that occur in the setting and how these changes affect the research approach (Trochim 2002). According to Guba (1981, 81), there can be no credibility without dependability. Therefore, it is not always necessary to demonstrate dependability separately, although this type of relation dependability is very weak. Dependability can be established by using inquiry audit, overlapping triangulation, or replication (Lincoln and Guba 1985, 317-318).

4.11.4 Confirmability

Qualitative research tends to assume that each researcher brings a unique perspective to the study. Confirmability refers to the degree to which the results could be confirmed or corroborated by others. Various types of data can be used in action research, from interviews, observations, document review, focus groups, and surveys to role play. The inclusion of different data sources can increase their confirmability through such techniques as triangulation (Levy 2006, 382-383; Reason 1994). There are a number of strategies for enhancing confirmability (Lincoln and Guba 1985, 318-327). The researcher can document the procedures for checking and rechecking the data throughout the study. Another researcher can take a "devil's advocate" role with respect to the results, and this process can be documented. The researcher can actively search for and describe negative instances that contradict prior observations. And, after a study, one can conduct a data audit that examines the data collection and analytical procedures and makes judgments about the potential for bias or distortion.

Confirmability can be established by using the following techniques (Lincoln and Guba 1985): confirmability audit, audit trail, triangulation, or reflexivity. An audit trail can be used to accomplish dependability and confirmability simultaneously.

4.12 Summary of Action Research

In this study we are about to implement action research in educational settings. Therefore we conclude our discussion of action research here from the educational point of view.

Action research can provide and address solutions to real-life problems in the classroom by combining theory with practice to start a critical process (Avison et al. 1999; Bawden 1991, 10). According to Calhoun (2002, 18), “action research can change the social system in schools and other education organizations so that continual formal learning is both expected and supported”. The key principles of action research involve strategies to improve teaching and learning by using data feedback in a cyclical process (Kelly 1985, 136-137).

During the action research process teachers will become more aware of the educational process, options, and possibilities for not only the classroom, but for the entire school or educational institute (Merrill 2004, 6). Johnson (1993) noted that teachers embarking on action research improve their understanding, methodology, and approach to the teaching process. Kelly (1985, 138) also highlights the increasing understanding of the totality of a given situation. According to Ziegler (2001, 4), “teachers become more critically reflective about their practice, gain confidence in their abilities, become more active professionally, make valuable connections with peers, increase their interest in research”, and “transform their practice for the benefit of the adults they serve.”

The action research process is efficient because people collaborate, and share their insights and resources to get the job done. For example, teachers are forced to share their thoughts and best teaching practices to improve their teaching environment. Action research assists in practical problem solving and expands scientific knowledge such that both are performed collaboratively (Kelly 1985, 134-135). This type of inquiry is a powerful learning experience that en-gages people in a meaningful, active, and reflective research process (Ziegler 2001, 4). Action research fosters supportive, open, and respectful working alliance amongst members (Stark 2006, 30). It increases the individual's motivation (Stark 2006, 30), enhances the competencies of the respective actors (Kelly 1985, 134), and develops the profession's knowledge base (Sagor 1993, 3; Stark 2006, 30-31).

The strength of action research is the in-depth and first-hand understanding the researcher obtains (Benbasat, Coldstein and Mead 1987). The results can be structured and reported in various ways and from different perspectives according to recipients' different needs. From the reliability point of view it is important to report the different phases and methods used as exactly as possible (Syrjälä and Numminen 1988). During the action research cycle results and recommendations formed during the previous stages are implemented in practice instead of being studied from the outside (Kelly 1985, 136).

During the action research process participants might also learn or strengthen some unexpected skills, such a communication skills, learning skills, writing skills through writing their own articles, critical reading, or performing skills when presenting their work and results at a forum, or a deeper level of reflection (Stark 2006, 31-32). Action research also results in positive changes within the workplace, such as improved communication channels within the organization, improved staff and learner moral, more empowered learners and work colleagues, and more effective team-working (Stark 2006, 32).

Action research is seen as an excellent way of improving pedagogical practices. The main goal is to develop a new theory, compare or test a theoretical model against the empirical results obtained from action research, and to improve target practices as well as understanding of participants and their actions. Action research seems to establish a well-formed framework, especially for collaborative pedagogical development and qualitative assessment.

There are several ways to execute the action research process. Which approach or model to use depends on the research goals and setting. The evaluation criteria for action research are not as clear as they are for other research methods. It might be hard to evaluate the success of an action research process. However, credibility, transferability, dependability, and confirmability have been stated by several scholars as the four most important qualities of the results of action research that should be discussed before collecting research data with different methods (see Section 4.11). The analysis of the research data includes (see Section 4.9.):

1. Selection and definition of problems, concepts, and indices

2. Defining data frequencies,
3. Interpretation of data and model-building
4. Reporting results

Within the context of the action research approach, it would be impossible to replicate the setting given that it is a live, actual organizational or teaching situation with all its inherent complexity. "What matters therefore is to document as much relevant data as possible, as accurately as possible given the circumstances, be reflective on what the data mean, apply a thoughtful analytical framework to the data, and arrive at some valid insights that contribute to knowledge in some significant way" (Marshak and Heracleous 2005, 75). The form of the report will depend upon the audience of the study as well as on the diversity of the evidence and data gathered.

According to previous studies, action research can provide and address solutions to real-life problems by combining theory with practice. It can also improve teachers' understanding, methodology, and approach to the teaching process. This has a significant effect when we move into another learning environment. However, in some cases, typically in technical and emancipatory action research (see Sections 4.2.1 and 4.2.3), the expected outcome of the research, a solution to some predefined problem, is stated but the actual outcome, the solution, is not known and might only emerge over time (Morton 1999, 220; Walker and Haslett 2002, 528-529). On the other hand, mostly in practical action research (see Section 4.2.2), there is no actual problem to solve. There is a motivation to improve practices and the whole action research process starts by setting that as the problem. In these cases there are some expectations regarding the outcome, but because the changes made are made by individuals who have gained a new understanding of their practice, the results are more unpredictable.

5 RESEARCH DESIGN AND RESEARCH QUESTIONS

As Kemmis (1991) encapsulates it, "education has an important role to play in improving society[, and] because society is constantly changing, our education must also undergo continual development and redevelopment" (p. 57). On the other hand, "education cannot continue to improve without the active participation of teachers in curriculum formulation, [educational] research and evaluation" (pp. 57-58). To be able to make all these improvements "education systems and educational institutions need to find new ways of supporting teachers in these tasks". (p. 58). Improving education here means "improving the nature and conditions of the work of education, the quality of our knowledge of education, and the distribution of power in our educational institutions" (Kemmis 1991, 57-58). This requires that the people involved are active agents in the educational development process.

Quantitative educational research does not fully support us in our attempts at improvement, because it does not adequately understand the nature and problems of change (Kemmis 1991, 58). We do not benefit sufficiently from the emerging trends in educational practice because the change process can be neither understood nor measured with the rational or experimental research model (Caine and Caine, 1994, p. 20). Caine and Caine are thus claiming that a need exist for more qualitative research in education. Babbie (2007) agrees with this proposed need for more qualitative research in education and states that through observations a breadth and depth of understanding about the human experience are gained. There are research questions where the breadth and depth of educational practice within the classroom or online setting cannot be appropriately represented in quantitative data.

Similarly, Arsenault and Anderson (1998) agree that studying and interpreting human experiences in authentic settings cannot be best represented quantitatively and state that "qualitative research is a form of inquiry that explores phenomena in their natural settings and uses multi-methods to interpret, understand, explain, and bring meaning to them" (p. 119). Furthermore, Yin (1989, 16-19, 29; 1981a, 1981b) views using the qualitative methodology in case

studies as being the preferred strategy for research studies dealing with contemporary phenomena within a real life context. He also considers case studies as the most appropriate methodology for studies focusing on "how" or "why" questions.

In the light of these statements, the most suitable approach for conducting a study in the educational context is to use a qualitative methodology. In choosing a research paradigm for this specific research, purpose of assessing and tailoring the web course design process, the case study, defined by Merriam (1988) as "an examination of a specific phenomenon such as a program, an event, a person, a process, an institution, or a social group" (p. 9) would seem the most appropriate. Merriam also explains the significance of using a qualitative case study methodology that seeks holistic description or explanation as follows: "by concentrating on a single phenomenon or entity ('the case'), this approach aims to uncover the interaction of significant factors characteristic of the phenomenon." (p. 10)

However, educational research findings published in books and journals have had little impact on day-to-day teaching practice (Zuber-Skerritt 1991, 112). An essential point here concerns participation: who is involved and the ways they participate (Kemmis 1991, 58). If teachers are simply told what to do – how to adapt knowledge and principles generated by various theorists to their practice - the majority of teachers would reject such technocratic advice (Zuber-Skerritt 1991, 112). Teachers need to get involved; they should be guided to do research into their own teaching practice, and to publish their results among their peers (Zuber-Skerritt 1991, 113). On the other hand, participation has to be voluntary, because that is associated with higher motivation to learn, a more positive reaction, and better performance or achievement than in the case of those who have merely been told to participate (Mathieu and Tannenbaum 1992, 831-832).

At this point, it might be asked why we don't use design research as a research methodology instead of action research (cf. Järvinen 2005). Design research investigates, mainly, the processes of design, development and evaluation and the tools that have been used and products or methods that have been created during the process (Richey and Klein 2007, 1). It helps one to test theories and to validate practices. However, in the present research we are not interested only in web course design process or the development of design methodology, but also in things that teachers and trainers do and how they think during training sessions and during the design process itself, and of course, whether they are able to improve their web course design knowledge and skills during the training. Beside the trainer, the practitioners participating in the training sessions are also active participants in this research. Of course, we also wanted to investigate how the design methodology or training sessions could be improved to meet the practitioners' needs better; however all this is based on the actions of active participants.

As stated in Chapter 4, the use of action research methodology helps practitioners to share their opinions and experiences, develop new theories, com-

pare or test theoretical models against empirical results, and to improve their practice as well as their understanding and actions. An insider, an active participant, is collaborating with other insiders. Altogether, action research seems to constitute a well-formed framework, especially for collaborative educational development and qualitative assessment. Understanding of action research also helps to document the experience more precisely.

5.1 Role of Action Research and Research Questions

The research approach to be employed here contains and combines characteristics from all action research approaches (Section 4.2):

- *Technical action research* for testing the theoretical web course design methodology against empirical results from action research project, and for improving the methodology through several training cases. The focus here is mainly on methodological development.
- *Practical action research* for improving web course design and training practices in collaboration with novice teachers and experienced practitioners. The focus here is mainly on practical development.
- *Emancipatory action research* for creating institutional guidelines for web course design and personnel training. The focus here is mainly on institutional development.

Therefore, we were not using any of the specific action research methodologies reviewed in Sections 4.4-4.6. Instead we used a generic and simplified methodology that follows the steps of typical spiral action research including planning, acting, collecting, observing, reflecting, analyzing, reacting, and evaluating (see Section 4.3). We also used multi-case study to confirm the results (see Section 4.2). In this study, action research is based on modifying the educational methods, roles, scheduling, and grouping used in different cases.

The research was conducted to examine what changes might be required in the web course design methodology employed in this study (see Chapter 3) in relation to participation in action research. A comparative analysis across the case studies provided a broader understanding of the key areas of investigation. There were three specific areas of investigation:

1. How can the design methodology employed in this study be enhanced to better suite the different kinds of design situations with heterogeneous design groups?
2. How can the pedagogical scripts be adapted to the different designs and design process itself?
3. What training modes would be best for training novices and practitioners to design their own web courses?

5.2 Context of Case Studies

Most of the web courses at the university level (at least in Finland) are still implemented without any written documentation or proper pedagogical design; most of the teachers do not even know where to start or how to proceed. We knew that teachers and professionals at the local university (University of Jyväskylä) were willing to try online learning and teaching in their own lectures, but most of the support they were initially able to get was related to technological support, e.g. use of different platforms, video recording and editing of lessons, Flash, and videoconferencing. In our case, however, comprehensive support was not available for the design process as a whole. There were some cases where individuals were guided side-by-side, but there were not enough resources to offer that kind of support to all.

The starting point in this research was the fact that individual side-by-side guidance that was deemed too time-consuming and taking too much of available guiding resources. To help teachers in their design process we planned five different training modes where the participants would be able to work with a design project and get support, guidance and tips as needed. The main goal in these case studies was to learn how to be an online teacher and how to author one's own web courses. The goal was set on the basis of the previous research findings, reviewed in Chapter 2.

The research includes seven case studies with several action research cycles, as follows:

1. Four-months training course for middle sized groups (Case 1)
2. Adaptation of pedagogical scripts (Case 2)
3. One-hour introductory workshops for larger groups (Case 3)
4. Twelve-hours learning-by-design workshop for smaller groups (Case 4)
5. Self-oriented online course for single participants (Case 5)
6. Three-hours learning network workshop for larger groups (Case 6)
7. One-hour participatory workshop for larger groups (Case 7)

Case 1, and Cases 3 to 7 are about different training modes, and Case 2 is about the use of pedagogical scripts as a tool in different cases. In the following sections, we take a closer look at the background and research setting of the different cases and their action research cycles. The case studies are presented in their order of implementation (Figure 18).

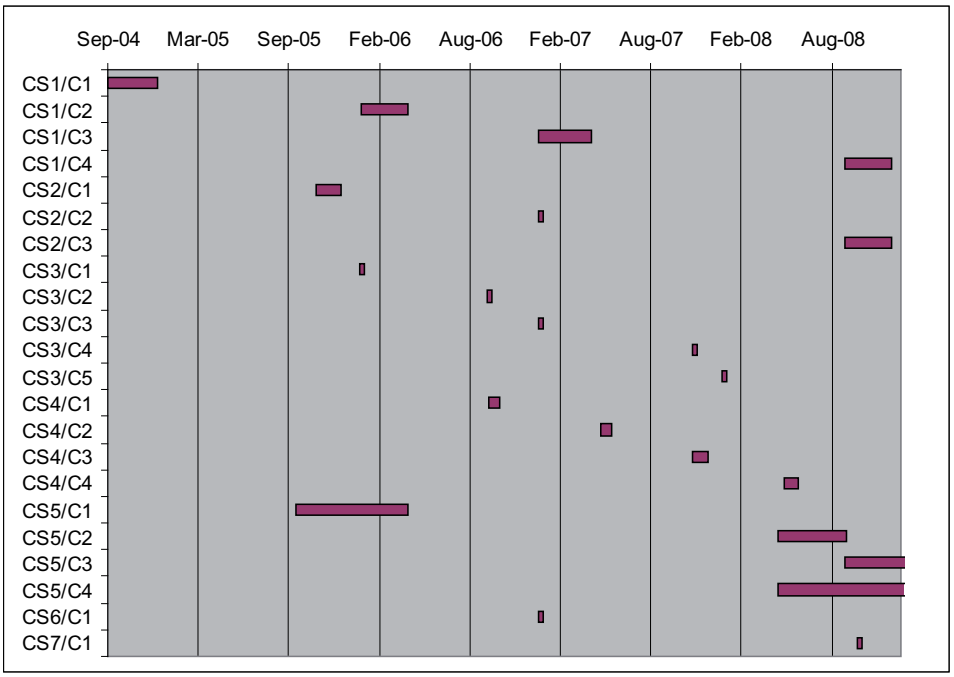

FIGURE 18 Timelines of different case studies (CSi, i=1,…,7) and each action research cycles (Cj, j=1, 2, 3, 4 or 5) in 2004-2009

5.3 Case 1: Four-Month Training Course

At the Department of Mathematical Information Technology, University of Jyväskylä, students may specialize in computer science teacher education and graduate as qualified computer science teachers. Students undertake both computational and educational studies as part of their curriculum. They are familiarized with different educational theories, and how this educational component can be blended with computing. They practice both learning and teaching in different learning environments.

Students review the differences between the traditional classroom environment and the virtual learning environment in both learning and teaching. They also practice web course design by designing their own web courses for distance or blended learning in a Web Course Design and Implementation course. Most of the students are graduate on-campus learners, but there are also some distance students who often are already working as unqualified teachers in an educational institution, and who are participating in a master's program to become qualified teachers. The first case study includes four action research cycles, as described in the next four sections.

5.3.1 Cycle 1: Autumn Semester 2004

The first cycle (CS1/C1 in Figure 18) was carried out as a Web Course Design and Implementation course during the four-months autumn semester starting in September 2004. There were twenty-five participating graduate students: nine distance students and sixteen on-campus students. The course was new and had just been introduced onto the curriculum. Twenty-one of the participants passed the course in four months, and one later on – seventeen of them with the grade very good or excellent.

5.3.2 Cycle 2: Spring Semester 2006

The second cycle (CS1/C2 in Figure 18) started in January 2006 with twenty one graduate students: three of them were distance students and eighteen campus students. One of the distance students lived in US. All the distance students were already working as teachers during the course. Thirteen of participants passed the course in four months, and five more later on – fifteen of them with the grade very good or excellent.

5.3.3 Cycle 3: Spring Semester 2007

The third cycle (CS1/C3 in Figure 18) started in January 2007 with fifteen graduate students: seven of them were distance students and eight on-campus students. Seven of the participants passed the course in four months and six more later on – eight of them with the grade very good or excellent. The last two of the participants never turned in their required self-evaluations.

5.3.4 Cycle 4: Autumn Semester 2008

The fourth cycle (CS1/C4 in Figure 18) started in September 2008 with fourteen graduate students: two were distance students and twelve on-campus students. Both distance students were working as unqualified teachers during the course. Eleven of the participants passed the course – eight of them with the grade very good or excellent. Two of participants finished the course as a self-oriented online course (see Case 5 in Section 5.7). The last one finished the course two years later.

5.4 Case 2: Adaptation of Pedagogical Scripts in Discussions

Many teachers face various problems when using online discussions in their mixed-mode or online courses, for example

- There are either too few or too many participants

- Everybody waits for someone else to start, time "runs out" and at the end participants write all their thoughts in one long message
- No real dialogue takes place
- Participants have not allocated enough time for discussion
- All participants take the path of least resistance

Typical solutions for these problems are e.g., 1) role discussions, which are difficult to apply to all subjects and all do not want to participate, 2) teacher-controlled discussions, where the teacher's workload grows and responsibility is passed to the teacher, or 3) compulsory discussions with a required minimum amount of messages or answers that lower discussion quality.

We wanted to try something else. We adapted pedagogical scripts for face-to-face and online discussions (O'Donnell 1999; Hämäläinen and Häkkinen 2006). We tested different scripts, first in face-to-face discussions (Cycle 1), so that participants would learn how a particular pedagogical script works, and then we adapted the script for online discussion. The goal of this case study was not only to try out different kinds of scripts, but also to test how the design methodology employed would support the use of pedagogical scripts during the design process.

In the next three sections we describe the different cycles of action research in the second case study in more detail. Cycles are defined in their order of implementation.

5.4.1 Cycle 1: Use of Multiple Pedagogical Scripts in Discussions

During the first cycle (CS2/C1 in Figure 18) starting in October 2005, we introduced nine different pedagogical scripts as follows:

(1) Address Circle - A Group Technique Based on Native American Healing Circles. In the address circle technique a chairperson introduces the topic to the participants, decides who will take the floor first, starts the discussion by formulating the first question, controls the silence, formulates the follow-up questions, and ends the discussion. Participants answer each question one-by-one in turn. In face-to-face discussion, a pebble or toy is usually circulated around address circle to signify turns to speak. In online discussion, turns can be decided according to, e.g., order of login-in or alphabetical order of participants' names.

During the discussion, others are not allowed to interrupt by heckling or making comments (not even whispering with one's neighbours in the face-to-face settings). While someone is talking or typing a message, the others are silently listening or waiting. Open discussion is not allowed, but all can talk as long as they like in their own turn. They can also comment on others' addresses during their own turn. Everybody tells exactly what story they like. When a speaker finished, she or he gives the floor to the next speaker. It is also possible to pass one's turn on to the next participant without saying anything.

(2) Brainstorming. The well-known brainstorming technique where the goal is to produce as many ideas as spontaneously as possible, also works in online discussion. The starting point for the discussion is a question or problem that the participants try to solve with new ideas during the group discussion.

First, the participants write down answers and ideas that might solve or help to solve the problem. No explanations are required at this point and evaluation or refusal is not allowed at this stage. The time frame for this first part is 5-15 minutes depending on the problem. Next, after this ideation part, the participants group, analyze, and comment on ideas and answers together with the chairperson. Ideas can be combined, approved or refused as a result of group discussion. To conclude the group makes recommendations and solves the problem.

(3) Theme Discussion. Theme discussion is guided and systematic discussion where the goal is to find an answer to a question. Typically, the chairperson starts the discussion by stating an argument that to be is explained and justified. The starting argument is usually well known so that all participants have some opinion about it. Other participants pose counter-arguments and alternative standpoints with reasons. Group members can also have predetermined roles or viewpoints to defend during the discussion.

(4) Panel Discussion. Panel discussion is a structured conversation among a group of people chosen to discuss a topic in the presence of an audience. Panellists usually represent a specific role or point of view. The chairperson usually leads the discussion with an introduction, well prepared questions, and by nominating speakers in turn. In first phase, the panellists discuss as a group, but in the second phase the audience can also join the discussion by asking questions of the panellists or commenting on something they have said earlier.

