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Conceptual Change Process of Polytechnic Teachers in
Transition From Classrooms to Web-Based Courses

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ABSTRACT

The objective of this research was to increase understanding of a conceptual change process in pedagogical thinking of polytechnic teachers as they were producing and later teaching their first online courses. The research was conducted at Lahti University of Applied Sciences. At the centre of the research were the central constructivist concepts that most clearly differ from the traditional, behaviourist orientation: a teacher's role as a facilitator, student-centredness and social interaction.

The research process followed the principles of constructivism drawing from the researcher's personal experience and involvement. First a questionnaire survey was conducted on polytechnic teachers' conceptions of teaching and learning and their use of Information and Communication Technologies in instruction. A proportionate random sample was drawn from the whole population, 194 permanent teachers in the polytechnic, yielding a final sample size of 65 teachers, of whom 49 completed the questionnaire. The data thus gathered were analyzed by means of simple frequency counts on Statistica.

These results were used to inform a subsequent in-house training programme for 20 teachers in the Faculty of Technology. Thus supported, teachers produced eight manuscripts for online instruction, of which four were realized as online courses or parts of courses. A sample of five teachers was then selected for deeper analysis of their conceptual change process. They were interviewed based on the analysis of their manuscripts and online materials. Interviews were analyzed as narratives on the levels of utterance and enunciation using an Actantial model to reveal what teachers considered important in teaching and learning and what their attitudes were towards their students and the online environment used. This analysis method provided a way to make the conceptual change process visible for research and showed how entreched beliefs may affect learning of new concepts.

Results indicate that polytechnic teachers' conceptions of teaching and learning are in transition although traditional teaching approaches still mainly prevail. Manuscripts show awareness of, and familiarity with, new constructivist concepts, but teaching online seems to be content-based, and courses material-heavy. Teachers disappear from their online courses, while students work alone on online tasks. Interaction and collaboration are missing. This research indicates that teachers' insufficient knowledge of new learning theories and, as a result, a lack of thorough understanding of related concepts, leads to misconceptions and unsuccessful online

solutions. The study suggests that intentional conceptual change is required of teachers in order to transform their conceptions.

TIIVISTELMÄ

Tämän tutkimuksen tavoitteena oli lisätä ymmärrystä käsitteellisestä muutoksesta ammattikorkeakouluopettajien pedagogisessa ajattelussa, kun he tuottivat ja myöhemmin opettivat ensimmäisiä verkko-opintojaksojaan. Tutkimus tehtiin Lahden ammattikorkeakoulussa. Tutkimuksen keskiössä olivat ne keskeiset konstruktivistiset käsitteet, jotka selkeimmin eroavat perinteisestä, behavioristisesta orientaatiosta: opettajan rooli ohjaajana, opiskelijakeskeisyys ja sosiaalinen vuorovaikutus.

Tutkimusprosessi oli konstruktivismin periaatteiden mukainen ja hyödynsi tutkijan henkilökohtaista kokemusta ja asiantuntemusta. Aluksi tehtiin kyselytutkimus ammattikorkeakoulun opettajien oppimiskäsityksistä ja heidän tieto- ja viestintätekniikan opetuskäytöstään. Otantamenetelmä oli suhteellinen satunnaisotanta koko ammattikorkeakoulun vakinaisesta opettajakunnasta (N 194), josta lopulliseksi otokseksi tuli 65 opettajaa. Näistä kyselyyn vastasi 49 opettajaa. Näin kerätystä aineistosta saatiin frekvenssijakaumat Statistica-ohjelmalla.

Tuloksia käytettiin apuna suunniteltaessa myöhemmin toteutettavaa verkko-opetuskoulutusta 20:lle Tekniikan laitoksen opettajalle. Koulutuksen tukemana opettajat tuottivat kahdeksan verkko-opintojakson käsikirjoitusta, joista neljä lopulta toteutui verkossa joko kokonaisina opintojaksoina tai opintojaksojen osina. Viiden opettajan käsikirjoitukset ja verkkomateriaali analysoitiin, minkä jälkeen opettajat haastateltiin. Haastattelut perustuivat analyysin antamiin tuloksiin. Haastatteluaineistot analysoitiin kertomuksina lausuman ja enonsiaation tasoilla. Analyysissä käytettiin aktanttimallia paljastamaan, mitä nämä opettajat pitivät tärkeänä opetuksessa ja oppimisessa ja mitkä heidän asenteensa olivat opiskelijoita ja käytössä olevaa verkkoympäristöä kohtaan. Tämä analyysimenetelmä teki käsitteellisen muutosprosessin näkyväksi, jotta sitä voitiin tutkia, ja osoitti, kuinka syvään juurtuneet uskomukset voivat vaikuttaa uusien käsitteiden oppimiseen.