(5) Poster Discussion. Poster discussion is a technique where a group of participants discuss ideas presented in each others' posters. During the first phase, all the participants create a poster alone or in pairs on a chosen topic (our topic was assessment in a computer science course). After finishing a poster, all participants publish their posters a few days before the scheduled poster discussion. During the discussion, all the participants introduce the ideas behind their poster and others join the discussion by commenting or asking questions of the poster presenter(s). Based on these discussions, participants were able to improve their posters before returning the poster assignment.

(6) Reading Groups. The reading group is a discussion technique where a group of participants discuss a book or other reading material. The goal is to produce a broad understanding of the content of the reading material and to adapt the viewpoints that emerge to the participants' own perspectives. Each participant prepares an introduction to a reading task and presents it to other participants, who join the discussion with their own ideas or comments.

(7) Group Investigation. A group investigation is an organizational medium for encouraging and guiding learners' involvement in learning. Learners actively share in influencing the nature of events in their classroom. By communicating freely and cooperating in planning and carrying out their chosen topic of investigation, they can achieve more than they would as individuals. The final result of the group's work reflects each member's contribution, but it is intellectually richer than work done individually by the same learners.

This strategy encourages learners to work cooperatively to learn content. The steps are usually presented as follows (Sharan and Sharan 1994):

1. *Topics and teams*: Topics for study are identified and participants are placed in groups.
2. *Planning*: Group members decide what sub-topics are to be investigated as well as the goals of their study and how the topics are to be studied.
3. *Action*: Group members gather information, review it, analyze/evaluate it, and reach some conclusions.
4. *Final Report Preparation*: Each group must prepare a summary activity. It may be in the form of a report, a briefing, etc., for the entire class. The teams, via representatives, must coordinate this activity.
5. *Presentation*: Each group presents its findings to other groups. Reduce "lecture/telling" by using role play, panels, simulations, etc.
6. *Assessment/Evaluation*: The purposes, methods, and means of evaluation can be negotiated collaboratively among the participants and the instructor. This is usually an important learning experience in itself.

(8) Concept Mapping. Concept mapping is a technique for visualizing the relationships between different concepts (Figure 19). A concept map is a diagram showing the relationships between concepts. Concepts are connected with labelled arrows, in a downward-branching hierarchical structure. The relationship between concepts is articulated by linking phrases, e.g., "gives rise to", "results in", "is required by," or "contributes to".

(9) **Workshop**. The goal in a workshop is to create and adapt new information based on previous knowledge. A workshop includes several "posts" or tasks which participants carry out in pairs or in small groups. Tasks are created by a teacher and are based on background materials on some theme or topic. Tasks can vary widely and groups perform them in turns. Workshop tasks can be based on background readings, literature presented together with a task, or material found on the Internet. The task can be a quiz, analytical assignment or making an interpretation. An online workshop can utilize the different discussion techniques presented above.

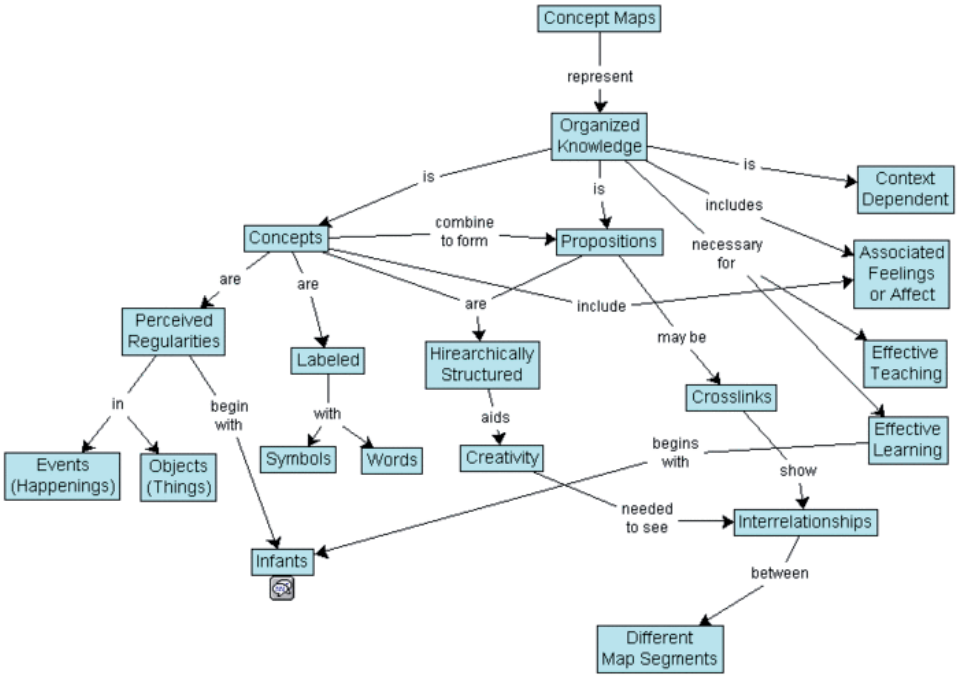

FIGURE 19 Example of a Novakian[13] concept map, created by using CMapTools[14]

Different pedagogical scripts were used by another (not Case 1) group of graduate students studying computer science teacher education in both face-to-face and online discussions. Most of the scripts were first used in face-to-face situation so participants could learn to use the script which was then adapted for online discussion. Overall group size was twenty three master's students; however, the main group was divided into smaller groups based on the pedagogical scripts and media (online or off-line) used. Discussion topics were related to learning and teaching in virtual learning environments. Participants were able to choose which pedagogical script to use each time. Some scripts were not used at all because the participants were not stimulated by them and some were used twice.

5.4.2 Cycle 2: Use of Role Play in Case 6

To stimulate group discussions in the sixth case study (CS2/C2 in Figure 18), we adopted role play as the instructive pedagogical script for face-to-face and online discussions. Working in small groups was structured with participant different roles or hats to wear, as follows (Auer 2007):

[13] See Novak (1998)
[14] See http://cmap.ihmc.us/

- **Responsible teacher (or content master)**: the "owner" of the content, defines the target group, and sets learning goals; takes care of selecting the content and financial issues; makes final decisions when needed; produces the content map with the help of the other group members
- **Pedagogical master**: person in charge of pedagogical solutions; documents pedagogical solutions based on group work
- **Learning material master**: person in charge of learning materials related to content and pedagogical solutions; defines different types and use of learning materials, what already exist and what have still to be produced; documents all decisions based on group work
- **Technical master**: person in charge of technical solutions related to content and pedagogical solutions; defines conceivable platforms as well as learning and content creation tools and techniques; documents technical issues based on group work
- **Support master**: person in charge of analyzing different types of support needed in different states of design and implementation process, as well as, during the learning process; defines requirements for technical and pedagogical support; documents requirements and methods for support based on group work
- **Quality master**: person in charge of quality assurance; analyses different quality factors, sets and documents criteria and quality indicators based on group work

The participants in this case study were university teachers from different educational fields. Each of them was already planning a web course for their own use. We consider this part of the sixth case study (see Section 5.7), the use of pedagogical scripts, as a new cycle in the second case study (CS2/C2 in Figure 19).

5.4.3 Cycle 3: Use of Role Playing in Cycle 4 of Case 2

To stimulate discussions in the first case study with a group of graduate students (CS1/C4 in Figure 18; cf. Section 5.3.4), we also adopted role play here as the instructive pedagogical script for online discussions. We consider this part of the first case study, the use of pedagogical scripts, as a new cycle in this second case study (CS2/C3 in Figure 18).

The roles in this research case were implemented in the same way as in Case 6 (see Sections 5.4.2 and 5.8), but here we used only four of the roles as follows: 1) responsible teacher, 2) pedagogical master, 3) technical master, and 4) support master. Every participant played each role in a different design projects.

5.5 Case 3: One-Hour Introductory Workshop

It emerged that there was a need to introduce the design methodology employed here for larger groups of university teachers; hence we planned a one-hour introductory workshop in which dozens of practitioners would be able to learn to use and follow the phased methodology simultaneously. So far we have run these workshops five times.

During these workshops, the practitioners have learned the basics of the methodology employed, and obtained guidelines for self-oriented design work. Most of the participants were not yet starting to design their first web course; they were only taking part in the workshop to see what should be done during the design process. Some of the participants took part in some of the other workshops later on to learn more, and to receive more guidance for when they design their own web courses.

Each cycle (cycles from CS3/C1 to CS3/C5 in Figure 19) was organized in the same way, as no need arose to change the training mode. The participating groups (60-80 participants) and goals were also similar in each cycle.

5.6 Case 4: Twelve-Hour Learning-by-Design Workshop

Some participants in the previous workshops reported that the workshop mode in Case 1 was taking too long to accomplish and that the previous introductory workshop, in Case 3, was not enough. Therefore, we resized the course in Case 1 to fit into twelve hours. So far, we have finished four such workshops (cycles from CS4/C1 to CS4/C4 in Figure 19) with five to eight participants in each. These workshops were organized in a computer classroom for a small group of practitioners. The limitation for group size was the number of computers in the classroom.

Each workshop was divided into three four-hour face-to-face sessions where each phase was first briefly introduced, after which the focus was on assignments following phases of the design process. The first session included background study and content design. The participants started their designs during the face-to-face session, and continued with them during the next two weeks between workshop sessions. The second session included pedagogical design, where the participants were first trained to adopt the role of the online teacher, and then to pedagogically design their own web course. The last session was about technical design. The workshops ended in a phase where all participants had their designs documented so they were able to continue with their implementation by themselves, or to hire someone to realize their web course as design. All the participants received as much guidance as they needed during each phase.

Because of resizing the allocation of time compared to Case 1, the amount of required documentation was also resized the minimum. Minimum here

means enough documentation for someone else to follow a design, and implement the plan. The contents and instructions used in the training mode were not changed during the different iterations, but were tailored to better fit the needs of participants.

5.7 Case 5: Self-Oriented Online Course

There are always few participants who are more self-oriented and would rather learn things by taking a self-oriented online course. These participants might have problems with scheduling face-to-face sessions in their calendar or they might just want to follow the instructions and works by themselves at their own pace. However, this way of learning is not suitable for everyone.

In this research case (CS5/C1-C3 in Figure 19), the online course for web course design was implemented on the basis of the online materials and learning assignments created for the course in Case 1. Participants were instructed and guided online. They received as much guidance during the design process as they required.

So far only five participants have been able to finish this course: one in the academic year 2005-2006, two in the summer semester of 2008, one in the summer semester of 2009, and one who started the course in the summer semester 2008, but only finished it at the end of the year 2009. However, five other starters have not been able to finish their designs, mainly because they were not as self-oriented as they first thought or were too busy to finish the course. In most cases these participants have since joined the Web Course Design and Implementation course described in Case 1.

5.8 Case 6: Three-Hour Learning Network Workshop

Next we faced the need to provide training for a larger group of university teachers at once. We considered that the simple introductory workshop, as in Case 3, would not be enough because all the participants were already planning their first web course and needed a "checklist" on how to proceed. Therefore we organized a so-called Learning Network Workshop (CS6/C1 in Figure 19) for seventy university teachers from different Finnish universities as a part of their Educational Use of ICT training.

This approach differs significantly from that used in the other cases: participants worked in groups (nine multidisciplinary groups) to prepare one participant's single topic, the goal being to design only a skeleton of the final web course so that the group members would be able to learn how to follow the design process by themselves later on. Furthermore, the focus was more on quality issues - how design model or process could promote quality assurance in finished web courses. The main educational focus was on learning networks

and reciprocal teaching. The workshop was held with a more compact timetable; the whole design process was carried out in four hours during two successive days.

In this workshop mode the main idea was to obtain support for the design from other group members and to learn to understand the design process by doing assignments based on the different design phases. This workshop has been run only once, but we received a lot of feedback from the participants for further developing the training mode.

5.9 Case 7: One-Hour Participatory Workshop

In some cases there is a need to train larger groups at once, but the simple introductory workshop, as in Case 3, is not enough. For these cases we implemented an one-hour participatory workshop (CS7/C1 in Figure 19) where the basics of the design methodology employed were introduced, as in Case 3, but all the participants received four phased assignments based on the phases of the design methodology, one assignment for each of the first four phases. In this way all the participants were able to start their own design process already during the workshop and continue it later on. During the workshop participants were able to ask about things they did not understand and later on they could ask for more questions, instructions or guidance through email.

This training mode has been run only once with seventeen qualified school teachers in math and science. However, the feedback from the participants was very positive.

5.10 On Quality of Training Modes

The Information Society Standardization System (ISSS) is an ICT focus group of the European Committee for Standardization (CEN). They have developed, based on Pawlowski's (2007) theoretical basis and ISO/IEC 19796-1:2005 standard, nine criteria for good practice in online learning. These guidelines were also approved as CEN Workshop agreements on "Providing good practice for online learning quality approaches" (CWA 15660:2007).

Based on these nine criteria of good practice (CWA 15660:2007), in order to be defined as a 'good practice', a practice should

1. Come from the field of practitioners who already use it
2. Be contextualized to a given field, a given community of users and a period of use
3. Address identified problems, needs and requirements
4. Be documented
5. Demonstrate improvement and effectiveness

6. Make for consensus
7. Be reusable in the future in a new context belonging to a similar field
8. Support innovation
9. Lead to continuous improvement

These criteria also summarize the basic characteristics of good online learning training practice: it should be a practice-based, contextualized, and well documented continuing process of improvement that identifies problems, needs, and requirements, demonstrates improvement and effectiveness, makes for consensus, supports innovation, and produces reusable learning objects for future use. These characteristics are also well suited qualities for assessing the training modes presented.

5.11 Participants

Typically in action research the group of participants continuously reflect on their learning from the actions and proceed to initiate new actions on the spot. However, in this study we used several research groups, as the main goal was the development of the design model employed and training modes rather than the professional development of the participants. However, a lot of professional development was observed and also reported in this research.

According to Tellis (1997), the selection of participants in a case study does not have to be done through random selection, but can be done by the researcher under the prevailing conditions. Keeping Tellis' statement in mind, four groups of participants were selected to participate in this research study for the following reasons. First, the key player in all of these research cycles was a computer science teacher with long experience of teaching and online learning. She was in charge of all the teaching, guiding and supervising.

Second, participants for CS1/C1 to CS1/C4, CS2/C1, CS2/C3, and C5 were selected on the basis of their applications for the master's course. The four-month course in Case 1 and self-oriented online course in Case 5 was a Web Course Design and Implementation course where graduate students designed and implemented their own web courses by following the design model employed. The course in Case 2 was labelled the Fundamentals of Teaching Computer Science.

Third, the participants in cases CS2/C2, 3, 4, 6 and 7 were selected on the basis of their application to participate for different workshops. All the participants in cases 3, 4 and 6 were professional university teachers from different educational fields. In case 7 the participants were qualified school teachers in math, chemistry, physics, or computer science.

5.12 Data Collection Procedures

As Merriam (1988, 10) states, a "case study does not claim any particular methods for data collection or data analysis. Any and all methods of gathering data from testing to interviewing can be used in a case study." However, some techniques, such as interviewing, observation, and document analysis, are used more than others (Merriam 1998, 134; also Section 4.8). The use of different data sources helps the researcher to validate and crosscheck findings (Patton, 1990, 244). In the present case studies, different types of qualitative data were collected from learning diaries written by the participants, documentary evidence such as work samples and logs of online discussions, researcher's field notes from the classroom and online observations, questionnaires, and video recordings. The data collection procedures, used in the different research cases, are defined in more detail in Chapter 6.

5.13 Data Analytical Procedures

As described in Section 4.9, typically, in action research, the data collected is first edited, coded, and sampled conceptually and theoretically before themes, issues or factors that seem to be emerging from the data are identified. These items can be both items that come up repeatedly and idiosyncratic items that seem particularly noteworthy.

In the present research we used content analysis to code and sample the field data (Silverman 2000, 825-826). There were two preset categories for data: 1) overall feedback and notions related to implementation and organization of the training mode itself, and 2) feedback and notions related to the web course design methodology. Both of these main categories also included two subcategories: highlights and improvements. Highlights include items that have been mentioned as working well. Improvements include items that have been mentioned as not working or requiring improvements.

The data was then mapped by the frequency of occurrence of issues, themes, and units. Four techniques were used for establishing the validity of the set hypotheses or analysing data gathered (see Section 4.10). In this study the data collected from the case studies were analyzed on an ongoing basis using multiple triangulation (Section 4.10.2).

Finally, meaning is made out of observations and constructs were created, relationships among the data are identified, and on the basis of the results, the topic-case driven web course design methodology as well as training modes implemented were elaborated and modified.

6 ACTIONS AND DATA COLLECTION

In this chapter we describe what activities were taken and how the data collection was executed in the different case studies and during the different action research cycles.

6.1 Case 1: Four-Month Training Course

Teaching activities on the four-month Web course design and implementation course include two-hour lectures once or twice a week. During some weeks the participants had only four hours of exercises related to video photography, sound treatment, web page design, graphic processing, or animation. There was a virtual learning platform in use where all the learning materials were linked. Lectures were streamed as online videos (if needed) so that the participants were able to follow the lectures in real time, e.g., from their home or workplace. Lectures were also recorded and linked to the virtual learning environment so that participants were also able to see the lectures later on.

Learning activities on the course were divided into learning assignments following the phases of the topic-case driven approach. By doing these learning assignments, and by following this used design methodology, the learners designed and implemented their own web courses. The teacher introduced each learning assignment beforehand and the learners were able to receive as much guidance as they needed during each assignment. During the course the participants wrote learning diaries and participated on online discussions. These learning diaries and recorded online discussions were used in the course evaluation, which also included teacher-evaluation of activeness, self-evaluation, and peer evaluation of designed web courses.

The course required a lot of work and was quite demanding, but carried 10 ECTS credits, which means 267 hours of work. Therefore, participants were informed at the beginning of the course that they were expected to devote approximately 15 hours per week to this course alone.

6.1.1 Activities in Case 1

In this section we describe the actions taken during the different action research cycles of Case 1 in more detail.

Activities During Cycle 1

During the first cycle, lectures were streamed and recorded, and stored into Finnish virtual learning platform called Discendum Optima, where also all the other learning materials were linked. Learning activities were divided into six learning assignments following the phases of the topic-case driven approach (see Figure 3), as shown in Table 2.

TABLE 2 Activities taken and learning assignments done during the course in Cycle 1

Weeks / Phases	**Activities**	**Learning assignments**
1	Two two-hour introductory lectures on the background of web course design: 1) Introduction to course 2) Specification of the web course	
2	Two two-hour introductory lectures on the background of web course design: 1) Clarification of basic elements on the web course by exploring web courses found on the Internet 2) Introduction to basics of the web course design and the topic-case driven methodology Two-hour f2f meeting with distance students.	
3 / Background study	1) One two-hour introductory lecture on the background analysis. 2) Participants chose the topic for their own courses, explored different resources (Internet, databases, books, articles, etc.), and created an online portal on their chosen topic based on the background materials. 3) Participants carried out the background study by defining and considering all the issues that could affect the feasibility of the planned web course (see Chapter 3.1). 4) Four-hour guidance session for those who had problems with web page creation or graphics processing.	**Learning assignment 1:** Create a www portal of ideas related to own course topic.
4 / Content design	1) One two-hour introductory lecture on content design. 2) Participants reviewed their own portal of ideas by evaluating different ideas and choosing the most suitable ones into their own web course.	**Learning assignment 2:** Create required topic-cases and a topic-case diagram of the desired web course with the topic-case descriptions.

TABLE 2 (continues)

4 / Content design	3) Participants designed and documented the basic content of their web course with topic-cases by describing the necessary issues that should be treated during the course. 4) Participants linked single topic-cases according to preliminary knowledge and target learning, and represented these relations in the topic-case diagram showing which topic-cases are essential to main concepts of the course and which are prerequisites for other topics.	
5-6 / Pedagogical design	1) One two-hour introductory lecture on pedagogical design 2) Participants sized up all the selected topic-cases and tried to find the best pedagogical solution for each case separately as their third learning assignment.	**Learning assignment 3:** Design learning and teaching acts, learning assignments, and learning materials for use in each topic-case.
7	1) One two-hour lecture about media choices. 2) Four-hour guidance sessions for those who had problems with editing video clips.	**Learning assignment 4:** Design some topic using audio or video, and record and edit it as a usable learning object.
8-9 / Technical design	1) On two-hour introductory lecture on technical design. 2) Four-hour guidance session for those who had difficulties with technical design or interface design.	**Learning assignment 5:** Design technical solutions for the desired course as well as user interface.
10-12 / Implementation	1) One two-hour introductory lecture on implementation, evaluation and possible exclusion. 2) Four-hour guidance session for those who had difficulties with animation (Flash). 3) Three two-hour guiding session for those who had difficulties on implementation.	
13-14 / Testing and evaluation	1) One two-hour introduction lecture on testing and evaluation of implementation. 2) Participants were finishing their web courses and evaluating some other finished web course as peer-evaluation assignment.	**Learning assignment 6:** Test and peer-evaluate some other finished web course.
15	Two-hour closing session where all participants shared their experiences of the course	

There were also three guidance sessions related to graphics processing, audio and video editing, and designing web pages (see Table 2).

During the course the learners wrote learning diaries which recorded their feelings, opinions, and descriptions of their own actions during the course. These learning diaries were used in the total course evaluation along with level of participation activity, self-evaluation, peer-evaluation, and execution of learning assignments on time. Learning assignments and keeping to schedule

were weighted more than the other forms of evaluation in the total course evaluation. Online discussions were not used during this first cycle.

At the end of the course a two-hour closing discussion session was held where all participants described their experiences of the course. Overall feedback from the course was collected with a formal online questionnaire.

Activities During Cycle 2

During the second action research cycle, learning activities were divided into nine learning assignments. The order of learning assignments three and four was switched (cf. Table 2), the learning assignment related to technical design in Cycle 1 was divided into two parts, and new learning assignments related to implementation and further development were added, as shown in Table 3. Unlike in Cycle 1, there were several guidance sessions and two-hour lectures once or twice a week (see Table 3).

TABLE 3 Activities taken and learning assignments done during the course in Cycle 2

Weeks / Phases	**Activities**	**Learning assignments**
1	Two two-hour introductory lecture as in Cycle 1 including clarification of basic elements on the web course by exploring web courses found on the Internet	
2	One two-hour introductory lecture on basics of web course design: 1) Theories behind web course design 2) Evaluation of online learning materials 3) Topic-case driven methodology	
3 / Background analysis	Similar introductory lecture on background analysis and guiding session as in Cycle	**Learning assignment 1** as in Cycle 1
4 / Content design	Similar introductory lecture on content design as in Cycle 1, and one two-hour lecture on media choices.	**Learning assignment** as in Cycle 1 **Learning assignment 3** same as learning assignment 4 in Cycle 1
5-6 / Pedagogical design	Similar one two-hour guidance sessions and introductory lecture as in Cycle 1	**Learning assignment 4 same** as learning assignment 3 in Cycle 1
7-9 / Technical design	Similar introductory lecture on technical design and two four-hour guidance session as in Cycle 1	**Learning assignment 5**: Design user interface for the desired course. **Learning assignment 6:** Design technical solutions for the desired course.

TABLE 3 (continues)

10 / Implementation	Similar introductory lecture on implementation and guidance session as in Cycle 1. One four-hour guiding sessions for those who had difficulties in audio or video editing.	**Learning assignment 7:** Define those parts, if there were any, which were not implemented during the first iteration.
11-12	Two two-hour guidance sessions for those who had problems with implementation.	
13-14 / Testing and evaluation	Similar introductory lecture on evaluation of implementation and further development and guidance session as in Cycle 1	**Learning assignment 8** as learning assignment 6 in Cycle 1 **Learning assignment 9:** Define possible designable issues for further iterations.
15	Two-hour closing session where all participants shared their experiences of the course.	

The total course evaluation was based on level of participation activity, learning outcomes described in the learning diary, and execution of learning assignments on time. Learning assignments and keeping to schedule were weighted more than the other forms of evaluation in the total course evaluation, as in Cycle 1.

At the end of the course a two-hour closing seminar session was held where all the participants presented their own web courses to the others, and the peer-evaluators commented and introduced their findings. Overall feedback from the course was also collected with a formal online questionnaire.

Activities During Cycle 3

When the course was started for the third time, it turned out that all the participants were working while taking the course. Therefore, learning assignments in the third action research cycle were the same as in cycle 2, but lectures were organized only once a week (cf. Table 3). Furthermore, there were ten two-hour guidance sessions: one for each assignment and each week, and one extra meeting at the end of the course, as well as an eight-hour closing seminar at the end of the course, where all the participants presented their own web courses and shared peer-evaluation comments (Table 4).

Learning outcomes were evaluated based on participation activity, self-evaluation, peer-evaluation, execution of learning assignments on time, and scheduled presentation of own web course at the end of the course in an eight-hour closing seminar session. On this occasion overall feedback on the course was not collected at the end of the course.

TABLE 4 Activities taken and learning assignments done during the course in Cycle 3

Weeks / Phases	**Activities**	**Learning assignments**
1	Similar introductory lecture (part 1) on background of web course design as in Cycle 2	
2	Similar introductory lecture (part 2) on background of web course design as in Cycle 2	
3	Two-hour introductory lecture on basics of the web course design and the topic-case driven methodology.	
4 / Background analysis	Similar introductory lecture on background analysis, and guidance session as in Cycle 2	**Learning assignment 1** as in Cycle 2
5 / Content design	Similar introductory lecture on content design, and guidance session as in Cycle 2	**Learning assignment 2** as in Cycle 2
6	Similar introductory lecture on media choices, and guidance session as in Cycle 2	**Learning assignment 3** as in Cycle 2
7-8 / Pedagogical design	Similar introductory lecture on pedagogical design, and guidance session as in Cycle 2; more time for designing work	**Learning assignment 4** as in Cycle 2
9 / Technical design	Similar introductory lecture on technical design, and guidance session as in Cycle 2	**Learning assignments 5 and 6** as in Cycle 2
10-11	Similar introductory lecture on implementation, and guidance session as in Cycle 2; more time for designing work	**Learning assignment 7** as in Cycle 3
12-15	Similar introductory lecture on evaluation of implementation and further development, and guidance session as in Cycle 2; more time for designing work	**Learning assignments 8 and 9** as in Cycle 2
16	Eight-hour closing session where all participants presented their finished web courses and shared their peer-evaluation comments and experiences of the course.	

Activities During Cycle 4

In the fourth action research cycle the learning assignments and guidance sessions similar to those in Cycle 3. The only difference was that participants were divided into discussion groups and there was one new learning assignment at the beginning, where the participants chose their topics and pre-defined their contents together in their online discussion groups.

Discussion groups gathered weekly to discuss the topic set in the learning assignments (cf. Table 4). Starting form the third learning assignment the participants also had different roles to play during the discussions: 1) responsible teacher, 2) pedagogical master, 3) technical master, and 4) support master (cf. Cycle 3 in Case 2). Each player commented on the designs of others from the point of view of their roles. Different roles are described in more detail in case study 2 (see Section 5.4.2).

Learning outcomes were evaluated based on participation activity, self-evaluation, peer-evaluation, learning diaries, execution of learning assignments on time, and scheduled presentation of own web course at the end of the course in the closing seminar session. The teacher blog was adopted as a new guidance tool: the teacher assembled each lecture afterwards and gave instructions on how to proceed with designs. The participants were able to comment on the blog notes. The guidance discussion was directed into the discussion forums, as the blog notes were available to public.

6.1.2 Data Collection in Case 1

During the first research case, data were collected with methods that had already been used for some other purposes. In Cycle 1 we were piloting the design methodology itself, and thus didn't want to overload the learners any more than was necessary. During the later cycles, when the participants were working hard with their designs, these assumptions were strengthened, and consequently we minimized any extra work. The main focus was on the learners' performance in following the design methodology.

Data were gathered by using the learners' learning diaries, teacher's field notes, learning assignments, teacher's feedback, self-evaluations, and feedback questionnaires (see Appendix 1). Learners wrote learning diaries during the course and they were instructed to write daily or at least weekly on, for example, the following issues:

- What is best in the content of the lectures or assignments?
- How we could improve them?
- What have you learned though the learning assignments?
- How has your learning been improved?
- What assignments or working methods are the best, and why?
- What assignments or working methods are the hardest, and why?
- How could you improve your own performance?
- What would you like to learn next?
- What have you already learnt?
- What is still unclear?
- What thoughts arise in your mind during the lesson?
- What would you like to ask or check up on?

The teacher wrote her field notes after each lesson, and issues that were discussed or asked about during the sessions could be check from the video-

recordings. The teacher commented on the learning assignments in written form in the online learning environment, so that these comments would be available later, if needed. A feedback questionnaire for participating learners was administered at the end of the course in Cycles 1 and 2.

6.2 Case 2: Adaptation of Pedagogical Scripts to Discussions

In the second research case the participants were both university students (Cycles 1 and 3) and university teachers (Cycle 2). During the Cycle 1 we adopted several pedagogical scripts, like Address circle, Brainstorming, Theme discussion, Panel discussion, and Poster discussion. During the Cycles 2 and 3 we used Role play.

6.2.1 Activities in Case 2

In this section we describe actions done during the different action research cycles of Case 2 in more detail.

Activities Taken in Cycle 1

In Cycle 1 the participants were able to choose if they wanted to participate in a face-to-face discussion group or an online group. Moreover, some of the pedagogical scripts described in Section 5.4.1 were not used at all, as the participants were allowed to choose which script used. Reading group, group investigation, concept mapping and workshop were not used, but both brainstorming and theme discussion were used twice.

All the discussions in Cycle 1 included some background readings to be read beforehand. Participants were grouped into smaller groups with a group size of from 5 to 11 learners. Discussions were lead by the teacher or a learner as a chairperson who was asked to prepare in advance some questions or ideas for discuss in advance. The teacher's role was to evaluate the discussion and each learner's participation.

Address Circle. The address circle was used with both the face-to-face group and online group. Topic of both discussion groups was the same, and related to the participants' everyday thoughts about learning and thoughts related to educational definitions of the idea of man and conceptions of learning. Both groups were given three texts beforehand to read and contemplate.

In the face-to-face group all eleven participants were seated in a circle. A chairperson (in this case the teacher) introduced the topic and asked the first question. She also passed a soft toy lion to the first participant as a sign that the floor had been given to the first speaker. The first speaker gave his answer or opinions, passed the turn on, and so on until everyone had said what they wanted. The chairperson then asked the next question and the address circle

continued with new questions and new turns until the chairperson summed the discussion and ended it. The whole face-to-face discussion was recorded for later use.

In the online group all eight participants signed into the chat room and a chairperson (again the teacher) introduced the topic and asked the first question. Then she passed the turn to the first speaker, who was chosen according to the alphabetical order of the participants' first names. Participants were asked to send short messages, but they were allowed to send as many messages as they wanted. After finishing their turn, the participants sent a "next" message, which was a sign for next speaker to start. The chairperson reminded also the group from time to time whose turn was next. Then the address circle continued with new questions and new turns until the chairperson concluded the discussion and ended it. The whole chat discussion was saved for later use.

At the end of the discussion the chairperson asked each participant to comment on the pedagogical script used.

Brainstorming. Brainstorming was used twice in both the face-to-face and online discussions. The first topic was related to possible differences between on teaching acts in different learning environments: the classroom and virtual learning environments. Participants were divided into two face-to-face groups and one online group. All participants were given references to read beforehand.

First, each group was allowed twenty minutes list all the actions that a teacher performs in the classroom when she or he teaches. In the face-to-face groups all the ideas offered were listed on post-its and attached to on flap board. Online, all the ideas were sent in messages to others to read and were recorded in a log file. Then each group was then given another twenty minutes to list all the actions that teacher uses when she or he teaches online. All the ideas were listed as on the first occasion. After this, both groups were asked to conclude their ideas with similarities and differences: which actions remain the same and which change.

The second topic was related to teaching methods that are suitable in teaching computer science. The participants were given sixteen short case study articles to read as background material. There were two face-to-face groups and one online group. The topic was divided into smaller brainstorming questions by different school levels – early-childhood and pre-school, lower level of comprehensive school (grades 1-6), upper level of comprehensive school (grades 7-9), and high school – and by different educational methods: integration or computer science as a school subject of its own. Each group were given the same questions and ten minutes for each question. After each question they had to sum up their ideas. All the face-to-face discussions were recorded and both online chat discussions were saved for later use.

Theme Discussion. Theme discussion was used twice, but only in the online discussions: first in a char room and second in a discussion forum. The first

topic was related to differences in learning when moving online. The participants were divided into three chat room groups each with six to seven participants, one of whom acted as chairperson. The chat discussion last for two hours. Participants were also given four source texts to read beforehand. They were instructed, first, to list five issues that come into their minds and then reflect on their own ideas in relation to the source texts. Later they reflected on their ideas in chat discussion groups lead by the chairperson. The chairperson was instructed to list topics for discussion beforehand and to keep the discussion on track. The chat discussions were saved for later use.

The second theme discussion topic was related to basic issues in computer science that should be taught at different school levels. The participants were divided into three discussion forum groups, seven to eight participants in each group, and they were given five source texts to read beforehand. The discussions were scheduled to last for two hours. In each group one participant acted as a chairperson. At the beginning the teacher introduced seven talking points for discussion, and the participants added a few more talking points during the discussions. The discussions were saved for later use.

Panel Discussion. Panel discussion was used in both face-to-face and online discussions. Group size in the face-to-face discussion group was eleven participants and in online group nine participants. The topic in both groups related to the image of a teacher participants would like to correspond to in the future after they have qualified as school teachers. In both groups each participant first presented their own thoughts about the topic, and later all were able to ask questions or comment on each other's speech. A chairperson (in both cases a teacher) introduced a new talking point to discuss after the previous one was exhausted. The face-to-face discussion was recorded and the online chat discussion saved for later use.

Poster Discussion. Poster discussion was used in both the face-to-face and online discussions. Group size in the face-to-face discussion was twelve participants and in the online group eight participants. Each participant was designing their own course to teach and at this point they were asked to make a poster about the methods and forms of evaluation used in their own course. They presented their posters in the face-to-face session or in online and asked questions and commented on each other posters. The face-to-face discussion was recorded and the online chat discussion was saved for later use.

Activities in Cycle 2

Cycle 2 was implemented as a part of Case 6, where the training of university teachers was structured in design groups by using role play. The different roles available are defined in Section 5.4.2. Each design group had one or two role players in each role, depending on group size. The design groups followed the topic-case driven design methodology and each member of the group pointed out issues related to design work from the point of view of their own role.

Activities in Cycle 3

Cycle 3 was implemented as a part of Case 1, where the participating university students used four of the roles used during Cycle 2 (see Section 5.4.2). These roles were 1) responsible teacher, 2) pedagogical master, 3) technical master, and 4) support master. Participants were divided into discussion groups of five to seven learners. Each of them was the teacher for responsible their own design project and played different roles related to others' design projects. The roles were divided in such a way that each design project involved all four role players.

The group discussions were structured with learning assignments related to the different design phases and each role player was instructed to share comments and ideas, especially from the perspective of their roles relating to the introduction of the design proposed by a responsible teacher.

6.2.2 Data Collection in Case 2

During Cycles 1 and 3 we used learning assignments, learners' learning diaries, teacher's field notes, video recordings, and online discussion logs (see Appendix 2). Learners wrote learning diaries during their studies. The instructions on writing were similar to those in Case 1 (see Section 6.1). Face-to-face discussions were recorded as online videos and online discussions were saved in textual format.

During Cycle 2, data were collected from both the face-to-face and online discussions, and from the teacher's field notes. However, the face-to-face discussions were not recorded; the online discussions, however, were saved in textual format, as during the other cycles.

6.3 Case 3: One-Hour Introductory Workshop

In Case 3 we used only few basic activities and data collection procedures that are described in the following sections.

6.3.1 Activities in Case 3

In the third research case teacher introduced the design methodology employed in a one-hour lecture with PowerPoint slides. The participants were allowed questions, but in each cycle only a few questions, if any, were asked. PowerPoint slides were delivered to all participants as handouts, and in two cases the lecture was also recorded for later use.

6.3.2 Data Collection in Case 3

In the third research case the data are mainly teacher's field notes; we received also one email message as feedback from a participant (see Appendix 3). Two of the workshops were also recorded for later use. However, video recordings were not used here as research data.

6.4 Case 4: Twelve-Hour Learning-by-Design Workshop

In the fourth research case a workshop, the so-called Learning-by-design workshop, was organized for five to nine local university teachers and professionals from different educational fields. The main educational focus was on learning by design. The workshop was divided into three four-hour computer class sessions, each of which had its own theme. The participants worked with their own topic and design goal: to design their first own web course. They got instructions, tips and guidance during the session when needed - also between sessions through email or a virtual workshop environment, where all the instructions and assignments were published.

6.4.1 Activities in Case 4

Each cycle was organized in similar way, as described in this section.

Session 1: Background and Content

During the first session, the trainer first briefly introduced the background analysis, after which the participants analyzed and documented the background of their own courses as follows:

- Why did they want to implement a web course? What were the benefits compared to a traditional classroom course?
- How were they planning to use the Internet? What would be the role of the Intenet? How highly structured would the course (or parts of it) be? Would there be dialogue or other cooperation among learners, or would it be more like a self-accessed course?
- What is the target group? Who are the learners? What kind of learning strategies and learning styles do they use?
- How much time and resources would be available for the project?
- What kind of technical infrastructure would be supported?
- What are the basic ideas, focus, and learning goals of the course?
- How would they handle copyrights and agreements, e.g., concerning content creation?

Next, the trainer briefly introduced the content design, and the participants focused on the content domain and concepts, and created a visual content map from their own course contents. Content maps (cf. concept maps) which created with free software called CMapTools (see Figure 19), enables visualization of alternative learning paths, and also functions as a content map of a final web course. The content map served as the documentation of this session. The participants started their designs during the face-to-face session and continued them later during the two weeks break between the scheduled learning sessions.

Session 2: Pedagogical Design

The theme of the second computer class session was pedagogical design. During this session the participants continued their work by designing pedagogical solutions, such as models, scripts, and assignments, for their own web course based on the trainer's brief introduction to topic. The participants could follow a comprehensive model, e.g. problem-based learning (PBL), anchored learning, learning through design, or collaborative learning in their web course, or design each learning situation separately by using more simple models or scripts that phase learning, e.g. scripts that guide and helps learners to collaborate, find information, or create cognitive conflicts – whatever best suited their web course and its content (e.g. CoSSICLE project[15]).

During this pedagogical design session the participants also planned several assignments for their learners, using the web course to motivate them, promote learning, and support their individual learning processes. All these issues were briefly documented for later use. The participants started their designs during the face-to-face session and continued with them later during the two weeks break between the scheduled learning sessions.

Session 3: Technical Design and Follow-on

During the third and last computer class session, the trainer and participants concentrated on technical design, how to implement the content technically with the desired pedagogical solutions. First, the participants had to decide, whether they wanted to use a learning platform or not (open web pages). The local university supports two learning platforms: Moodle and Optima, so in most cases the participants wanted to use one of these. The participants then made their media choices: what kind of media to use to present the content and to support different kinds of learners, e.g. text, pictures, graphs, videos, sounds, animations, or simulations.

During this session other technical solutions were also considered and documented for later use, like the user interface, usability, maintenance, scaling, and the compatibility of the final web course, and the reusability of learning objects (content items or topic-cases). Finally, based on all decisions made and

[15] See http://cossicle.noe-kaleidoscope.org/

previous documentation, the teachers wrote the production manuscript for their web course. The production manuscript contained detailed instructions for implementation or realization, i.e., how to complete individual content items (topic-cases) using the chosen pedagogical and technical solutions.

6.4.2 Data Collection in Case 4

Because the participants in the fourth research case were university teachers who participated in training during their working hours, we didn't want to overload them with any extra work. Therefore data were collected with functions that were already integrated as a part of the training environment, i.e., learning assignments and the teacher's field notes. We also used preliminary questionnaires during Cycle 3 and feedback questionnaire after cycles 1, 2 and 3. Moreover, we received emails from participants that also included feedback information. All the data sources used are listed in Appendix 4.

6.5 Case 5: Self-Oriented Online Course

Content of the self-oriented course followed the content of Case 1. Activities and data collection are described in following sections.

6.5.1 Activities in Case 5

In the fifth research case the participants followed given instructions, and returned their learning assignments when they finished. The examiner gave feedback on the learning assignments and, if needed, requested changes. The total course evaluation was based on the learning outcomes as described in the self-evaluation and peer-evaluation, and teacher-assessed execution of learning assignments. Overall feedback from the course was also collected with a formal online questionnaire.

6.5.2 Data Collection in Case 5

In Case 5 the data were gathered from learners' self-evaluations, learning assignments and feedback questionnaires, as listed in Appendix 5.

6.6 Case 6: Three-Hour Learning Network Workshop

In the sixth research case, the participants were divided into groups of six and they were asked to choose one of their own topics to go through as a group. Each participant was assigned a different role to play during the design process. These roles are defined in more detail in Section 5.4.2.

6.6.1 Activities in Case 6

During the design process, each participant commented on the designs of the others from the point of view of their role. The support master and quality master were involved during each design phase. All the group members participated in all the discussions, and workshop materials were available both during the face-to-face group work and also later on when the discussions continued online. In the next four sections the progress made during the learning network workshop is described in more detail.

Part 1: Background and Content

Role differentiation and topic selection were made at the beginning of the first part of the workshop (on the morning of the first day) based on the participants' preparations: all participants were asked to prepare a proposal for the group's web course topic in advance. Some even had a lot of materials on they own topic with them or ready on the Internet. The choices were made by the group members. Roles were assigned out on the basis of willingness, competence or experimentation (some were also willing to try something that they had never done before).

The next task was to define a target group for the web course. Here the key role was played by the content master, whose topic was selected. She or he described the target group as it would be in her or his finished web course. Group work continued with the background analysis and content design as in the local workshop described in Case 4 (see Section 6.4.1). The groups had about 45 minutes in which to draw the basic guidelines for the contents and to form a basic content map with the central concepts. The group members argued, rationalized, justified, and gave intensive explanations to achieve agreement. They were very annoyed if their work was interrupted too often; groups wanted to get all the information at once and then be left alone to work. The group work was supervised and help was available if needed. The total time frame for the first part was 75 minutes.