Tulosten mukaan ammattikorkeakouluopettajien käsitykset opetuksesta ja oppimisesta näyttäisivät olevan muuttumassa, vaikkakin perinteinen opetustapa on vielä vallitseva. Käsikirjoituksissa esiintyy uusia konstruktivistisia käsitteitä, mutta verkko-opetus on sisältöpohjaista ja materiaalipainotteista. Opettajat katoavat verkosta, ja opiskelijat jäävät yksin tekemään verkkotehtäviä. Vuorovaikutusta ei synny, ja yhteistyö puuttuu. Tutkimuksen perusteella näyttää siltä, että opettajilla ei ole riittävää teoreettista ymmärrystä uusista oppimiskäsityksistä ja niihin liittyvistä käsitteistä. Tämä johtaa vääriin käsityksiin ja epäonnistuneisiin verkko-opetusratkaisuihin.

Johtopäätöksenä esitetään, että muuttaakseen oppimiskäsityksiään opettajien tulisi pyrkiä intentionaaliseen käsitteelliseen muutokseen.

1   INTRODUCTION

This paper reports on a conceptual change process in the pedagogical thinking of teachers at Lahti University of Applied Sciences, Finland, as they were faced with a challenge of exploiting Information and Communication Technologies (ICT) in instruction.

Teachers participating in this study were all creating and piloting their first on-line courses alongside their full-time teaching hours. Previous research (Coomey & Stephenson 2001; Cuban 1986; Ilomäki & Lakkala 2006; Sinko & Lehtinen 1999) shows how teachers' first attempts in applying new technologies to teaching draw heavily from their classroom practices and tend to remain material-heavy and/or technology-led. This seems to be the case even though teachers describe their teaching approach in constructivist terms and aim at creating courses with a lot of student interaction and student-centred learning.

The study reported in this paper focused on the gap between teachers' good intentions and the actual realization of their courses in an online environment. The study was an attempt to understand and describe on a conceptual level teachers' transition from classroom teaching and traditional teaching approaches to a more constructivist orientation in their use of ICT in instruction. Results show that despite the outcomes – rather traditional online courses – changes occurred in teachers' conceptualization of teaching and learning. Unsuccessful online solutions could be better understood in light of teachers' conceptual change process affected by their entrenched beliefs about teacher- and student roles. This paper suggests that before launching into new projects with new pedagogies, teachers should seek to become more aware of their existing conceptions and possible entrenched beliefs.

1.1   Background

Polytechnics in Finland were established at the beginning of the 1990's to meet the requirements of shifting labour and societal demands. When this research was conducted there were 31 polytechnics, also known as Universities of Applied Sciences, in Finland. All Finnish polytechnics co-operate via participation in The Finnish Virtual Polytechnic Network. Polytechnics can offer their courses through the portal of

the Virtual Polytechnic. The Virtual Polytechnic also arranges teacher collaboration projects to produce web-based teaching and learning materials.

Polytechnics award degrees in a variety of disciplines ranging from arts and physical activity to social and health care, business and engineering. Education and training in polytechnics is characterized by its close relationships with the working life. Polytechnics are expected to respond to demands and development needs of business and industry and train experts for different fields of working life. Expertise here is defined as deep and broad knowledge; deep in the mastery of one's own special field, and broad in a sense that polytechnic graduates should have an understanding of the special features of different occupational fields and ability to communicate across different fields (Friman 2005, 41).

Polytechnics also have a responsibility to conduct applied research together with local industries in order to support regional development and working life in general (Ammattikorkeakoululaki 2003/351). Thus, the purpose of polytechnic education and training is not to maintain stability but to enforce development.

A big part of the information society is technological innovation. Beairsto (2000, 52) uses the Internet as an example to point out how "*each new development is obsolete virtually instantly.*" In the wide-spread use of Information and Communication Technologies we can clearly see the change in society. There is hardly an occupation today where ICT skills are not required. One of the aims in the Finnish government's Information Society Programme is to ensure that ICT is utilized in all organizations and that employees' ICT skills are at a high level regardless of their duties or line of work (Hallituksen tietoyhteiskuntaohjelma 2003). Polytechnic education and training plays an important role in ensuring that graduates have the necessary skills when they enter their working life.