Part 2: Pedagogical Design

The design process continued (on the afternoon of the first day) with the second part, pedagogical design, in a way rather similar to that in the local workshop (see Section 6.4.1): first, a short introduction was given after which the design groups defined and documented pedagogical solutions as well as learning materials for their own web course. The key roles were played by the pedagogical master and learning material master who presided over the discussion. The total time frame for the second part was also 75 minutes. It was surprising how intensively the design groups worked on what was a totally foreign topic for most of the group members.

Part 3: Technical Design and Follow-on

The third part of the workshop (on the morning of the second day) started with technical design. The goal was to define technical solutions related to the content and pedagogical solutions of the groups' own web course: possible platforms (if used) as well as learning and content creation tools and techniques. The groups continued the design process presided over the technical master.

Before starting the group work a few short presentations were delivered to show how things were managed in the local university: the use of the web publishing platform, Moniviestin[16], and the content management system, Plone[17], to store different kinds of contents for the learners, some examples of executed learning materials and web courses, and the introduction to the course management system of the University of Jyväskylä, called Korppi[18], that covers registration, scheduling and assessment of courses as well as self-assessment, personal study plan, and soon also ePortfolios.

At the end of this part, the follow-on was introduced; how to implement the designed web course, how to test and assess it, and how to expand it during the next incremental iterations. The total time frame for the third part was 90 minutes.

Part 4: Online Discussions

The design groups finished the workshop with documentation of contents, and pedagogical and technical solutions. The documents were stored in the Optima learning environment, where the groups continued their discussions. The group members were also asked to write a short description from the point of view of their role. After this they were asked to define the quality criteria and indicators for the web course and also discuss how this kind of workshop and design process could elicit quality in the designed web course.

Twenty participants who were not able to come to the face-to-face workshop joined the groups at this point as external reviewers. They read all the workshop materials and group products, and gave a neutral review of the design plans and quality issues of the different groups. This was very fruitful for the groups as the reviewers raised a lot of new ideas and issues that had not yet been discussed properly.

6.6.2 Data Collection in Case 6

Because only four hours were allocated for first three parts of the training, we didn't want to overload the participants with extra data collection. Therefore, data were gathered from the teacher's field notes, online discussions, logs and learning assignments (see Appendix 6).

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[16] Media server of the local university
[17] International content management system; for more information see http://www.plone.org
[18] Local course management system

6.7 Case 7: One-Hour Participatory Workshop

In Case 7, only a few basic activities and data collection procedures were used, as described in the following sections.

6.7.1 Activities in Case 7

In the seventh research case the instructor first briefly introduced the used methodology phase-by-phase with PowerPoint slides, and after each phase the participants were given a learning assignment. The participants had a few minutes to answer these learning assignments. Through these learning assignments the participants were already designing their own web course while learning to follow the design methodology. The participants were given brief handouts with the learning assignments on them, along with empty space for the answers.

During the workshop, the participants were able to ask for more information or for correctives to the instructions, if needed. The whole workshop was recorded for later use, so the participants were also able to practice later on.

6.7.2 Data Collection in Case 7

In the seventh research case the data comprised the teacher's field notes only, as there was no time to administer any questionnaires. However, the whole session was also recorded as a screen capture video, so some comments can be found on the video. We received also one feedback email.

7 ANALYSIS OF DATA AND RESULTS

In this chapter the data gathered is analyzed and results of the research are summarized. Multiple data sources are used to confirm and/or illuminate one another. As described in Section 4.9, in each case study and action research cycle, the field data is first coded and categorized with content analysis, and then analyzed using triangulation. Finally, on the basis of the results, the existing topic-case driven web course design methodology (see Chapter 3) and implemented training modes (see Sections 5.3.-5.9.) were elaborated and modified.

7.1 Case 1: Analysis of Cycle 1

During the first cycle of Case 1 the field data were collected from learning diaries, learning assignments, self-evaluations, teacher's field notes, and a feedback questionnaire (see Appendix 1). The field data is summarized in more detail in Appendix 8. Assessments of Cycle 1 are summarized in Sections 7.1.1-7.1.3.

7.1.1 Assessment of Training Mode in Cycle 1

The field data included only some mentions of possible improvements, but a great many highlights related to the training mode in use. The improvements are described mostly on the basis of the instructor's field notes.

Highlights. The participants were very satisfied with the way the course was organized and carried out: 71 percent of them were totally satisfied, and the remaining 29 percent were nearly satisfied. The participants liked the way that the course was designed as a web course; according to 65 percent of learners, it was extremely good and efficient, and according to 29 percent of learners, it was better than courses on average. According to participants' feedback, the course supported each individuals learning style. The first two lectures were mostly recapitulation from previous studies for most of the participants, but

most of participants stated nevertheless that during this course they finally realized what all these issues related to educational design really meant.

The idea to tie the learning assignments into the phases of the design methodology used was considered excellent, although they admitted that they didn't always realize this when completing a certain phase or assignment. The actual meaning of certain phase or assignment was often understood later during the following phases. According to the participants, without this step-by-step procedure they wouldn't have been able to pass the course so well. However, one participant managed to skip all the instructions and was late with his designs, and yet managed to implement whole course before actually writing down any of the required documentation.

The creation of one's own idea bank was part of the background study, and it was seen as a good basis for one's own design project. The participants were able to explore different implementations found on the Internet, and they obtained a lot of new ideas. They were also able to refresh their web page design skills. Most of the participants included the idea bank in the references to their completed online course. The testing another's finished online course was also seen positively; it helped to see one's own designs in a new, more critical, light and to find new issues and areas to improve in one's own online course. The participants also liked the use of different tools and techniques, like video recording, video editing, and Flash during the content creation.

The streamed online video lectures were valuable, especially for the distance learners. They were able to see and hear the same things as the learners in the lecture room. The video recordings were essential for those who were not always able to be present at the lectures. Most of the participants watched the videos, even though they followed the lectures in real time either at a distance or in the classroom.

Improvements. There were some difficulties with the schedule: it took some time to realize how much work the course required and that the participants had to start working already at the beginning of the course – not just at the end as in previous courses. There were some complaints about the detailed documentations required in each phase, but later on all of participants realized how useful and helpful this proper documentation was. Some of the participants were impatient to wait until actually implementing something; they would have rather skipped designing and documentation, and just gone through trial and errors, as they had in most cases previously.

There was also some criticism of the fifth learning assignment, i.e., technical design and user interface: design of the user interface was difficult without proper content design, that is, a content manuscript with detailed contents. Not all the participants produced as detailed content design as was requested in the instructions.

Only few of participants were motivated to take a parting the guidance sessions. Of course, there were some who had no problems, but those did so participate were always able to finish their designs always on time. Some dis-

tance learners complained that they would have needed more guidance during the design process, perhaps because they were not able to participate in the face-to-face guidance sessions.

Six participants worked in pairs; others designed their online courses individually. One participant who worked in a pair complained that she ended up doing most of the work alone. She didn't recommend pairs as working method, because reconciling each other's schedule and skills, and contributing equally was hard. Another pair had fewer problems, but reported that they had to put a lot of effort into communication and collaboration to get the pair work done. In one pair, one person stated that the other person was very supportive and that they pushed each other forward.

Some distance learners complained that, because of the technology used, it was difficult to see on the streamed and recorded videos what was happening on the teacher's screen. The teacher's actions on the computer screen and voices were recorded with a digital video camera and Macintosh QuickTime Broadcaster.

7.1.2 Assessment of Design Methodology in Cycle 1

Field data related to the use of the design methodology included only a few mentions of possible improvements, but great number of highlights.

Highlights. The process model worked very well; it strongly supported the working process. The participants gained a lot of new ideas throughout the whole process. The process model split the work into smaller pieces, and after that designing of one's own web course wasn't such a hard task - as it had seemed at first. On the other hand, the process model also helped to see the big picture more clearly.

Design was the key word for good results. According to the participants, detailed design and following the phasing of the process model helped a lot to achieve one of the course goals, a well designed self-made web course. The phasing and learning assignments spread the workload equally over the scheduled four months.

Designing was sometimes difficult, but diligence and exactness were rewarded, at the latest, in the implementation phase and often already during the next step. Participants were also able to utilize designs from the previous assignment in the next one. In particularly, the creation of a content map during the content design was considered an excellent foundation for further designs.

Before taking this course, most of the participants had not realized how many different aspects they need to consider during the pedagogical design phase, e.g., different approaches, interaction, communication, guidance, tutoring, design of assignments, authenticity, and different learning styles.

According to most participants, the technical design phase was, unexpectedly, fun and ultimately, by following the previous designs, quite easy. All the participants agreed with the traditional Finnish dictum: "well designed is half done". Implementation is much easier with good designs.

Improvements. The only comment related to improvement was a complaint about the amount of documentation required. Some participants wrote as many as 150 pages of documentation, which is indeed too much.

7.1.3 Results from Cycle 1

The participants listed three main things in their feedback that needed more attention and improvement in the future: 1) amount of guidance, 2) scheduling, and 3) amount of required documentation (Table 5). Some distance learners complained that they did not get enough guidance during the course. On the other hand, at the same time some other distance learners reported that they received as much guidance as they needed. One reason might be the fact that some students were simply more active and asked for more guidance. There are also individual differences: some participants need more guidance than others. In the future guidance has to be improved: more guidance has to be available and teacher's feedback has to be given without delay.

TABLE 5 Summary of results from Cycle 1

Desired improvement
More guidance, especially for distance students
More flexible schedule
Less required documentation

Some distance learners said that the schedule proceeded too fast and they would have needed much more time to achieve better results. All the distance students were working during the course and most of them also had other studies at the same time, so the scheduling is partly students' personal timing problem. However, in the future two-hour lectures will be given mostly only once a week, so that the participants will get more time to internalize all the theoretical issues and to finish their designs.

Furthermore, the need for and amount of detailed documentation was also obvious to the participants, but they didn't see its importance right away. Therefore, the importance of documentation has to be underlined during the next cycles. Possibly, the amount of required documentation can also be reduced.

Next, we list some notions that also have to be considered during the next cycles:

1. Participants have to be better motivated to take part in the guidance sessions
2. Some learning assignments have to be split in half and arranged in a different order
3. Video streaming and recording techniques used need to be improved

Most of the desired improvements were related to the implementation of the course, only one to the design methodology used. The design methodology was considered very positively. In the first cycle the course was organized for the first-time, so first time enthusiasm might have had a slightly positive effect on the results.

7.2 Case 1: Analysis of Cycle 2

During the second cycle of Case 1 the field data were collected from learning diaries, learning assignments, self-evaluations, teacher's field notes, and feedback questionnaire (see Appendix 1). Feedback was taken into account only from fifteen participants, because the others took so much longer to finish the course. Moreover, only seven of the participants gave feedback through feedback form. The field data are summarized in more detail in Appendix 9. Improvements and highlights of Cycle 2 are summarized in Sections 7.2.1-7.2.3.

7.2.1 Assessment of Training Mode in Cycle 2

In this case the participants had only some or no experience on online learning before participating in this course. Most of them agreed that the technical issues worked well on the course. We received only a few isolated complaints.

Highlights. All the participants agreed that this course was laborious, but efficient, interactive, useful, and better that university courses on average. The learning materials were considered excellent. The course schedule was seen as strict, but realistic. The course was also considered an excellent practice for actual teaching situations; the participants were able learn and test their ideas without any learners suffering from their possible mistakes.

According to most participants, the interactive lectures related to the different design phases gave clear guidelines for their own design: what has to be considered and how it should be documented. In particular, the pedagogical design was first considered as a something of a monster because most of the participants didn't have any experience of using different pedagogical models, but after the lecture most stated that it was not as difficult as they had first thought.

Most of the participants stated that they had learned more than they expected at the beginning of the course, and they were excited and waiting for a new opportunity to design their second online course. They also learned how much work teachers or instructors need to do to make online courses available.

Moreover, the guidance sessions were considered very useful, as during those sessions participants were able to test their ideas under the guidance of the instructor and they were able to get instant feedback from instructor as well as from the other participants. The assignment centricity and interaction during the lectures between participants were considered very positively. Authentic

learning assignments drove the course design forward without their being just extra exercises. Most of the participants agreed that they had enough instruction to be able to do all the learning assignments.

Improvements. There were a few complaints about the use of Optima as la earning environment. Some would have preferred to use Moodle instead of Optima, because they desired something new; they had already used Optima in other online courses earlier. There were some complaints about the instructions for the learning assignments and the return box for the participants' answers having been placed in different folders; the instructions were right next to the learning materials and the return boxes were all in another folder.

There were some complaints about the low volume during questions from the audience in the recorded online videos. However, at that time it was not possible to solve the problem technically in the lecture room used. Also, in relation to the online videos, there were still some complaints about difficulties in seeing what happened on the teacher's screen, even though the teacher paid more attention to displaying the content.

There were some comments about having more examples related to the learning assignments to follow when doing one's own designs. Someone proposed that real-life examples from implemented designs and related documents should be included.

Furthermore, one of the participants would have needed stricter deadlines for the learning assignments to stay better on schedule. Some of the participants had also problems finding enough time to do all the design work. A few participants also complained that writing the learning diaries was too laborious and a bit boring.

7.2.2 Assessment of Design Process in Cycle 2

Field data related to the use of the design methodology included only a few mentions of possible improvements, but a great number of highlights.

Highlights. Most of the participants agreed that design methodology was easy to use and the design process proceeded logically. The learning assignments divided the workload into smaller and convenient segments. Some of the participants stated that they didn't actually realize how important and useful doing the documentation was until later on. During a certain phase documentation didn't seem to be so important, but later on they realized why they had to do all that work – or why they shouldn't have skipped something that was required earlier. This was noticed especially after the content design phase; if they missed something out during the content design phase they had difficulties or more work during the later phases.

The participants stated that the learning path method used in content design phase was illustrative and helped the designers to hold the content better together; it helped to see which domains were important and in which order topics have to be learned. Moreover, most of the participants had not previ-

ously known the core knowledge analysis or workload analysis used (Karjalainen and Jaakkola 1999), and they considered these as an excellent way to divide topics with a scale of must know – should know – nice to know, and to measure how much learner's work an assignment would require.

Technical design, especially the production manuscript, was first considered as pointless duplication, but later, during the implementation phase, all the participants noticed how useful it actually was; they were surprised how many usable templates, instructions, and even some learning materials they already had as a result of designing and documentation.

Improvements. Most of the difficulties with using the design methodology were related to content design: participants had difficulties on deciding what content to include in their own course. These were also difficulties related to pedagogical design: how to teach specific topics online. Both of these difficulties, however, can be explained by lack of teaching experience: those who complained didn't have much experience of teaching as yet. The amount of work required also surprised some of the participants.

7.2.3 Results from Cycle 2

First of all, the improvements implemented after the previous cycle had significant influences on results of the second cycle (see Section 6.1.1). There were no complaints about the amount of guidance. All seemed to receive as much guidance as they needed. The course schedule was now realistic, with two-hour lectures once a week. This rescheduling also helped the distance students to proceed on schedule. The importance of the required documentation was emphasized, but it still took a while before the participants actually realized this. The workload was also lower, with use of the learning path, core knowledge analysis, and methods of workload analysis during the content design phase. Furthermore, the participants were better motivated to take part in guidance sessions, which were now considered very useful.

During the second cycle, the order of third and fourth learning assignments was changed. Three additional learning assignments were added to guide the design process. First of all, the previous fifth learning assignment was divided into two separate assignments: interface design was separated from other technical design. Secondly, a new learning assignment was added before the previous testing and evaluating assignment. In this assignment the participants predefined those issues, if there were any, which were not implemented during the first iteration. Finally, a new learning assignment was added at the end to set some guidelines for further development.

The participants had some improvements in mind (Table 6). First of all, they wanted more examples of learning assignments to follow in their own designs. Second, they would have preferred to use Moodle instead of Optima, and relocate the instructions for learning assignments and the return box in the same folder right next to related learning materials. Third, the participants continued to report that there was too much written work, especially the learning

diaries. Finally, the technology used was not able to solve the problems related to volume and lack of clarity of the recorded videos. Therefore, we need to enhance the technology further.

TABLE 6 Summary of results from Cycle 2

Desired improvement
More examples of learning assignments
Use of Moodle instead of Optima
Instructions for learning assignments closer to the assignments themselves
Less extra work, like writing learning diaries
Enhancement of new technology

However, all the desired improvements were related to the implementation or technology, not to design methodology used. The design methodology was considered very positively.

7.3 Case 1: Analysis of Cycle 3

During the third cycle of Case 1 the field data was collected from learning assignments, self-evaluations, and teacher's field notes (see Appendix 1). Learning diaries were not required and we didn't use any formal feedback forms at the end of the course either. Therefore, most of the findings are based on the instructor's field notes and written feedback from participants. Improvements and highlights of Cycle 3 are summarized in Sections 7.3.1-7.3.3.

7.3.1 Assessment of Training Mode in Cycle 3

Field data related to the training mode included only a few mentions about highlights, but much more mentions of possible improvements.

Highlights. Half of the participants didn't attend any of the lectures in person, because of the distance or duties at work, but they were able to follow the course and finish their designs on schedule. Most managed to implement an excellent and usable online course that in some cases are already in use.

Improvements. At the beginning, some learners seemed to have a lot of difficulties in understanding the instructions for the learning assignments, and also some contentual issues, especially in relation to pedagogy. However, as the course proceeded and the participants learned to use the integrated examples as guidelines, all such difficulties were solved and the design process progressed smoothly.

Occasionally, some participants seem to miss some of the instructions and didn't pass the learning assignment first time. Some of the participants com-

plained that there was too much work, but they admitted that they didn't believe the warnings given at the beginning of the course. The participants stated that they didn't have enough time to do everything properly, because they were all working at the same time.

Some of the participants stated that they would have preferred more discussion on the different topics and assignments, and also to have feedback from the other participants on how they were progressing with their designs. As it was, they received comments and recommendations on how their designs could be to modified or improved, but only from the teacher.

7.3.2 Assessment of Design Process in Cycle 3

There were no complaints related to the design methodology used. However, some highlights were reported as follows.

Highlights. A few of the participants already had some experience of web course design, but they stated that the methodology used here was better than their previous approach to design – in fact they had often just been implementing web courses without a proper design process.

Moreover, some participants reported later on that they had already improved their course in accordance with the design process documented during the course. So they had realized the iterative and incremental nature of the design methodology employed.

7.3.3 Results from Cycle 3

The improvements made after the second cycle (see Section 6.1.1) had conflicting impacts on participants; especially the addition of new examples. First of all, we re-designed and documented the preliminary knowledge course required before attending into this specific course with the design methodology employed, and presented it as an example related to the learning assignments. We also added the best parts of the previous implementations made by the participants in Cycles 1 and 2 as examples. However, it seemed that some of the participants in Cycle 3 found the added examples of no help. They managed anyhow to get lost doing their learning assignments. However, it was notable that participants were too busy to properly concentrate on the assignments and maybe they messed up because of lack of time.

Second, we decided to use Moodle as the learning environment instead of Optima. This also solved the previous problem of relocating the instructions for learning assignments and the return box in the same folder right next to related learning materials. Thirdly, we lessened all the extra work, including learning diaries. During the third cycle, the total course evaluation was done on the basis of participation activity, self-evaluation, peer-evaluation, execution of learning assignments on time, and scheduled presentation of own web course at the end of the course. The participants were satisfied with having less work, but there

were not enough data for evaluating the implementation. Finally, we provided some new technology to increase the quality of the streamed videos; the instructor's actions on the screen were now captured with Ephipan's VGA2USB[19] frame grabber instead of a digital video camera. We also used new software, Wirecast[20], to combine sound and grabbed frames.

As a result from of the third cycle, the course realization included too little field data to enable any penetrating analysis to be made from the data. Only concrete idea was to include more discussion and comments from the other participants as well as just the instructor. The design methodology used was again considered very positively – even more so than previously.

7.4 Case 1: Analysis of Cycle 4

During the fourth cycle of Case 1, the field data were collected again from learning diaries, learning assignments, self-evaluations, teacher's field notes, and a feedback questionnaire (see Appendix 1). This time the learning diaries were more compact and structured by weekly questions related to the learning assignments. The field data are summarized in more detail in Appendix 10. Improvements to and highlights of Cycle 4 are summarized in Sections 7.4.1-7.4.3.

7.4.1 Assessment of Training Mode in Cycle 4

Five of participants in Cycle 4 already had a lot of experiences of teaching in the classroom. Therefore the basic issues at the beginning of the course were especially well-known to them. However, in general the comments were similar to the comments made after the previous cycles.

Highlights. All the participants stated that the course was laborious, but rewarding, and they all stated that they had learned a lot during the course. The video recordings of the lectures were considered very important, especially by the distance students. Also the new teacher's blog was considered useful; it helped to follow the instructions better.

According to all the participants, they received as much guidance as they needed and answers to questions were received quickly. Most of them also stated that the feedback, received during the online discussions from the other participants was very useful, especially at the beginning of the design process. Some of the participants had also noticed that the instructor always had a plan B, if something didn't work as well as first planned.

The phased learning assignments guided the design work and helped the participants to reach the goal of the course, their first self-designed and self-

[19] See http://www.epiphan.com/products/frame-grabbers/vga2usb/
[20] See http://www.telestream.net/wire-cast/overview.htm

implemented web course. The seminars at the end of the course, where all participants presented their designs and finished web courses, were considered as one of the best parts of the course because the participants were able to learn from others designs and implementations.

Improvements. According to the participants, the course was generally organized well. Most of the complaints were related to the discussions, especially the activity of the other participants. Role setting (see Section 6.1.1) was considered positively, but it seemed that some of the topics were unfamiliar for most of the participants, which made it difficult to discuss them or to comment on design plans from a specific role point of view. Some stated that they only commented on others' designs because they were required to do so, even if they had nothing to say.

Some participants complained that the same three questions in the learning diaries each time were little confusing – they didn't always know what to write. According to the participants, the questions should be more closely linked with the topic of the week.

A few learners complained that they didn't always know if they were doing the right thing or working in the right way. They stated that they would have liked some written feedback in half-way through just to be sure that everything was right. This statement is a somewhat confusing, because after each learning assignment they all got written feedback on how to improve their designs. Some of the participants were also looking for more examples to see how the designs could have been done.

Some participants complained that the schedule was too strict; at the beginning they all did well, but by the end they had too much work to do. This was mostly because they had not planned the contents of the web course sufficiently enough during the content design phase.

7.4.2 Assessment of Design Process in Cycle 4

Feedback related to the design process included both highlights and improvements, but because all the statements always contained some buts, we exceptionally report these as one.

Highlights and improvements. The design process itself was considered positively, but the implementation of process model in practice could have been more iterative and incremental; the basic idea of the model was covered under the waterfall depiction used (see Figure3). The participants complained that they would rather have produced or have tested some ideas in practice already during the content or pedagogical design phase just to be sure that their ideas actually work. This was in fact possible, because of the iterative and incremental nature of the design methodology, but the waterfall visualisation used seemed to limit their actions.

One participant also stated that it would have also been good to use some another process model to see how others work, and to compare different design

model at the end. However, getting to know other design methods would require more time (approximately 4 to 6 hours per model).

7.4.3 Results from Cycle 4

As a result of the feedback on previous cycle, we added more discussions and peer reviews into the fourth cycle. We also adopted the role discussion tested in Case 6 (see Section 6.6) with university teachers to guide discussions. In order to obtain more research data for analysis, we also brought back the learning diaries, but in reduced form. These improvements were considered both positively and negatively (Table 7).

TABLE 7 Summary of results from Cycle 4

Desired improvement
Add more face-to-face discussions
Delay grouping at the beginning of the course
Re-formulating of questions for learning diary
Re-formulating of the visual description of the design methodology used

First of all, the participants stated that feedback from the others was valuable. They gained a lot of new ideas to include in their designs that they would have not otherwise discovered. However, the roles used in the discussion groups were quite difficult to adopt, especially when the discussion topics were unfamiliar. Some participants were designing web courses with more specific topics that were unfamiliar to others, who consequently didn't have so much to say or comments on. This flattens out the online discussion. Some of the participants' would have preferred to discuss their successes also face-to-face as well, but this would be quite difficult to arrange because of the number of distance students – unless some new videoconferencing tool could be used.

Secondly, we had problems with grouping; six participants started the course, but they either quit the course after two weeks because of other duties, or asked to be moved into the self-oriented online course (Case 5) because of difficulties in fitting the course in with their other duties. Therefore, we had to regroup and merge the groups that were left. It again took sometime for the new groups to merge, so that the discussions were not so successful. Next time the grouping should be delayed till all participants are sure that they are able to follow the course schedule, or we restructure the groups. Both of these solutions would fit into the current course concept.

Thirdly, learning diaries were brought back to the course in a new form. The participants were asked to answer three questions each week as follows:

1. What have you learned during the learning assignment this week?
2. How have you yourself promoted the work of your group members?
3. How have others in your group promoted your or your group members' work?

Some participants considered it difficult to answer these same questions every week. Next time, we could formulate at least some of these questions differently each week or change the learning diaries to reflections.

Finally, it was clear that most of the participants had difficulties in applying the design methodology used, because they interpreted the model as waterfall model based on the visualization of the model (see Figure 3). Therefore, topic-case driven web course design methodology should be visualized differently.

7.5 Summary of Results from Case 1

The first case study was carried out as a Web Course Design and Implementation Course. The first course was held in the autumn term 2004, since when we have carried out four implementations of the course as action research cycles.

Learning activities on the course followed the phases of the topic-case driven approach (see Section 6.1). During the first cycle there were six learning assignments, but during the later cycles the learning assignments were divided into smaller units based on participants' feedback. By doing these learning assignments and by following the topic-case driven methodology the students designed and implemented their first web courses. Learning diaries and teacher's field notes were used as research data along with formal feedback that was collected using a feedback questionnaire at the end of the course.

Very encouraging results were obtained in the first case study concerning the topic-case driven methodology and its utilization in a bootstrap fashion. After each cycle the participants pointed out some issues that were then improved before the next cycle. A summary of the results from the first case study is presented in Table 8. As can be seen, most of the feedback was related to the implementation of the course itself or the technology used, not to design methodology.

Based on the latest feedback, the participants had difficulties on identifying the web course design methodology as an incremental and iterative design process. The main reason for this seemed to be the visualisation of the model (see Figure 3). Typically, the model is perceived as a waterfall model in software development (Royce 1970). Therefore, the visualisation of the model should be re-designed, e.g., a spiral model might be easier to understand. However, we would like to keep the visualisation as simple as possible, because most of university teachers and students don't understand the upper level notations used in software development. Re-designing the model could also lead to re-designing the course concept to better support the iterativeness and incrementality of the design process.

Secondly, the participants also wanted more face-to-face discussions and peer support. Both of these were difficult to implement because of heterogeneity of the student group; there were both on-campus students and distance students in the group. As a solution to this, we are planning to introduce videocon-

ferencing via Adobe Connect Pro that would support recording lectures, discussions, and the guiding of distance students.

TABLE 8 Summary of results in Case 1

Cycle	*Desired improvements*	*Improvements made afterwards*
Cycle 1	More guidance, especially for distance students; more flexible schedule; fewer required documents	Participants were encouraged to ask more and instructor has been more active; two-hour lectures mostly only once a week instead of twice a week; number of required documents reduced by adaptation of new techniques, such as learning path, core knowledge analysis and workload analysis methods
Cycle 2	More examples for learning assignments; use of Moodle instead of Optima as a VLE; instructions for learning assignments to be closer to assignments themselves; less extra work, like writing learning diaries; enhancement of new technology for video recordings	Re-designing and documentation of the preliminary course as an example of design process, and best parts of the designs made during Cycle 1 were added as examples; started to use Moodle as a VLE; use of Moodle solved the distance problem between instructions and assignments; learning diaries were not required anymore; adaptation of new recording technology, Ephipan's VGA2USB frame grabber instead of plain digital video camera
Cycle 3	More group discussions as peer support; difficulties in evaluating learning outcomes	New online role discussions were added, as well as examples; learning diary has reset and guided with pre-set questions
Cycle 4	Delayed grouping at the beginning of the course; more face-to-face discussions; more illustrative examples for pedagogical design; re-formulation of learning diary and visual description of the design model; difficulties in role adaptation	Re-design of the course to support better iterative and incremental design process; activating group assignments during the lectures, including face-to-face discussions;

Finally, participants complained about the instructions for the learning diaries. During the next cycle we are planning to introduce learning diaries as reflections: participants will be instructed to write reflection on the specific theme that is on the schedule, and then comment on two other reflections. The goal is to get the participants to discuss problems that they might have.

7.6 Analysis of Case 2

Most teachers have problems with online discussions: there are either too few or too many participants involved, everybody is waiting for someone else to initiate the discussion, time "runs out", and at the end participants express all their thoughts in one long message. That is, no real dialogue appears, the participants have not allocated enough time for the discussion, or all go where the fence is lowest, avoiding all the hard work. One solution to these problems is role discussions (e.g. Lebaron and Miller 2005); however, these might be hard to adapt to all subjects or to ensure that everybody participates. In teacher-controlled discussions (Jarvis and Gibson 1997, 91-92), on the other hand, all the talk is directed to the teacher, the teacher's workload grows and responsibility for the success of the discussion is passed to the teacher. In compulsory discussions a required minimum number of messages or answers may lower the quality of the content (Roberts 2007). According to Mathieu, Tannenbaum, and Salas (1992), learners who voluntarily attend a learning session react more positively and may even perform better than learners who are required to attend.

7.6.1 Assessment of Using Different Pedagogical Scripts in Cycle 1

During Cycle 1, all the online discussions were clearly themed and the learners were given background readings beforehand. Discussions were led by a learner as a chairperson who was asked to prepare in advance questions or ideas for discuss. The teacher's role was to evaluate the discussion and each learner's participation, and to help if needed. The group size was 5-7 learners. In the asynchronous two-hour chat discussions almost all participated actively and there were no need for a minimum limit on the amount of messages. For some participants the tempo was to fast: too much to read synchronously (sometimes over 250 messages in two hours) or they were too slow to write an answer.

In the synchronous weekly forum discussions all the participants had time to think through and form their ideas, and all were easily able to follow the tempo. A problem was that some were too lazy to start and the chairperson had a challenging job to motivate others to participate. According to the participants, similar repetitive discussions began to be boring after four discussions. To cheer up and vary the discussions we tested different techniques in both asynchronous and synchronous discussions (see Appendix 11). We adapt traditional face-to-face techniques to online discussions, such as Address circle, Brainstorming, Theme discussion, Panel discussion, Poster discussion, Reading group, Group investigation, Concept mapping, and Workshop (see Section 6.2.1).

The Address circle technique works asynchronously with a small group (4-6 participants) and better when all the participants know each other. Brainstorming works well in asynchronous online discussions. The problem or question to solve has to be well defined and group size can not be too large (4-6 participants). Theme discussion works well in both asynchronous and synchronous

online discussions. In synchronous discussions group size can be little bit larger (6-10 participants).

Panel discussion works better in asynchronous online discussion after small modifications: the audience has to have more active role. This can be done by allowing the audience to ask their own questions after each discussed topic by the panellists, or each participant introduces a new viewpoint that is discussed first by the panel after which the audience can comment on it. A good size of panel group is 4-8 panellists and the audience can contain 4-8 participants.

Poster discussion can be run online either asynchronously or synchronously. The optimum discussion group size is 5-8 participants. Reading group discussion works well in both asynchronous and synchronous online discussions. Group size can be 4-6 participants. In group investigation the groups work and the communication and discussions can be placed in online. The different discussion techniques presented above can be used to support and structure discussions.

Concept maps can be created synchronously and collaboratively e.g. through a shared online CMapTools network. Chat for a discussion is included in CMapTools. Workshop online can be based on the different discussion techniques presented above.

7.6.2 Assessment of Using Different Roles in Cycle 2

During Cycle 2 with the university practitioners, we used only role play to structure the design process. The participants were voluntary, choosing different roles in their groups. The different roles are described in Section 5.4.2. Some participants were willing to play a totally new role that they had never played before in real life and some played the same role that they play in the workplace. There were no complaints about the use of different roles. Discussions were intensive and proceeded well. The participants were even irritated if they were for some reason interrupted during the discussion session.

All the complaints that were reported during this cycle related to choosing only one course topic for the group to develop – most of the participants would prefer to design their own course. In the future we could also use this kind of role setting in other workshops where the practitioners are designing their own web courses.

7.6.3 Assessment of Use of Role Play in Cycle 3

During Cycle 3, in which university students played different roles while designing their web courses, most of the participants had difficulties with the role play requirements (see Section 5.4.3), mostly because they didn't have any experience of web course design or teaching overall. This led to unwillingness to participate in the online discussions. Some participants stated that they didn't have anything to say, but commented on other's designs only because they were required to do so.

This result suggests that setting roles in this way doesn't suit undergraduate students who don't have any experience of teaching in the classroom or in online. In the future, discussions among novices should be structured in some other way.

7.7 Summary of Results from Case 2

In Case 2 we first (Cycle 1) tested some pedagogical scripts that were intended to guide and help the use of the presented design methodology. In this case all face-to-face and online discussions were clearly themed. The discussions were led by a participant acting as a chairperson, who as in Cycles 1 and 3 was also asked to prepare in advance some questions or ideas to discuss. Discussion group size was 5-7 participants.

In the asynchronous discussions almost all participated actively and there were no need for, e.g., a minimum limit on the number of messages. For some participants the tempo was too fast, or they were too slow to write their answers.

In the synchronous weekly forum discussions all the participants had time to think through and form their ideas, and all were easily able to follow the tempo. A problem was that some participants were too lazy (or busy) to start, and the chairperson had a challenging job to motivate the others to participate. To cheer up and vary the discussions, we tested different techniques in both the asynchronous and synchronous discussions.

During Cycle 1 we adapted traditional face-to-face techniques to online discussions, such as Address circle, Brainstorming, Theme discussion, Panel discussion, and Poster discussion. During Cycles 2 and 3 we used Role discussions. The very positive results obtained are summarised in Table 9. However, in the role discussions more experienced participants were able to adopt a role more easily compared novice participants.

7.8 Analysis and Assessment of Training Mode in Case 3

There was a need to introduce the proposed design methodology for larger groups. Therefore, we planned a one-hour introductory workshop (Case 3) for 70–100 university practitioners. During the workshop the participants were able to learn about the use of the web course design methodology. So far we have held these workshops four times.

During these workshops, participants have learned the basics of the used methodology and received guidelines for self-oriented design work. At that stage, most of the participants were not yet planning to design their first web course; they were only taking part in the workshop in case the need arose in the future. However, the participants reported that the lecture inspired them to

take part in some of the other workshops later on, in order to learn more, or to receive more guidance.

> Thank you for an excellent lecture, and your answers. I would like to come a long for to next workshop. (Female participant)

TABLE 9 Summary of results from Case 2

Pedagogical script	*Experiences and observations*
Address circle	Works fine in chat discussion; easy to follow the discussion when only one participant is "on the air" at a time; turn-taking was easy when done by writing "next" after finishing own turn
Theme discussion	Easy way to discuss. In chat, discussion requires some kind of turn-taking procedure (cf. Address circle). Discussion in forum requires deadline that, on the other hand, limits the discussion
Brainstorming	The planned 20 minutes for posting ideas was too long in online; participants were able to do brainstorming without the instructor also
Panel discussion	It is better to hold a brief discussion shortly after each introduction; by waiting till all the panellists have expressed their opinion, some ideas get lost
Poster discussion	Works fine if there are only a limited number of posters to present and evaluate, especially in chat discussion; requires strict deadlines to enable all participants to see posters beforehand
Role discussion	Works fine with more experienced participants; novices had problems with a role identification. More experienced participants were also able to adopt new roles.

There has not been any need to change this training mode on the basis of the feedback reviewed so far. It has served its introductory purpose well, as planned.

7.9 Analysis of Case 4

The learning-by-doing workshop has been organized four times, with a total of 27 participants. One workshop was tailored for a group of teachers from the local Open University and one for a group of teachers on the local master's program.

Most of the participants had a lot of experience (from 6 to 40 years) in traditional classroom teaching; most of them had also completed their teacher training and qualified as teachers. Half of them had some experiences of online learning, as well as online teaching or guiding. However, most of the participants were planning their very first own web course during the workshop. Feedback from the participants was collected through email and with questionnaires (sees Appendix 12).

7.9.1 Assessment of Training Mode in Case 4

All the participants were extremely busy university practitioners who had difficulties finding enough time to finish their designs between the workshop sessions.

Highlights. All the participants were satisfied with the guidance they received during the workshop. They were sure that they were now able to plan their own web courses. They reported that there was a real need for this kind of training. However, not all of them were convinced at yet that they would also able to implement their designs as finished web course. They reported that they would need more technical training before they would be able to implement their designs.

According to the participants, during the workshop sessions they were able to see how the web course design process works. They also received instant feedback as well as a lot of new ideas and tips on how to make own web course work better. According to the participants, the best part was the atmosphere of doing the task together, but there was still enough space for individual progress and working.

From the instructor's point of view, the best part of the workshop was the moment after the face-to-face sessions when the participants sent positive feedback and greetings that they have been able to finish their design and implementation processes, and have run their first web courses with real online learners and obtained excellent results.

> My […] web course was quite successful. I got nice feedback from the structure of the course, learning assignments and scheduling. The group of participants was heterogeneous […], but they supported each other well. They all participated well in the online discussions which were the base of the course. The most interesting issue was the way learner-centricity was adopted. The learners took responsibility for doing learning assignments and keeping on schedule. I have never ever received, e.g., all my students learning diaries in time. The funniest thing was that they applauded the presence of the teacher – and I limited that to the minimum! Thank you once more for the good tips […]. (Female university teacher)

Improvements. Because of their busy schedules, some participants proposed that the workshop should have lasted longer (cf. other workshops). Some participants would have preferred to be able to receive the learning materials also in printable form, which is quite easy to arrange. One of the participants was not a native Finnish speaker, which made it slightly harder for her to follow the

workshop; in the future there might be also a need for an international workshop in English.

7.9.2 Assessment of Design Methodology in Case 4

According to participants, the design methodology employed gave them more confidence to design their own web courses. It was considered an excellent and practical device for teachers to design their own web courses. It helped them to document designs clearly and to run the whole process from beginning to end. Some participants stated that the design process model can be used as a checklist when they design their next web course.

7.10 Summary of Results from Case 4

For some university practitioners the four-month design course in Case 1 was too long and the one-hour introduction in Case 3 was too short;, therefore, we implemented a twelve-hour learning-by-design workshop for smaller groups (Case 4). During this workshop the participants were introduced to the presented design model through designing their own web courses. The workshop has now been held four times.

The structure of the workshop followed the proposed web course design model and the learning assignments were resized from Case 1. Because all the participants had dozens of years teaching experience in the classroom, we were able to concentrate on the differences between traditional teaching in the classroom and online learning. In the learning-by-doing workshop the participants worked with their own topic and design goal: to design their first web course. They received instructions, tips, and guidance during the session as needed - also between sessions through email or a virtual workshop environment, where all the instructions and assignments were published. They were also encouraged to discuss and express their ideas as well as problems. After each face-to-face session the participants continued their designs during the two-week break between sessions. At the end of the workshop all the participants had a documented design for implementation of their own web course.

This training mode can also be tailored to meet the needs of a specific educational institute or group of participants. The participants followed the topic-case driven methodology in planning their own web courses. The workshop ended at the point where participants had detailed plans for their course implementation. They were able later to continue the development process by themselves or to hire somebody else to realize their plans.

The results of the learning-by-design workshop are summarized in Table 10. According to the participants, there was an obvious need for this kind of training. The form of the course was considered excellent, even though, some participants had difficulties finding enough time for the training. The participants were very satisfied with the training they received. After the training,

most of the participants were confident that they would be able to design more web courses in the future if needed. One participant even reported later on how well her own online course, planned during this learning-by-doing workshop, was received.

TABLE 10 Summary of results in Case 4

Issues	*Comments*
University teachers need and want this kind of training	"There is an obvious need for this kind of course"; "I'm very pleased with this course"; "The course has improved also my online teaching skills"; "The course was excellent"
The form of the course was considered excellent	"Role of the instructor was very important"; "I prefer contact lessons more than just reading instructions"; "It was good that the required learning assignments formed the skeleton of the practical work"; "I have implemented some own online course already before, but this new way of doing it gave me a new perspective on design"; "The importance of the design manuscript should be highlighted even more"; "I like this kind of learning"; "The online material was excellent; it didn't give us too direct answers, instead it forced us to think"
Difficulties inding enough time for training	"I had difficulty finding enough time for designing"; "I end up doing the course on my own just because I had difficulties with scheduling"

7.11 Analysis and Assessment of Training Mode in Case 5

During case studies 1 and 4, a few participants had difficulty staying on schedule. Therefore, we implemented a self-oriented online course (Case 5) for those who are more self-oriented, who would rather plan their own schedules, and learn to design web courses simply by following instructions. The online course was based on the online material created for the course in Case 1. Participants were instructed and guided online; they received as much guidance during the design process as they wanted. So far, two participants have finished the course with the grade excellent.

Because only two participants have actually completed this workshop, we do not have very much field data to analyze (see Appendix 13). Those two participants were motivated and self-oriented. They didn't have any problems that would have impeded their design work. Although one participant stated that she would have preferred to receive more face-to-face guidance, because she was not so good at reading instructions. In the future we could also adapt videoconferencing as a part of this training model to guide and support participants.

Another five participants started the self-oriented online course. However, they were unable to finish it. These participants complained that it is too hard to schedule something like web course design along with other duties by themselves. These participants have since taken part in other workshops (like in Case 1) in order to finish their designs. Therefore, we can conclude that this kind of training is not suitable for everyone.

7.12 Analysis of Case 6

In this learning network workshop (Case 6) the participants were divided into groups of six, and were asked to choose one of their own topics to develop as a group. Each participant had a different role to play during the design process. The six roles were 1) responsible teacher (or content master), 2) pedagogical master, 3) learning materials master, 4) technical master, 5) support master, and 6) quality master (see Section 5.4.2). Each player commented on the designs from the point of view of his or her own role. Otherwise, the workshop was implemented as in Case 3, except that only one hour was allowed for each session. The findings are based on the instructor's field notes and participants' comments during the workshop.

7.12.1 Assessment of Training Mode in Case 6

Field data related to the training mode included only a few mentions of highlights and improvements.