There is nothing new in the fact that authorities and policy-makers are quick to embrace new technologies in education. The results, however, have not always met expectations. In 1922 Thomas Edison said:

> *I believe that the motion picture is destined to revolutionize our educational system and that in a few years it will supplant largely, if not entirely, the use of textbooks.*
> (Cuban 1986, 9)

Apart from the introduction of film into education, Cuban reports of similar experiments of the use of educational TV and radio that not only failed to revolutionize education, but resulted in a far worse learning experience for students than conventional classroom teaching at the time (Cuban 1986). Research findings from the earliest online courses are not encouraging, either. Paavola, Ilomäki and Lakkala (2004, 40) refer to Mioduser, Nachamias and Lahvin's research (2000) and aptly point out that one step forward in technology usually seems to mean two steps back in pedagogy. Often information technology is used to copying information from the Internet or to assist in teacher-specified individual tasks (Ilomäki & Lakkala 2006, 190).

At the centre of this changing educational field stands a vocational teacher whose work description, professional qualifications and skill requirements have changed accordingly. Following the requirements set for polytechnics, teachers are expected to be not merely educators, but also regional functionaries, researchers and developers (Jaatinen 2004, 70; Rauhala 2004, 63; Sonninen 2005, 47). Networking and co-operation with local industries and business life, as well as collaboration with colleagues near and far belong to a polytechnic teacher's work (see also Luukkainen 2004b, 27). Integration becomes central and takes time from teaching and tutoring (Ora-Hyytiäinen 2004, 81). Teachers already changed from implementers' of curricula to decision makers as Finnish schools were given the responsibility for designing their own curricula within certain national guidelines in 1994 (Kohonen 2000, 127).

Teachers are thus increasingly seen as part of society and working life. Auvinen (2004) divides polytechnic teachers' new challenges into three; new requirements in the content of work, new pedagogies and theories of learning, and new expectations regarding teachers' personal qualities. New skills required from teachers seem to a great extent to be the same as for other professionals in today's labour market. Professional growth and ability to co-operate and collaborate in creating new knowledge are in the centre of polytechnic teachers' new professional qualifications.

With more student-centred pedagogies, students' self-directedness and self-regulation abilities come to the forefront and teachers face a new challenge of guiding and tutoring instead of traditional frontal teaching (Mahlamäki-Kultanen et al. 2006; Rauhala 2004, 61). Auvinen (2004, 252–290) also found that writing and computer skills were gaining ground in teacher communication while the proportion of speech was diminishing.

Encouraging the use of ICT in instruction is part of the Finnish government's educational policy. Further development, research and increased use of ICT in all education have been pursued in government programmes since 1995. The objective is for 75 % of all teachers to have gained ICT skills in instruction by the year 2007 (Koulutuksen ja tutkimuksen tietoyhteiskuntaohjelma 2004–2006, 22–26). By 2003, 68 000 teachers had participated in continuous education on ICT in instruction arranged by the National Board of Education (Koulutuksen ja tutkimuksen tietostrategia 2000–2004). Thus, more and more teachers are engaged in online instruction, either because they are genuinely interested or because they feel the pressure from policy-makers or their own organizations.

Sonninen (2005) reports on a Pedagogical Development program at Laurea Polytechnic provided to support teachers in meeting the new requirements. Interim results indicate, among others, that teachers are aware of the paradigm shift in teaching and learning, but find it difficult to accept it at the personal level. They feel that their professional identity is changing, and some even worry where teachers are disappearing: "*Am I going to be a consultant?*" (ibid., 50) Syrjäläinen (Rauhala 2004, 59) shares the same concern: "*Why isn't a teacher allowed to teach anymore, why isn't a*

pupil allowed to be a pupil anymore but a client, why is a curriculum a quality assurance manual?"

Luukkainen (2004b, 15), however, draws attention to the power that teachers have through their work; methods being used become models for students of what should be learnt, and how.

> *Siksi opettajalla tulee olla kyky analysoida omia käsityksiään opettajan työstä sekä tiedostaa tekemiensä ratkaisujen perusteet. Tämä on osa opettajan ammatillista kasvua.*
>
> (Luukkainen 2004b, 15)

Therefore, he continues, teachers should be able to analyse their own conceptions of teaching and to be aware of the basis for their solutions. This is part of teachers' professional growth.

Teachers' attitudes and beliefs form the basis of their conceptions of teaching and learning and ultimately influence the way they teach:

> *Quality of learning depends heavily on such factors as the teachers' attitudes and beliefs, and their shared norms and expectations; that is, the culture of the school. It is, therefore, imperative to support changes in the teachers' beliefs, assumptions, knowledge and understanding, linking these with their pedagogical skills.*
>
> (Kohonen 2000, 131)

A conceptual change in how teachers understand teaching and learning is likely to effect changes in their teaching approach and, consequently, have a positive impact on students' studying approaches resulting in better learning (Ho et al. 2001; Trigwell et al. 1999).

Polytechnic education and training has been studied since its beginning, and often from the inside, as polytechnic teachers have taken up postgraduate studies to upgrade their degrees. The following literature review is restricted to research that pertains to this research topic, i.e. polytechnic teachers' professional growth and/or online instruction in polytechnics.

1.2   Previous research

Martti (1996) followed 16 engineering teachers who participated in vocational teacher training in 1990–1992. Martti's research focused on development of teacher trainees' meaning structures. Although Martti's work is not related to online instruction, it is relevant in its interest in conceptual change of vocational teachers.

According to Martti, teachers' meaning structures comprise personal beliefs, values and principles, which are based on 'common sense' and experience. Her findings

suggest that these prior assumptions play a central role in how teachers in training internalize the new information. Martti's findings also indicate that the prior assumptions did not essentially change during teacher training. Instead, novice teachers tended to seek confirmation of their old beliefs. This phenomenon is in this research understood to be one form of assimilation (von Glasersfeld 1995/2002, 62), which prevents a learner from taking in all the aspects of new information (see Chapter 2.4).

Conclusions that Martti (1996) draws from her study are 1) that professional growth requires intentionality. Teachers must want to change their beliefs and assumptions in order to reconstruct their existing meaning structures. 2) This presupposes a cognitive dissonance. 3) Foreign terminology and new concepts that teacher-trainees encounter during training slow the change process.

Professional growth and development of teachers' pedagogical thinking is an integral part of online instruction as well. Online instruction in polytechnics started swiftly and generated various networked projects, such as Averko, launched in 1992 to promote co-operation between polytechnics in online instruction, and Tie-tie in 1995 for teaching data processing with the help of information technology (Kiviniemi 2000). Often such projects have had support from simultaneous training for teachers and ongoing research. Aarnio and Enqvist (2004) report on their own project, DIANA (Dialogical and Authentic Netlearning Activity). The aim of Diana is mutual knowledge construction online to solve authentic work-related problems. The project included teacher training and produced a support system for teachers wishing to teach online. Aarnio and Enqvist conclude that teachers need support with their online courses. They quote a teacher, who participated in the project: "*Why is it so much easier to learn the DIANA model in theory than in practice (even though one strongly agrees with it)? Why is learning new – although fun and desirable – so difficult?*" (Aarnio & Enqvist 2004, 55).

Research has covered practically the whole field of online instruction from practical arrangements (Niinimäki 2003) to the change in teachers' work description (Storti & Tulonen 2005). Recent research that has investigated changes in polytechnic teachers' pedagogical thinking in online instruction (Leppisaari & Helenius 2005; Leppisaari & Lehto 2005) is perhaps the most relevant to present research interests. Results emphasize the teacher's new role as a facilitator of the learning process and draw attention to the effect teachers' beliefs and assumptions may have on their teaching online.

Pulli (2003) reports on a case study in which 100 polytechnic teachers and 50 vocational school teachers participated in a three-year study of online instruction. The project included producing online courses or online material supported by ongoing pedagogical training, much like my research. Pulli's data similarly consists of theme interviews of teachers who had either made a plan for online teaching or already run the online course at least once.

Pulli concludes that descriptions of online courses carried constructivist features; they emphasized construction of knowledge, reflection, individual differences, peer and self-evaluation, students' goal setting, working in groups, etc. Pulli's report does not, however, reveal which of the course descriptions at the time of the interviews were still at the stage of "good intentions" and which courses had been piloted at least once to learn how the plan was realized.