Highlights. Working in groups and the use of role discussions were considered a positive experience. The participants discussed topics very intensively; they did not like being interrupted in the middle of discussion. The participants had a lot of experience in traditional teaching in the classroom; therefore, they had plenty of ideas and experiences to share with others.

Improvements. The main issue to rethink is the principle of choosing one individual's topic to develop, as most of the participants would rather have designed their own topic during the workshop. The participants were instructed briefly between different tasks; however, the participants complained that being

given instructions in this way interrupted their discussions. They would have preferred to be given all the instructions at once, and then through discussion, without any interruptions, plan the design related to the specific phase.

7.12.2 Assessment of Design Methodology in Case 6

Participants were satisfied with receiving their instruction in a new way of designing web courses. During the online discussion the participants discussed web course design and the implementation process, and its effects on quality assurance. Quality requirements were easier to find when design process was broken down into smaller tasks. The conclusion regarding the quality requirements discussions are presented in Table 11.

Participants also listed some quality problems related to web course design, quality indicators, and instruments and tools for quality evaluation. These are listed in Appendix 14. However, these issues are less interesting from the research goals point of view.

7.13 Summary of Results in Case 6

For a larger group of university practitioners from different universities who were already planning their online courses a simple introduction workshop (Case 3) was not enough and a learning-by-design workshop was difficult to arrange because of travelling arrangements. Therefore, we implemented a three-hour learning network workshop (Case 6) where the participants used the presented web course design model to design a web course as a group. The design process was structured with role playing (see Sections 5.4.2 and 6.6). The learning network workshop has been run only once, but we received a lot of feedback from participants that encourages us to develop this training mode in the future (see Table 11).

TABLE 11 Conclusion from online discussion about quality requirements in the design process

Phase	**Advantages**
Design model as a whole	• Clarifies, facilitates, and simplifies the design process with proper instructions, decisions are documented for later use, best practices are easy to copy from documentation • Guidance on gathering feedback from students and teachers, and re-designing the web course incrementally and iteratively if needed
Background analysis	• Helps efficient exploitation and optimization of resources and workload, realistic scheduling, and collaboration between different participants • Reminds planner to define and document learning goals and desired learning outcomes
Content design	• Helps to define domain and concepts, and size and structure explicit contents as a whole • Guidance on diversity and illustrativity of learning materials, reminds of workload and dosage of information (required vs. extra readings) • Reminds planner about functionality and sufficiency of information and simplicity of instructions
Pedagogical design	• Guidance on implementing pedagogically designed learning situations, and individual learning paths • Guidance on designing teaching acts that provoke desired learning acts • Guidance on designing assessment of learning outcomes based on learning assignments, assessing absorbed knowledge and skills, and adaptation (use in real life contexts), not rote learning • Guidance on evaluating attained learning goals and creating coherent assessment practices • Reminds planner to pay more attention to guidance; enough and well-timed, individual, emphasizes correctness, competence, consistency, reliability, supportiveness, and simplicity • Guidance on supporting different learning styles and strategies
Technical design	• Reminds designer about importance of extensive support, both pedagogical and technical • Reminds designer about testing before use and comprehensive evaluation of whole process • Reminds designer about usability, accessibility (design for all), availability, scalability and pedagogical usability of technical solutions

The main issue to develop is the principle of choosing one person's (single) topic for development; most of the participants would rather have designed their own topic. Before making any changes, we should run this workshop for a second time. In the meanwhile, we could introduce a new kind of workshop, so-called a Consulting workshop. In this new training mode individual design work, where all the participants design their own web course, could be supported with a design group sharing their experiences. The educational focus would be on consulting, where the design process is supported by technical and pedagogical experts. Moreover, the role-based discussion was evaluated positively. In view of this, the roles defined here were also used in the fourth cycle of Case 1 and reported as Cycle 2 in Case 2 (see Section 7.6.2).

7.14 Analysis of Case 7

In some cases there is a need to training large groups in a single session. However, the simple introductory workshop provided in Case 3 is insufficient, because the participants are already planning their own web course. For these larger groups we conducted a one-hour participatory workshop in which the basics were introduced, as in Case 3. The difference was that in this training mode the participants receive four phased assignments, based on the design phases of the used design methodology. There was one assignment for each of the first four phases. In this way, all the participants were able to start their own design process during the actual workshop, and then continue it later on.

During the workshop, participants were able ask questions about issues they had not understood; later, they were able to ask for more instructions or guidance via email. So far, this training mode has been implemented only once, but the feedback from participants has been very positive. The findings are based on instructor's field notes and participants' comments during the workshop.

7.14.1 Assessment of Training Mode in Case 7

Field data related to the training mode included only a few mentions of highlights and improvements.

Highlights. According to the participants, the presentation was well-defined and clearly outlined. It guided the design process well. On the basis of the presentation the participants felt they would be able to design a web course of their own.

Improvements. On the first occasion, the workshop was actually run in 45 minutes, which was obviously too little time for it. Fifteen more minutes taken from the following break was enough to cover the lack of time. In the future, the workshop should run for 60 minutes.

We received only a few feedback comments from the participants, therefore it would be useful to make available some kind of feedback form or questionnaire in order to get more feedback from the audience.

7.15 Summary of Results from Case 7

For those practitioners who were already planning their first own web course, but were unable to participate in the learning-by-design workshop (Case 4) or learning network workshop (Case 6), and for whom introductory workshop (Case 3) was not enough, we implemented a new one-hour participatory workshop. Through this workshop, participants were able to start their planning during the training and continue it later in more detail. During the face-to-face session the participants received also guidelines for later development. So far, this workshop has been held only once, but we obtained very encouraging results.

8 DISCUSSION AND CONCLUSIONS

On the basis of the action research findings (Chapter 7) and previous studies (Chapter 2), teachers need more guidance and unified ways to proceed in the web course design process. Online education utilizes new kinds of tools and techniques that require novel competences from teachers. The implementation of ICT presumes that teachers are confident enough of their technical skills in order to use the new methods in teaching and to guide their students. The use of ICT provides a lot of new possibilities nowadays, but far too many online courses are still based on students reading and writing answers to assignments by themselves.

However, technology itself doesn't automatically bring high quality education or provide learning. The design of online learning processes, creation of learning assignments, guidance of the learning process online, promotion of asynchronous reflection and synchronous discussion, and the variety of media that support diverse learning styles have important implications for students' learning outcomes. Teachers have to design students' learning processes in detail in advance, because learning online is usually self-oriented, the teacher is not physically present, and guidance of the learning process is not so situation-related as in face-to-face learning. Most of all, it is essential to design how the learning process is phased, what kinds of interaction are supported, and what kinds of learning assignments are required during the online course. Face-to-face periods, if there are any, have to be closely integrated with online periods to generate a complete learning process.

Online education adds to the teacher's workload and intensivity, fetters teachers right next to computer, requires a lot of writing, and takes more time than classroom teaching and guiding. This has an effect on the characteristics of teaching and learning duties, and on the design and realization as well as implementation of the whole teaching-studying-learning process and scheduling. However, this has not been taken into account so far when setting teacher workload.

To achieve its goals, online education requires commitment, high motivation, and shared effort in the learning process from both teachers and students.

Teachers experience their work as hard, because of continuously expanding requirements at a time when there is no concomitant increase in resources. This leads them to a constant feeling of being too busy and to motivation problems. In this light, it seems that the biggest threat to realizing online education is the interrelationship between lack of teachers' time or other resources, and the requirements set by online education. Moreover, stress related to teacher's work and other health problems have increased during the past few years.

University teachers are extremely busy with other duties and they are struggling to find enough time for proper web course design. Therefore, in this educational research project our goal was to find ways to guide and help them in their efforts at web course design. By participating in the training sessions university teachers were able to design their web courses in a structured way and avoid most of the pitfalls. The problem remains that most teachers end up designing their own web courses alone. We are not sure if this is for cultural reasons, out of organizational necessity, or an individual choice.

In this study we sought to solve at least some of these problems. We used a topic-case driven web course design methodology (Chapter 3) as a base for six training modes which were tested with university teachers and graduate students in computer science teacher education. This educational study was set-up as a multi-case study in an action research framework (see Chapter 4). All the case studies were planned to load participants as little as possible. Moreover, none of the case studies were developed solely for the present research purposes, i.e., all the data was secondary data from the research perspective (see Chapters 5 and 6). The use of a multi-case study also allows use of triangulation to confirm the research results. In this study we used multiple triangulation, that is, three types of data triangulation – groups, time, and settings – and also methodological triangulation in the form of multiple data collection method, and both qualitative and quantitative research methods.

8.1 Summary of Results

The results from this research can be summarized as follows: there is an obvious need for communication and collaboration during the design process and for the multiple training modes.

8.1.1 Need for Communication and Collaboration

In the first case study the process model used and the phased learning assignments, which were based on the model, worked well. All the participants stated that they learned a lot during the course and were satisfied with the execution of the course; in particular, the order of the course contents (i.e. the phasing of topic-case driven methodology) was praised. Most participants stated that learning assignments based on the design model supported their learning well.

It divided the design process into smaller components which were easier to piece together. The participation was considered as overall positive experience.

The amount of documentation should be lessened. Some of the participants in the first case study complained about the amount of documentation and the level of exactitude required. However, most of them stated later on that they had come to understand why they had to do all that work earlier and how it supported their design process during the following phases.

During the first case study, several participants suggest that there could have been more peer-to-peer discussions between participants during the design process, instead of everyone just working alone. Discussions would have helped them to obtain more feedback on designs and might have brought new ideas. In this case the teacher was the only person who commented on their work during the design process; others gave feedback only at the end when the web course was already finished. Sometimes teacher was also overloaded and it took more time than expected (i.e. days) to give proper feedback to all participants.

Inspired by the findings from the first case study, we executed the second case study where we tested different kind of pedagogical scripts to activate and instruct discussions. Most of the pedagogical scripts were originally implemented for face-to-face discussions, and so we had to modify some of them before online utilization. For example, we had to invent new ways to avoid typical black spots in online discussions (e.g., too many or too few participants, no-one wants to start, or time frame ends too soon), how to organize turn-taking from one "speaker" to another, and how to shorten length of written messages. After some rehearsal, the discussions started to work out well.

From the second case study, we realized that it is beneficial to use different discussion modes and techniques in rotation, e.g., asynchronous and synchronous online discussions. A discussion group could start with asynchronous two-hour chat discussions where participants are required to be active, and after two or three discussions shift to synchronous weekly forum discussions. Activity usually stays at a high level during the next two or three synchronous discussions. If participants start to lose their impetus and become inactive in the synchronous discussions then a return to asynchronous discussions should reactivate them once. The use of different discussion techniques helps participants to be active, and it also brings variation into the discussions.

Inspired by the first case study, participants were encouraged to engage extensively in discussion during the fourth case study. Unfortunately, the participants were too busy to take part in online discussions situated between the face-to-face training sessions. However, the scheduled workshop helped the participants to find enough time to complete their plans for their own web course. Most of the participants stated that they would have not been able to finish their designs in time without the workshop schedule.

In the fourth case study we reduced the amount of documentation required into suitable level, because the participants in the third case study were busy university teachers and the amount of documentation had already been

questioned during the first case study. The designs were documented in written form so that it would be possible to hire someone else to realize them. Moreover, based on the documentation the participants would be able to show others how their web course has been designed and explain the choices they made during the design process.

The topic-case driven methodology supported the university teachers as well as the computer science students. According to the participants in the fourth case study, the learning-by-doing workshop provided a phased process model or "checklist" (as someone described it) to guide what to do and when. The phased process model also divided a large project into smaller components that were easier to handle.

In the sixth case study we combined all findings from the previous case studies: the participants worked in groups, they were instructed to engage extensively in discussion by using a role-based pedagogical script, the amount of documentation was reduced, and the design process was strictly scheduled beforehand. As a result, the participants were satisfied with the proposed way of designing web courses, and working in groups was considered very positively.

In the last, seventh case study we combined ideas from the one-hour introductory workshop (Case 3) and three-hour learning-by-doing workshop (Case 4). This one-hour participatory workshop will work with participants who are already planning their own web course, but are unable to participate in longer training. The basics of the design process are better learned when the participants work on their own designs.

On the basis of these case study experiences, teachers do not need to work alone when designing their own web courses, even if there is only one teacher of particular subject on the web course. Group work training can also support individual design work.

8.1.2 Need of Multiple Training Modes

A web course design process can be supported with different kinds of training sessions, as presented in this dissertation. With a phased design model, web course design and implementation can be divided into smaller components, which also make quality assurance easier.

In training either large groups or single teachers, we can use different training mode settings as follows:

- Short-term introductory workshops for those who are just looking for some ideas, but not yet planning their own web course;
- Short-term participatory workshops for those who already are planning their own web course, but don't have time to participate in longer training sessions;
- Middle-term learning network workshops for large groups or learning-by-doing workshops for smaller groups where the participants are already planning their web courses;

- Long-term training courses for those who want to do all the design and implementation by themselves while getting as much guidance and support as needed; and
- Long-term self-oriented online courses for those who want to schedule their learning by themselves.

In view of this, we have created an adaptable series of training workshops, based on the used design methodology. By focusing on the various characteristics that advance the individual teacher's online education capabilities, we have been able to create a continuum of training modes. The choice of training mode for use in a given situation will depend on the participants and their particular needs. We have had encouraging results from all six training modes, both when applied individually and when delivered in combination.

8.2 Contributions to Knowledge of Theoretical Background

The results of the study make a contribution to knowledge of the theoretical background, which was reviewed in Chapters 2 to 4. These issues are discussed in the following sections.

8.2.1 Reflections on Learning

As stated in Section 2.1, differences in learning online compared to learning in the classroom appear in the requirements that are set for the learner. Based on the results of this study, course participants should interact more with their fellow learners, ask for help and guidance when needed, exploit others' knowledge during the design process, reflect on what has been learned, and give feedback to both teachers and other participants.

Moreover, participants do not need (or may not even want) to work alone when designing their own web courses. Group work training can support individual designing as well. Enhancing collaboration and communication could also better support the learning process.

8.2.2 Reflections on Teaching

As stated in Section 2.2, there is a need for different methods of interaction to be employed in online learning. The results of this study indicate that, the use different pedagogical scripts, such as role play, has benefits in motivating participants to interact and in guiding interaction. However as the result of the second case study showed, we should also pay more attention to the background and experience of participants so as to match different scripts to the needs of participants. Novices are not able use some scripts (such as role play) as easily as

practitioners. With novice participants we would use a more reflective approach, as described in Section 7.6.3.

Moreover, as stated in Section 2.4, the role of the teacher is changing: the teacher's role is no longer (simply) to deliver information; instead, the teacher is becoming more of a facilitator than a traditional lecturer. The present results, underline the need for the teacher to act as a motivator, a networker, an organizer, a signaller, and an instructor. As teachers, we also have to activate participants, use examples effectively, solve problems collaboratively, use feedback effectively, and include motivational components (see Section 2.4).

The biggest problem in each of the case studies seemed to be lack of time: the participants were too busy to take part in the online discussions slotted in between the face-to-face training sessions, and to execute their design process properly. However, the scheduled workshop helped the participants to find enough time to complete their plans for their own web course. Most of the participants stated that they would not have been able to finish their designs in time without the workshop schedule. In the fourth case study we even reduced the amount of required documentation, because the participants were busy university teachers and the amount of documentation had been questioned earlier.

8.2.3 Reflections on Assessment

As stated in Section 2.5, assessment is often divided into three types: 1) diagnostic assessment, 2) formative assessment, and 3) summative assessment. During the second case study, it was clear that diagnostic assessment of the participants' qualifications is needed for planning pedagogical solutions (e.g., mode of discussion) of the web course or training session.

During Cycle 2 in the first case study, the amount of written documentation, including learning diaries, was lessened. This led us into a situation of having very little evaluation data (i.e., self-evaluations and peer-evaluations) with which to assess the learning process of the participants. However, the assessment of the learning outcomes was still possible on the basis of the participants' design documentation and completed web courses. The same occurred in the other case studies, although the learning process and learning outcomes of the university teachers were not assessed in the same way; the importance of the training as well as competences achieved during the training period had to be evaluated on the basis of the feedback and other comments received from the participants.

In this study we did not assess the actual learning process or learning outcomes; instead, we evaluated the learning process from the perspective of the web course design process: what has been experiences as important or meaningful during the design process, and what the participants themselves consider they have been learned.

8.2.4 Contribution to the Topic-Case Driven Web Course Design Methodology

The topic-case driven web course design methodology was introduced in Chapter 3 and employed in the different case studies reported in Chapters 5 to 7. Based on the results of this study, the method itself was considered very positively. It offered a "checklist" to follow during the design process. Moreover, the phasing of the learning assignments based on the model worked well. It divided the design process into smaller components which were easier to piece together.

All the participants stated that they learned a lot during the design process and were satisfied with the execution of the training; in particular, the order of the training contents (i.e. the phasing of the topic-case driven methodology) was praised. However, the incremental and iterative nature of the design methodology was in most cases ignored, and we propose an improvement on this in Section 8.3.2.

8.2.5 Assessment of the Action Research framework

This study was executed within an action research framework, as described in Chapter 4 and Section 5.1. The action research cycles in each case study provided valuable data that helped us to develop both the design methodology employed and different training modes tested during the case studies. The case studies also helped the participants to improve their web course design practices.

The design methodology was improved already between the action research cycles and the results were reported after each cycle (see Chapter 7). Different training modes were also improved between the action research cycles, and also between the different training modes, as reported in Chapter 7.

8.3 Implications of Results for Practice

This research has several implications for practice and offers ideas for future research. We obtained new ideas for further development of training modes, and requirement for emphasising the incremental and iterative nature of the design process along with new visualisation of the design process. In this section we take a closer look at these areas of interest.

8.3.1 Concrete Ideas for Further Development of Training Modes

As a result of different case studies we gained new ideas for developing different training modes. During the four-month training course (in Case 1) the participants wished for more discussions opportunities with other participants and, thus, peer-support. This would not be possible with such a heterogeneous

group of participants without using a videoconferencing system. Therefore, we have already started to test Adobe Connect Pro for recording lectures, enabling distance students to participate better also during the online lectures, and to guide distance students better, also during the online lectures, and to guide distance students better overall through videoconferencing and shared desktop views.

Participants in the four-month training course frequently complained about the workload and having to fill in boring learning diaries, and inactivity in online discussions. As a solution to this, we have been planning to combine learning diaries and online discussions as reflections. In reflections, participants would first write their own reflections related to a scheduled course topic, such as content design, and then comment on at least one or two other participant's reflections. Commenting in this way would (hopefully) lead them to discuss each other's problems, difficulties, and experiences.

To activate online discussion we should also adapt different pedagogical scripts to structure and guide online (and face-to-face) discussions, as shown in Case 2. However, we should also pay more attention to the background and experiences of participants to reconcile different scripts with participants, as emerged in Cycle 3. Novices are not able use different script (like role play) as easily as practitioners. With novice participants we would use a more reflective approach, as described above.

The one-hour introductory workshop (in Case 3) is an excellent way to introduce web course design methodology for those who are willing to know the basics, but who are not yet ready to start a planning process. For those who have already started planning, we recommend an other workshop, such as the participatory workshop (in Case 7) or learning-by-doing workshop (in Case 4). Both of these other workshops can also be tailored for special target groups.

In the future, however, we would like to see teachers working together more to avoid exhaustion under their already heavy workload. The individual design process could be supported with roles and online (or face-to-face) discussions, as in the Case 6. That is, we could use pedagogical scripts to guide teachers in their individual work and to get them to support each other's design process. We would use the same role setting as in the Learning network workshop, or launch on new concept of a Counselling workshop, as mentioned in Section 7.13. Working in this way would also forces participants to think of the design process from different perspectives.

There are a lot of new ideas to test and a lot of field data that were not even used in this research. Therefore, we shall continue on the blended development of the design process and tailored collaborative learning and production approaches.

8.3.2 Incremental and Iterative Nature of the Design Process

The incremental and iterative nature of the design process seemed to be unclear. Especially, the participants in Case 1 complained that the visualisation of the web course design methodology used was somewhat confusing; it was pre-

sented as a waterfall model (see Figure 3), but it was used iteratively and incrementally.

New visualisation of the topic-case driven web course design methodology is presented in Figure 20. It is a spiral model following the basic spiral models from the software development (e.g., Boehm 1988). In this new visualisation all the phases are presented similarly, as in former visualisation (see Figure 3), but now the iterativeness is emphasised with spiral form, and incrementality with an upwards enlarging hyperboloid form.

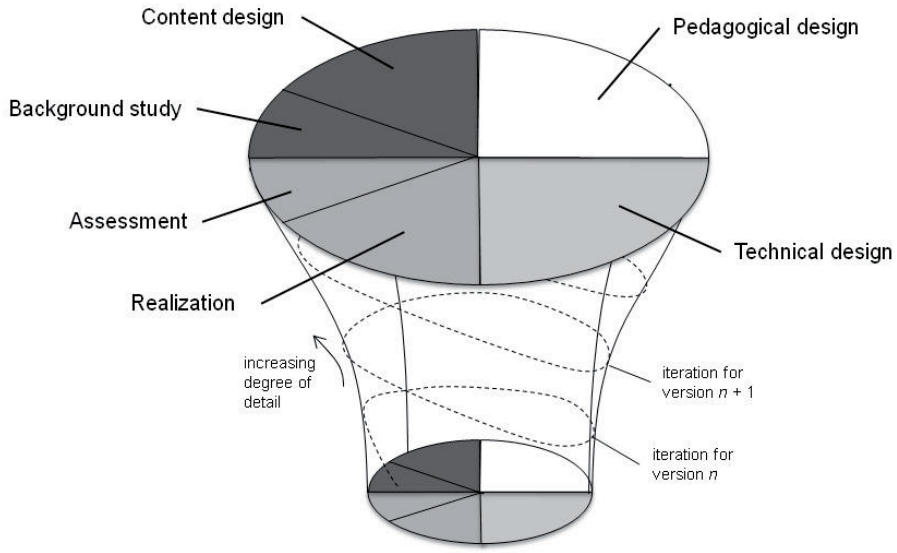

FIGURE 20 Topic-case driven framework for web course design

In the future we will emphasise these characteristics of the design methodology by realising at least two iterations of the design process during a single workshop (or training course). This is possible and is required at least in Case 1 with four-month training course, where the training course last four months

During the first iteration we will design only a part of the web course, which will then later be completed with the remaining content, a new pedagogical idea, or a new technical solution. During the second iteration different phases of the design model can also be overlapped more than during the first iteration when the participants are only learning to implement different phases of the design process.

8.4 Evaluation of the Study

In action research credibility, transferability, dependability, and confirmability are the most important qualities as described in Section 4.11. Typically, in action

research we are not seeking to define the ultimate truths of learning theories or completely generalize issues that occur in the learning situation. The main goal is to understand what is happening and to define what might improve things in that specific context (Sagor 1993). However, in this case, the quality of the research and findings can also be evaluated from two other perspectives: quality of used design methodology, and quality of training modes.

8.4.1 Assessment of Action Research Quality

Credibility refers to the degree to which a presented solution accurately solves a given problem (see Section 4.11.1). In this particular study we hoped to ensure, by using a multi-case study approach that the web course design methodology employed would help our participants to design their web courses and that the training would be meaningful.

Transferability refers to the degree to which the results can be generalized or transferred to another context (see Section 4.11.2). Transferability can be established by using thick descriptions as these provide the widest possible range of information, there by allowing others to understand the intricacies of the current situation. In this study data were collected from multiple sources (data triangulation) and the results from each research cycle had implications for the succeeding research settings. The actions taken in the case studies are described in Chapter 6, the field data in Chapter 7 and in Appendixes 1-14, and the analysis of the field data is described in Chapter 7. These actions demonstrate transferability in this research process. Moreover, in this research the design methodology employed were already used with different groups of participants in different case studies. Therefore, it has already been successfully transferred to other contexts.

Dependability emphasizes the need for the researcher to account for the ever-changing context in which the research occurs (see Section 4.11.3). In this research topic-case driven web course design methodology was used by different groups of participants, in different times, and in different cases. By describing the changes that occur in the setting and how these changes affect the research approach (Chapter 6) and by using this overlapping triangulation, dependability can be demonstrated in this research.

Confirmability refers to the degree to which the results could be confirmed or corroborated by others (see Section 4.11.4). In this research, results from one research cycle have been used as a base for the next cycle or case study. Thereby, results have been already confirmed by other participants; the inclusion of different data sources (triangulation), as described in Chapter 6, has increased confirmability.

In the light of these statements, the present research is credible and dependable, and results of the study are transferable and confirmable.

8.4.2 Assessment of Used Web Course Design Methodology

ISO/IEC 19796-1:2005 (see Section 3.6) gives us guidelines for the excellent design process: what phases or categories a design process should include and what kind of sub-processes should be involved. The topic-case driven web course design methodology employed in this study executes these recommendations well:

- *Needs analysis:* requirements, demands, and constraints of the planned online course are identified and described during the background analysis phase
- *Framework analysis:* the framework and the context of the planned online course are identified during the background analysis and content analysis phases
- *Conception/design:* the conception and the design of an educational process are defined during the content, pedagogical, and technical design phases
- *Development/production:* realization of the concepts is planned during the technical design phase
- *Implementation:* description of the implementation of technological components is planned during the technical design phase
- *Learning process:* realization and use of the learning process are planned during the pedagogical design phase
- *Evaluation/optimization:* evaluation is executed during the realization and assessment phase

Based on this assessment and the results of present research, the topic-case driven web course design methodology is, according to ISO/IEC 19796-1:2005, an excellent design process that meets the requirements of the customers (mainly university teachers).

8.4.3 Assessment of Uses Training Modes

Presented training modes can be assessed based on nine criteria for good practice in online learning (see Section 5.10). Based on these nine criteria used training modes should be practice-based, contextualized, and well documented continuing improvement process that identifies problems, needs, and requirements, demonstrate improvement and effectiveness, make consensus, support innovation, and produces reusable learning objects for the future use.

Used training modes were planned based on the needs of the university teachers and tailored based on the needs of specific group of the participants as described in Chapters 5 and 6. Problems, needs, requirements, and highlights are documented in this study, and training modes have been emphasised based on these findings. Participants have stated that there is a need for this kind of trainings (see Section 8.1.2) which support their own creativity. During the

training the participants were mostly planning their own online courses that allow them to use those designs also in the future.

Based on this assessment, training modes used complete each of the nine criteria for good practice in online learning. Therefore used training modes can be considered as good practices.

8.5 Conclusions

This research focused on web course design and training university teachers (and students) to design their own web courses. The aim was to help busy university teachers to learn an easy and supportive way to design online courses. The objective was to enhance the proposed topic-case driven web course design methodology and training modes using action research.

The action research findings indicated that the topic-case driven web course design methodology works well in different design and training situation for heterogeneous groups. The confusions concerning the incremental and iterative nature of the process model can be clarified as presented in Section 8.3.2.

A web course design process can be supported with different kinds of training sessions, as shown in this study. The web course design process can be supported and guided by adapting different kinds of pedagogical scripts. For example, traditional face-to-face scripts can be adapted for use in an online environment, providing the background and previous experience of the participants are considered; existing practitioners, compared to novices, are able to adopt, e.g., different roles in role play.

In training either large groups or single teachers different training modes can be used in different settings. Short-term introductory workshops are appropriate for those who are simply looking for ideas, but not yet planning their own web course. These can be used with both novices and practitioners. Short-term participatory workshops are appropriate for those who are already planning their own web course, but don't have time to participate in longer training sessions. Workshops of this kind work better with practitioners who already know the basics of teaching and learning, and have years of experience of teaching.

Middle-term learning network workshops are appropriate for large groups, and learning-by-doing workshops for smaller groups. Both of these modes work well with both novices and practitioners who are already planning their own web courses, and both are excellent for those with busy schedules. Long-term training courses are appropriate for those who want to do all designing and implementation by themselves while receiving as much guidance and support as they feel they need; and long-term self-oriented online courses for those who want to schedule their learning by themselves.

In this study we tested six different training modes for web course design with positive results. The teacher or instructor in each of these training modes

was very familiar with the design methodology employed, which might have had a slightly positive effect on the results. However, we intend to continue with the blended development of the design process, and with the tailoring of collaborative learning and production approaches. Some problems have already been resolved in this research process, but some organizational and individual problems remain: how can more time be found for university teachers to design their web courses? How can organizations be induced to support teachers more so that they would not have to do web course design in their own free time?

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YHTEENVETO (FINNISH SUMMARY)

Tässä väitöskirjatutkimuksessa, jonka otsikko on ”Verkko-opetuksen suunnittelun kehittäminen toimintatutkimuksen keinoin”, tarkastellaan toimintatutkimuksen viitekehyksessä verkko-opetuksen suunnittelumallin kehittämistä erilaisten koulutusmuotojen kautta. Verkko-opetuksen suunnittelu ja toteutus ovat viime vuosina olleet keskiössä etä- ja monimuoto-opetuksen levitessä eri kouluasteille. Verkko-opetuksen suunnittelun tueksi on vuosien saatossa kehitetty monia suunnittelumalleja, joilla on pyritty tukemaan opetuksen siirtämistä verkkoympäristöihin. Malleissa on suuriakin eroja: osa unohtaa pedagogisen suunnittelun kokonaan, osa pakottaa koko opintojakson ajan noudattamaan tiettyä pedagogista lähestymistapaa, ja osa vaatii suunnitteluun ison työryhmän. Mikään aiemmin kehitetyistä ja löydetyistä malleista ei kunnolla tue yksittäisen opettajan urakkaa verkko-opetuksen aloittamisessa. Eri mallien käyttöä rajoittavaksi tekijäksi onkin muodostumassa opettajien resurssien sekä tietojen ja taitojen puute. Tutkimuksessa käytetty aihetapauslähtöinen verkko-opetuksen suunnittelumalli kehitettiin vastaamaan tähän ongelmaan.

Väitöskirjatutkimuksen keskeisimpinä tavoitteina oli aihetapauslähtöisen verkko-opetuksen suunnittelumallin jatkokehitys sekä erilaisten koulutusmuotojen kehittäminen suunnittelumallin käyttöönoton ja käytön tueksi toimintatutkimuksen avulla. Tutkimuksessa sovellettiin myös tapaustutkimusta kuuden erilaisen koulutusmuodon (casen) kehittämiseen. Erilaisia koulutusmuotoja ovat 1) pitkäkestoinen kurssimuotoinen koulutus, 2) lyhytkestoinen esittely, 3) tekemällä oppiminen, 4) itseopiskelu, 5) verkostoitunut oppiminen, sekä 6) lyhytkestoinen osallistava koulutus. Lisäksi tutkimuksessa selvitettiin erilaisten pedagogisten mallien (skriptien) soveltamismahdollisuutta verkko-opetuksen suunnittelun ja toteutuksen tukemisessa.

Kaikista koulutusmuodoista saatiin positiivisia kokemuksia ja hyviä ideoita käytetyn suunnittelumallin sekä koulutusmuotojen kehittämiseen. Verkko-opetuksen suunnittelua voidaan tukea erilaisilla koulutusmuodoilla. Lisäksi suunnittelua voidaan tukea erilaisilla keskustelua aktivoivilla pedagogisilla malleilla (skripteillä). Pedagogisten mallien valitsemisessa tulee huomioida osallistujien aiempi kokemus opetuksen suunnittelusta, sillä aloittelijoille kaikki mallit eivät sovellu yhtä hyvin kuin kokeneemmille opettajille. Esimerkiksi roolikeskusteluissa roolin omaksuminen on selkeästi vaikeampaa vähemmän aiempaa opetus- ja opetuksen suunnittelukokemusta omaaville.

Eri koulutusmuodoista lyhytkestoiset esittelyluennot soveltuvat hyvin kaikille oman verkkokurssin suunnittelusta haaveileville. Lyhyt esittelyluento antaa lisätietoa verkko-opetuksen suunnittelusta, mutta ei vielä tue riittävästi itse suunnittelua. Osallistava luento antaa riittävät perustiedot niille, jotka jo suunnittelevat omaa verkko-opetusta ja omaavat aiempaa opetuskokemusta. Molemmat esitellyistä luentomuodoista voidaan toteuttaa sekä pienille että suurille opetusryhmille.

Pidempikestoisia verkostotyöpajoja voidaan soveltaa suurillekin opetusryhmille, kun taas tekemällä oppimiseen pohjautuvat työpajat soveltuvat parhaiten pienille opetusryhmille. Molempia työpajoja voidaan räätälöidä kohderyhmän mukaan jo verkko-opetuksen suunnittelua toteuttaville opettajille. Pitkäkestoiset luento- ja itseopiskelukoulutukset soveltuvat sekä aloittelijoille että pidemmän opetuskokemuksen omaaville. Molemmissa oman verkko-opetuksen suunnittelu aloitetaan nollasta, jolloin aiemman kokemuksen puute ei ole ongelma.

Tutkimuksessa testatut kuusi koulutusmuotoa toimivat hyvin. Esitellyn suunnittelumallin ja sitä soveltavien koulutusmuotojen kehittelyä jatketaan edelleen, vaikka osa verkko-opetuksen ongelmista voidaankin jo tämän tutkimuksen perusteella ratkaista. Ratkaisua vaille jää vielä myös se, miten opettajille saadaan lisää resursseja verkko-opetuksen suunnitteluun, ja miten oppilaitokset saadaan tukemaan paremmin tuota suunnittelutyötä.

APPENDIX 1: DATA OF THE CASE STUDY 1

DIARIES	Learning diaries	Cycle 1 [N=19; 66 pages] Cycle 2 [N=15; 96 pages] Cycle 4 [N=13; 79 pages]
DOCUMENTARY EVIDENCE	Learning assignments	Cycle 1 [N=6] Cycle 2 [N=9] Cycle 3 [N=9] Cycle 4 [N=10]
	Teacher's feedback	Cycle 3 [N=13; 21 pages]
	Self evaluation	Cycle 1 [N=6; 26 pages] Cycle 2 [N=9; 21 pages] Cycle 4 [N=11; 28 pages]
FIELD NOTES	Teacher's field notes	Cycle 1 [6 pages] Cycle 2 [9 pages] Cycle 3 [9 pages] Cycle 4 [10 pages]
INTERVIEWS AND QUESTIONNAIRES	Feedback questionnaire	Cycle 1 [N=18] Cycle 2 [N=7]

APPENDIX 2: DATA OF THE CASE STUDY 2

DOCUMENTARY EVIDENCE	Learning assignments	Cycle 1 [N=7] Cycle 2 [N=7] Cycle 3 [N=10]
	Online discussion logs	Cycle 1 [N=17; 105 pages] Cycle 2 [N=35; 21 pages] Cycle 3 [N=13; 79 pages]
	Research documents	Cycle 1: Abstract and presentation in VYOPP '06
	Self-evaluations	Cycle 3 [N=11; 39 pages]
FIELD NOTES	Teacher's field notes	Cycle 1 [8 pages] Cycle 2 [2 pages] Cycle 3 [2 pages]
VIDEO RECORDINGS	Recorded discussions	Cycle 1: Four recorded face-to-face discussion sessions, á 90 minutes

APPENDIX 3: DATA OF THE CASE STUDY 3

DOCUMENTARY EVIDENCE	Emails	1 message
FIELD NOTES	Teacher's field notes	4 pages

APPENDIX 4: DATA OF THE CASE STUDY 4

DOCUMENTARY EVIDENCE	Learning assignments	Cycle 1 [N=5] Cycle 2 [N=5; tailored] Cycle 3 [N=5] Cycle 4 [N=5] Cycle 5 [N=5; tailored]
	Emails	20 messages
FIELD NOTES	Teacher's field notes	8 pages
INTERVIEWS AND QUESTIONNAIRES	Preliminary questionnaire	Cycle 3 [N=7]
	Feedback questionnaire	Cycle 1 [N=1] Cycle 3 [N=2] Cycle 4 [N=2]

APPENDIX 5: DATA OF THE CASE STUDY 5

DOCUMENTARY EVIDENCE	Learning assignments	N=9
	Self evaluation	[N=2; 3 pages]
INTERVIEWS AND QUESTIONNAIRES	Feedback questionnaire	[N=1]

APPENDIX 6: DATA OF THE CASE STUDY 6

DOCUMENTARY EVIDENCE	Learning assignments	148
	Online discussion logs	20
FIELD NOTES	Teacher's field notes	4 pages

APPENDIX 7: DATA OF THE CASE STUDY 7

DOCUMENTARY EVIDENCE	Emails	1 message
FIELD NOTES	Teacher's field notes	2 pages
VIDEO RECORDINGS	Recorded session	Recorded presentation, 45 minutes

APPENDIX 8: DATA FROM LEARNING DIARIES AND SELF-EVALUATIONS IN CYCLE 1 OF CASE STUDY 1 (N=21)

Group work
- Working as a pair does not work as well as expected (5)
- It is hard to find shared time to do course assignments as a pair (2)
- Working as a pair needs a lot of communication (2)
- Expertise of each pair can be shared (2)
- Working in pairs supports collaborative learning (3)
- Working in pairs requires shared opinions (4)
- Working in pairs enabled getting feedback and peer support from one's partner (4)

Timing of the course
- It is good to start planning course assignments already at the beginning of the course (3)
- Required more work than first expected (5)
- Difficulty finding enough time to do designs properly (9)
- Difficulty finding enough time to follow lectures (5)
- Takes too long to take the course (3)
- It was hard to estimate how much time all the planning and implementing would take (4)
- More time needed for content design (1)
- More time needed for testing (1)

Usefulness of the documentation
- After doing the planning and the documentation properly during the earlier stages, the implementation of the design was quite easy (20)
- Learning assignments were useful(3)
- Double work with documentation and the actual implementation (1)
- Development of the course structure based on a concept map (2)
- It was surprising how extensively things had to be designed (3)
- Most of the content elements were actually ready when the documentation was finished (2)

Usefulness of the course itself
- The course was very useful and rewarding (8)
- Learned a lot about designing (1)
- One of the best university courses ever (3)
- Well structured as a course (6)
- Difficulties in seeing the "big picture" at the beginning of the course (4)

Development of guidance
- Overall development of guidance (1)
- Useful guidelines given in the lectures (1)
- More personal feedback from the instructor, e.g. by email or f2f (6)
- More instant feedback (4)
- More contacts and discussions with other learners (5)
- Guiding sessions were excellent support for the design process (3)
- Stricter deadlines (1)
- Distance learners got as much guidance as needed, you only had to ask (1)
- More f2f sessions with distance learners (2)
- More detailed information for distance learners after each lecture (1)
- Should have asked for more guidance when needed (2)

Usefulness of the design methodology
- The design model was logically phased (1)
- Online course is not just contents delivered in online, also need for pedagogical planning (3)
- Background analysis was very useful also later on (2)
- Phased learning assignments divided the workload evenly and guided the design process well (7)

Excellent individual activities
- Different tools and techniques, like video recording, editing, and Flash (10)
- Lectures clarified issues well and supported practical work (8)

- Examples presented by the instructor (1)
- Graphics processing (4)
- First learning assignment, idea bank or portal, helped to clarify ideas (4)
- Streamed and recorded lectures make learning more flexible (10)
- More edited video recordings, like lecture 8 (4)
- Clear instructions on how to do learning assignments (1)
- Excellent online learning materials (8)
- Peer evaluation was very useful, e.g. it showed also how own web course could be improved (4)

Not-so-excellent individual activities

- Some difficulties with recorded lectures (14)
- Some difficulties with computers and software in video editing or graphical processing (3)
- Remote participation in guiding sessions (2)
- Peer evaluation form is too long (1)
- Need for more different learning platforms (1)
- Opportunities to comment on streamed and recorded lectures lacking (1)
- More concrete examples lacking, especially in relation to pedagogical design (4)

What has been learned?

- How to design web courses by doing (10)
- Learned to see things as a whole (5)
- Learning goals that were set at the beginning, things that learners were seeking for were attained (3)
- Broadened knowledge and skills in both educational and technical issues (7)
- Helped to clarify previous knowledge (4)
- Importance of good planning (9)
- More confidence to design web courses (2)
- How to design learning assignments (1)
- Learned to use different tools (6)
- Reusability of learning materials (2)

APPENDIX 9: DATA FROM LEARNING DIARIES AND SELF-EVALUATIONS IN CYCLE 2 OF CASE STUDY 1 (N=15)

Group work
- Working as a pair does not work as well as expected (1)
- It is hard to find shared time to do course assignments as a pair (1)
- Needs a lot of communication (1)
- Expertise of each pair can be shared (4)
- Working in pairs supports collaborative learning (1)
- Working in pairs enabled getting feedback and peer support from one's partner (6)

Timing of the course
- It is good to start planning course assignments already at the beginning of the course (1)
- Required more work than first expected (9)
- Difficulty finding enough time to do designs properly (9)
- Difficulty finding enough time to follow lectures (5)
- It was hard to estimate how much time all the planning and implementing would take (9)

Usefulness of the documentation
- After doing the planning and the documentation properly during the earlier stages, the implementation of the design was quite easy (13)
- Learning assignments were useful(2)
- Double work with documentation and the actual implementation (3)
- Development of the course structure based on a concept map (1)
- It was surprising how extensively things had to be designed (2)
- Most of the content elements were actually ready when the documentation was finished (6)

Usefulness of the course itself
- Very useful and rewarding (5)
- Learned a lot about designing (4)
- One of the best university courses ever (1)
- Well structured as a course (3)

Development of guidance
- Useful guidelines given in the lectures (1)
- More personal feedback from the instructor, e.g. by email or f2f (1)
- More instant feedback (2)
- More contacts and discussions with other learners (3)
- Stricter deadlines (1)
- Distance learners got as much guidance as needed, you only had to ask (2)
- I got as much guidance as I needed (5)
- More detailed directions for learning assignments (3)
- Skillful and exhilarating instructor (2)

Usefulness of the design methodology
- The design model was logically phased (6)
- Online course is not just contents delivered in online, need for pedagogical planning (1)
- Background analysis was very useful also later on (3)
- Phased learning assignments divided the workload evenly and guided the design process well (5)
- Some difficulties to understand the basic idea of the model (1)
- Some difficulties in executing the iterative and incremental aspects of the model (1)

Excellent individual activities
- Instructions and examples for pedagogical design (3)
- Learning path in pedagogical design (2)
- Core content analysis (2)
- Different tools and techniques, like video recording, editing, and Flash (10)
- Lectures clarified issues well and supported practical work (13)
- Discussions during the lectures and in online were very useful (9)
- Streamed and recorded lectures make learning more flexible (5)
- More edited video recordings, like lecture 6 (1)
- Clear instructions on how to do learning assignments (4)
- Excellent online learning materials (12)
- Peer evaluation was very useful, e.g. it showed also how own web course could be improved (7)
- Copyright issues (3)
- Assignment centricity (3)
- To be able to see all topics in advance (1)

Not-so-excellent individual activities
- Required too strict technical designs (3)
- Learning assignments were too large or there were too many learning assignments (2)

- Some difficulties with streamed or recorded lectures (3)
- Some difficulties with computers and software in video editing or graphical processing (4)
- Difficulties on seeing the "big picture" at the beginning of the course (1)
- Need for more learning platforms (1)
- Opportunities to comment on streamed and recorded lectures lacking (1)
- More concrete examples lacking, especially in relation to pedagogical design (9)

What has been learned?

- How to design web courses by doing (14)
- Learned to see things as a whole (1)
- Learning goals that were set at the beginning, things that learners were seeking for were attained (3)
- Broadened knowledge and skills in both educational and technical issues (4)
- Forced to revise web page design skills (5)
- Helped to clarify previous knowledge (4)
- Importance of good planning (4)
- More confidence to design web courses (3)
- Learned to use different tools (6)
- Reusability of learning materials (1)

APPENDIX 10: DATA FROM LEARNING DIARIES AND SELF-EVALUATIONS IN CYCLE 4 OF CASE STUDY 1 (N=11)

Group work
- Support collaborative learning (2)
- Working in groups enabled getting feedback and peer support from one's partner (12)
- It would be better to do this in pairs or groups (6)
- Participants in discussion groups don't participate or they come in late (14)

Timing of the course
- More work than first expected (16)
- Difficulty finding enough time to do designs properly (10)
- Difficulty finding enough time to follow lectures (4)
- Takes too long to take the course (1)
- It was hard to estimate how much time all the planning and implementing would take (5)
- More time for content creation (8)

Usefulness of the documentation
- After doing the planning and the documentation properly during the earlier stages, the implement of the design was quite easy (7)
- Designing assures that new tools and techniques are used variedly (1)
- Designing enables attention to be paid to different kind of learners (1)
- Learning assignments were useful (3)
- Double work with documentation and the actual implementation (1)
- It was surprising how extensively things had to be designed (5)

Usefulness of the course
- Very useful and rewarding (7)
- Learned a lot about designing (1)
- Well structured as a course (1)

Development of guidance
- More personal feedback from the instructor, e.g. by email or f2f (2)
- More discussions with other learners (10)
- Guiding sessions were excellent support for the design process (3)
- Stricter deadlines (2)
- I got as much guidance as I needed (6)
- More detailed instructions for learning assignments (1)
- Skillful and exhilarating instructor (1)
- More concrete learning goals lacking (1)

Usefulness of the design methodology
- Background analysis was very useful also later on (1)
- Phased learning assignments divided the workload evenly and guided the design process well (8)
- Some difficulties in understanding the basic idea of the model (2)
- Some difficulties in executing the iterative and incremental aspects of the model (5)

Excellent individual activities
- Instructions and examples for pedagogical design (2)
- Different tools and techniques, like video recording, editing, and Flash (3)
- Lectures clarified issues well and supported practical work (9)
- Discussions during the lectures and in online were very useful (12)
- Online role discussions (5)
- Examples presented by the instructor (1)
- First learning assignment, idea bank or portal, helped to clarify ideas (4)
- Use of concept mapping in content design (6)
- Streamed and recorded lectures make learning more flexible (3)
- Clear instructions on how to do learning assignments (4)
- Excellent online learning materials (4)
- Peer evaluation was very useful, e.g. it showed also how own web course could be improved (9)
- Copyright issues (9)
- Choosing media elements (1)
- Assignment centricity (3)
- Instructor's blog (1)
- Instructor seemed to always have a plan B in case of something didn't work (1)
- Change from streamed and recorded lectures to screen capture videos (1)
- Close-up seminars (1)

Not-so-excellent individual activities
- Learning assignments were too large or there were too many learning assignments (1)
- Peer evaluation form at the end was too long (3)
- Difficulties in seeing the "big picture" at the beginning of the course (2)
- More concrete examples, especially related to pedagogical design lacking (2)

- Repeated questions in learning diaries were boring; need for more leading questions (2)
- All participants didn't participate actively in online discussions (12)
- It takes longer to assimilate all that information that was the time allowed (1)
- Some course topics are unfamiliar, which makes it is hard to make any comments or suggest new ideas (3)
- Some difficulties on adopting different roles in online discussions (5)

What has been learned?

- How to design web courses by doing; learning by doing (8)
- How to write instructions into the web (2)
- Importance of good designs (7)
- Learned to see things as a whole (8)
- Broadened knowledge and skills in both educational and technical issues (3)
- Visual design and storytelling (1)
- Forced to revise web page design skills (4)
- Helped to clarify previous knowledge (1)
- More confidence to design web courses (2)
- Learned to use different tools for content creation (6)
- How to evaluate learning (2)
- We don't need to do all by ourselves (2)

APPENDIX 11: DATA FROM LEARNING ONLINE FORUM AND CHAT DISCUSSIONS IN CYCLE 1 OF CASE STUDY 2 (N=23)

Address Circle - Chat

Date: 1st of November, 2005
Duration: two hours
Number of groups: one
Participants: 7 learners and instructor
Topic: How participants' ordinary conceptions of learning differ from or are equal to common conceptions of human being and learning?
Roles: Instructor took the chair giving instructions and organizing the turn-taking.
Number of posts: 274

Comments related to pedagogical script used:
"This discussion was good. New way to learn for me :) "
"I would rather discuss face-to-face, but I just can't speak right now, because I was at the dentist's and they took a wisdom tooth out. It's always more comfortable to act face-to-face. "
"Discussion was a little bit perfunctory, but it was suitable for this kind of analysis."
"This kind of chat is ok, but the discussion here was a little stiff."
"It was my first time in chat, so I was to slow to write and made a lot of misspellings that I didn't have time to correct."
"In my opinion, a discussion circle is also usable online. Face-to-face it can be more difficult to wait your own turn."
"Chat was a new tool for me, but I think it's an excellent tool."
"I kept blushing more than in face-to-face."
"It was ok. I missed some things that I would have wanted to comment on, but I didn't want to come back to those later on. It might have been easier face-to-face."

Teacher's notes:
It was easy to follow the discussion when only one participant was "on the air" at a time. Turn-taking was easy when each speaker passed the turn on to the next by saying "next" after they had finished their turn.

Theme discussion 1 - Chat

Date: 7th and 8th of November, 2005
Duration: two hours
Number of groups: three
Topic: How will learning change when it transfers online, or will it changes at all?
Roles: In each group, one participant took the role of the chairperson.

Group 1:
Participants: six
Number of posts: 351
The group started using similar turn-taking procedure as in the discussion circle after some participants complained that it was too difficult to follow discussion when everybody "speaks" at the same time.

Group 2:
Participants: six
Number of posts: 207
At the chairperson's request, the group started to the use turn-taking procedure right from the beginning of the discussion.

Group 3:
Participants: five
Number of posts: 212
The group started to use turn-taking procedure right from the beginning of the discussion.

Comments related to pedagogical script used:
None

Teacher's notes:
Participants started to use turn-taking procedure to guide the discussion. They used the login order as in the previous address circle discussion.

Brainstorming 1 - Chat

Date: 14th of November, 2005
Duration: two hours
Number of groups: one
Participants: 5 learners and instructor
Topic: How does teaching in different kind of learning environments affect teaching acts?
Roles: Instructor took the chair giving instructions and organizing the turn-taking.
Number of posts: 235

Comments related to pedagogical script used:
None

Teacher's notes:
20 minutes for posting ideas was a little too long online. Fortunately, the participants were brave enough to say so, so we were able to proceed.

Panel discussion - Chat

Date: 22nd of November, 2005
Duration: two hours
Number of groups: one
Participants: nine and instructor
Topic: Me as a computer science teacher – what king of teacher would I be and what kind of teacher would I like to be?
Roles: Instructor took the chair giving instructions and organizing the turn-taking.
Number of posts: 350

Comments related to pedagogical script used:
"Introductions too long; I had difficulty reading, when someone posted so much to read at once."
"Too much too soon; introductions should be limited, e.g., to one sentence each."
"This doesn't work online."
"I could learn to use it."
"Introductions were too long. We missed a lot of good discussable issues because of the amount of text."
"The goal was to follow the original pedagogical script."
"It might have been better to have a brief discussion after each introduction."
"Otherwise, it was perhaps the best chat discussion so far."
"I have some difficulty seeing the script as a whole when we are discussing online."

Teacher's notes:
It would have been better to have a brief discussion related to each introduction. By waiting till all had presented their introduction, we missed some of the key issues that should have been discussed.

Theme discussion 2 – Discussion forum

Date: 24th- - 30th of November, 2005
Duration: 7 days
Number of groups: three
Topic: Which topics related to computer science should be taught at different school levels? With four school levels and six preset sub-topics to discuss.
Roles: Instructor took the chair giving preset sub-topics to discuss.

Group 1:
Participants: 7 learners and instructor
Number of posts: 71 with three sub-topics started by participants; most of the participants posted 6-14 posts, but one posted only two posts

Group 2:
Participants: 6 learners and instructor
Number of posts: 62 with five sub-topics started by participants; most of the participants posted 5-12 posts, but two of them posted only 3-4 posts.

Groups 3:
Participants: 6 learners and instructor
Number of posts: 70 with two sub-topics started by participants; most of the participants posted 6-17 posts, but one of them posted only 4 posts.

Comments related to pedagogical script used:
None

Teacher's notes:
It seems that when we set the duration or deadline for a forum discussion, all participants stop, if they still have some unfinished topic to discuss.
Learners were allowed to choose the pedagogical script by themselves, and they picked the theme discussion.

Brainstorming 2 - Chat

Date: 8th of December, 2005
Duration: two hours
Number of groups: one
Participants: 7 learners and instructor
Topic: What kind of teaching methods and pedagogical conceptions can and should be used in teaching computer science in classroom and in online?
Roles: Instructor took the chair giving preset sub-topics to discuss.
Number of posts: 346

Comments related to pedagogical script used:
"Are we supposed just to dash off some ideas related to teaching methods for other to discuss?"
"Are we able to start without the instructor?"
"Let's just start."

Teacher's notes:
The instructor was late, but participants were willing and able to start the discussion without the instructor. They didn't use any rules for shifting turns; they just posted different ideas related to the topic. All of them also posted new specific questions for others to discuss. The instructor joined in

one-hour late, but just in time to guide the discussion onto a new track.

Poster discussion – Chat

Date: 15th of December, 2005
Duration: two hours
Number of groups: one
Participants: 8 learners and instructor
Topic: How to evaluate learning in participants own topics? What kind of evaluating methods to use instead of traditional final exam?
Roles: Instructor took the chair giving instructions and organizing the turn-taking.
Number of posts: 409

Comments related to pedagogical script used:
"I could have presented my poster in a pithier way."
"One moment, I have to think."
"Shall we answer these questions in turns?"

Teacher's notes:
Participants have learned to send shorter posts; one sentence or even half of a sentence in one post. Therefore, number of posts increased during the course.
Participants had some difficulties in seeing each others' posters.
Participants started to target their questions and answers at other participants, particularly by adding their name at the beginning of the posted message.
All had some difficulty staying on schedule; too many posters to present in two hours. It was not possible to take enough comments.

APPENDIX 12: DATA FROM EMAILS AND QUESTIONNAIRES IN CYCLES 1-4 OF CASE STUDY 4 (N=27)

Cycle 1: Autumn term, 2006

Participants: eight

Comments by email:
"Thank you for the exhilarating and excellently implemented lecture. I did the requested exercises right after the first lecture. I'm really interested in teaching online. It would be nice to learn how to put material properly online, e.g., into Optima. "
"I will learn these things; this was only my first experiment."
"I would like to warn you that even if I do everything as well as I can and I really do want to proceed with the course, but I realized that I have difficulty to understand the learning materials because of the language issue; I'm not a native Finnish speaker. I have difficulty understanding this topic-case thing, and how I'm supposed to document my designs. I need more explanations and examples. I feel like I don't understand much of it!"
"I hastily returned my first assignment, but I will complete it after I'm able to get that concept mapping tool and be able to concentrate on this more."
"This course is exhilarating. I will come tomorrow, if I somehow can; I have a fever today."
"Can I skip the lecture because of fever?"
"I just started my two months study leave and therefore I have to drop out from the course."
"It has been very rewarding to take a part in these different courses. It helps to see the university as a whole."
"Thank you for a productive course. How do know when we've passed it? Do we get a certificate that can be used as a appendix to a CV?"
"The course was exactly what we needed to be able to teach online."

Questionnaire 2 at the end:
Number of respondents: 1

Cycle 2: Spring term, 2007

Participants: six

Comments by email:
"Just to inform you that I have now completed all the assignments. Thank you for a good course."
"I was so excited after this course that I just signed up for another ICT course – thanks to you!"

Questionnaire 2 at the end:
Number of respondents: 2

Cycle 3: Autumn term, 2007

Participants: eight

Comments by email:
"Thank you! Even if I was already familiar with some of the issues in the course, this was more robust and systematic way to design and implement a new online course."

Questionnaire 1 at the beginning:
Number of respondents: 7

Questionnaire 2 at the end:
Number of respondents: 2

Cycle 4: Spring term, 2008

Participants: five

Comments by email:
"I got excellent feedback from the course that I designed and implemented based on this course. All the learners participated on the discussions and the way of learning was adopted well; the learners actually took responsibility for their own learning and staying on schedule. I have never received all the learning diaries in time, like this time. The funniest thing was that the learners commented the presence of the teacher even if I had limited it to a minimum. Thanks again for excellent teaching."

Questionnaire 2 at the end:
Number of respondents: 0

APPENDIX 13: DATA FROM SELF EVALUATIONS AND FEEDBACK QUESTIONNAIRES IN THE CASE STUDY 5 (N=2)

"There is an obvious need for this kind of course."
"I have returned to the course materials often and I think I will also read them many times also after this course."
"The role of the instructor is very important in this kind of course."
"I missed some face-2-face sessions occasionally to clear practical issues, like what to do next."
"I realize that I would find all the information in the materials, but still … I have to admit that I rather do than read."
"I prefer a contact lesson now and then rather than total online learning."
"As a whole, I'm very pleased with this course."
"I didn't really understand the importance of the manuscript until later when I was already in the implementation phase and forced to return to improve my designs."
"Being a learner in this online course has definitely also improved my online teaching skills."
"I read a lot of the materials, but I forget to read the instructions."
"I was really pleased with the support that I got from the instructor, it was really motivating."
"I would have needed more of the practical guidance that is given in face-to-face lectures, like do this or that next. Of course, all these instructions were written into the learning materials, but I missed more personal contact."
"The course was meaningful, but onerous."
"I was good that the learning assignments formed the skeleton of the practical work."
"I had difficulty finding enough time to find time for designing."
"I end up doing the course on my own just because I had difficulties with scheduling."
"The most beneficial part of the course was the learning of design."
"I have done some online courses before, but this new way of doing it gave me a new perspective on design."
"There were nothing useless in this course, but there were some issues in the design process that require more thinking."
"If all online courses would be done in such a way, implementation would be too onerous; part of the implementation might be left out."
"Work of the instructor was admirable".
"Importance of manuscript should be highlighted even more."
"I asked for a lot of the instructions and I got quick answers."
"If I had just been patient enough to read all instructions …"
"I like this kind of learning."
"The online material was diverse and it didn't give you too direct answers. It gave you something to think about and hopefully I'll also be able to use it later on."
"The learning materials supported learning excellently."
"Sometimes it was difficult to find a piece of information that I had just read. Luckily navigation in the learning material was clear enough that I was always able to find what I was looking for."
"There were a lot of materials to read, maybe even too many. On the other hand, it was a good thing, because it offered good options for different kinds of implementations."
"The course was excellent."

APPENDIX 14: DATA FROM LEARNING ONLINE DISCUSSIONS AND PRACTICAL WORK IN THE CASE STUDY 6 (N=70)

Quality requirements:

- Design process itself
- Goal setting
- Content design; concepts and domain
- Group work as a source of shared knowledge; learning from others' experiences
- Effective use of resources and individual learning paths
- Pedagogically designed learning situations
- High quality learning materials
- Includes both pedagogical and technical support
- Clear process model
- Assessment of implemented online courses
- Reactions to quality assessment
- Optimization of resources in design process
- Realistic scheduling of design process
- Amount and availability of learning materials
- Pedagogical usability of learning materials
- Course assessment
- Collaboration between different participants
- Measuring of learning outcomes with learning assignments
- Pedagogically meaningful for both learners and teachers
- Appropriate sizing of the course
- Meaningful content
- Appropriate amount of content
- Quality of teaching acts, what a teacher does
- How deeply a thing has to be learned
- Use of learned knowledge and skills in new real-life context
- Quality of guiding and supervising
- Progress in studies
- Feedback from learners
- More information in smaller pieces
- Professional development of learners; competences and goals
- Reflection
- The effect of indicators on quality
- Collaboration
- Level of guidance
- Usability
- Availability
- Support
- Clear division between learning content and supplementary readings
- Clear structure of the course; simplicity of the course structure
- Clear and unequivocal written instructions
- Pre-testing of the implemented course
- Meaning of good planning
- Overall assessment based on different types of evaluations
- Permanence of the project and usability of produced learning materials can be confirmed by using common production and management approaches and by using open source learning environments
- Instructions for teachers on how to use the online learning environment
- Structures of updating training that support online education
- Multidisciplinarity
- Internationality
- Interaction between science and practice
- Diversity of education

Overall quality problems:

- Institutional strategic goals are not visible in single online courses
- Each online course looks like it's instructor
- No-one has the overall responsibility in ICT-based teaching
- Basic requirements for teachers' technical skills
- No-one collects the assessment data from online courses
- Online courses are not documented
- Need for some kind of design model to use in online course design
- Taking learner feedback into account when developing existing courses
- Most of the training is done during the teacher's free time
- Time spent on online course design has to be separately agreed with one's superior
- Time limitations for different tasks in online
- Projects related to training have to be implemented in free time
- No discussion in the workplace related to basic implementation rules or guidelines for online education
- Common quality criteria are missing
- Learner evaluation between different courses varies a lot
- Online courses should be evaluated based on commonly agreed criteria
- Common indicators and criteria for measuring the quality of online courses are missing

- We should evaluate not only implemented online courses and their quality from the learners' and institutional point of view, but also resources that are available for teachers and learners through the educational online portal
- Need for commonly shared quality criteria for online courses that are delivered through the same educational online portal
- Quality of online environment
- Technical quality, such as functionality of the environment, smoothness of functions, timing, aesthetic attractiveness
- Quality of interactivity and guidance, such as peer support through discussion forums, working in pairs, tutoring, guidance, instructions, confirmation of multidisciplinarity
- Quality of learning: contents, assignments, alternative accomplishment techniques, authenticity, motivating, consisting of entity, observation and analyzing of practice, critical points of view, blended learning
- Learning assignments should support learning
- Guiding sessions
- Structure of content
- Learning outcomes
- Participants are able to proceed according to their own schedule
- Unambiguous instructions
- User friendliness
- Need of knowing where to get help if needed
- Consulting hours
- Peer support available if needed

Quality indicators related to learning environment, technical solutions, interactivity and guidance, and content

- Design process, documentation, pedagogical solutions and learning goals
- Implementation, content and characteristics of online courses
- Support for learners, guiding, communication, peer support, motivating, and feedback procedures
- Evaluation of learning outcomes and feedback to learners
- Functionality of learning environment used, and the support it gives both learners and teachers
- Interactivity
- Communication
- Timeliness
- Learner centricity
- Knowledge centricity
- Evaluation centricity
- Communality
- Qualitative evaluation on how the online course has been designed and documented, how well expertise has been utilized, and how different user groups and backgrounds have been considered
- Quantitative analysis on utilization rates of different online courses: how many users/teachers and learners are utilizing the course, and what kind of study achievements have been reported
- Feedback from different user groups, quantitative analysis of feedback and statistics like satisfaction and loading
- Quantitative analysis of log files from the learning platform used
- Online questionnaire forms for systematic data collection
- Meaningfulness and impressiveness of the course according to participants
- Realization of the training supports learning process of participants well and easily
- Training is meaningful also for trainers
- Training goals are achieved
- Training can be realized cost-effectively
- Loading of training will decrease when it is repeated
- During the training participants would produce new content for the training itself
- Recognizability of training increases
- Training can be transferred to some other context
- Training is seen so significant that it is further developed
- Functionality of feedback system and quality assurance system
- Tutoring
- Number of situations that require interaction among learners or with the teacher
- Learner's participation in interaction
- Learning outcomes and credits
- Numbers and reasons for dropouts
- Activity and naturalness of discussions
- Number of participants
- Motivation and willingness of designers to redesign and modify the course

Instruments and tools for quality evaluation:

- Continuous feedback collection both written and oral, and also in the middle of the training
- Deferred evaluation of the impressiveness of the training to six months after the training ends

- Impressiveness of the training is also evaluated by the trainers
- Training is evaluated from different points of view, like loading, frugality, repeatability, knowhow requirements, and added value to other training programs

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