According to Pulli, teachers saw the online environment as a tool for promoting interaction and for helping students in time management. Teachers' pedagogical solutions seemed to be mainly based on intuition and their teaching and work experience, although the influence of pedagogical training during the project was also visible. However, few teachers offered theoretical explanations to their pedagogical decisions (ibid., 47). Also, teachers who did not base their pedagogical solutions on learning theories seemed to see the online environment more as a delivery vehicle than a tool for interaction. Most of the teachers in the study seem to have fallen into this category, since few were reported to have offered theoretical considerations. Nevertheless, these teachers said that their pedagogical thinking had developed as they had learnt to look at their courses more from students' point of view. They noted that students asked more via the Internet than face-to-face, and through their questions the teacher was able to monitor the learning process better than before.

Pulli did not observe differences in the online pedagogical solutions between teachers from different disciplines. However, she states that those teachers who were more accustomed to online teaching dared leave the course open enough to flexibly adjust it to students' various needs, whereas teachers new to online instruction tended to make the course more "ready", complete from the beginning (Pulli 2003, 38).

Based on her study, Pulli concludes that these online courses were closely tied to specific subjects in the curriculum and focused on mastering the contents of those subjects. Therefore, there was not much learning transfer to other contexts outside the specific subjects. Also, those who had piloted their online courses found that students were not able to set their own goals, even when given the opportunity and encouraged to do so. Pulli states that more attention should be given to development of students' metacognitive skills that would enable better learning transfer to new situations.

Other researchers conclude that online instruction challenges teachers to renew their pedagogical thinking. However, changing one's assumptions requires intentional cognitive processing (Leppisaari & Helenius 2005, 167). In addition, finding a way to combine theoretical understanding and its practical applications requires self-reflection and collegial dialogue (Leppisaari & Lehto 2005, 139).

Undoubtedly, research findings shed more light on teachers' new professional qualifications and professional development, particularly in online instruction. The need for conceptual change is generally recognized. However, previous research seems to focus on outcomes rather than conceptual change processes. Sometimes,

there does not seem to be much change in the outcomes (Martti 1996). At other times, changes have been reported in teachers' pedagogical thinking (Leppisaari & Lehto 2005; Leppisaari & Helenius 2005; Pulli 2003).

I attempt to reconcile this disparity and propose that changes are occurring on a conceptual level, which may not always have been evident in prior research findings.

1.3 Objectives, scope and approach of study

Previous research is not concerned with conceptual change processes; it has not been able to detect changes on the conceptual level, if the changes are not apparent in the outcomes. There is also a risk of naïve interpretation, where respondents' answers are taken as evidence of changes in their thinking. Self-reporting may explain intentions but it does not accurately represent actual behaviour (Leino 1999, 13).

Two examples may suffice to illustrate the point made. Leppisaari and Helenius (2005, 168) quote a respondent who describes her own change, "*From behaviourist modelling to socio-cultural learning. From a transformer of knowledge to a facilitator. From monologue to dialogue.*" The respondent may have changed. On the other hand, she may be merely parroting back the language she has learnt during training. There is no telling, whether the respondent has made the connection between the terminology and the concepts she is referring to. Looking at the outcome only, the respondent's words as such, the change is obvious. This study, however, challenges such a "surface interpretation" and tries to grasp the underlying conceptual understanding.

Another example illustrates restricted understanding of new concepts. Leppisaari and Lehto (2005, 136) quote a respondent who comments on peer evaluation in teacher training in which she participated: "*I suppose that I got some ideas from the comments I read. So, that apparently indicates some kind of interactivity, which I understand to be a synonym for dialogue.*" Here the respondent seems to be unsure of the meaning of interactivity and has a very narrow understanding of dialogue.

It is this kind of conceptual confusion that this study is interested in, and whose origins it tries to illuminate. In some ways, this research continues Martti's work by attempting to make conceptual change processes visible and to understand the effect of prior assumptions on conceptual change. It seems that Sahlberg (2000) is right in assuming that teachers are aware of the paradigm shift in learning theories, but they may not fully understand what it entails. He states that research on teachers' interpretations of teaching has been neglected, as constructivist research has largely focused on student learning. Sahlberg is critical of the benefits of continuous teacher

training programmes, if the effects of teachers' prior assumptions and beliefs are not considered.

Teachers' thinking in general has been studied extensively since the 1990s (Freeman 1994; Kansanen et al. 2000). Research, however, has focused more on <u>what</u> has been said than <u>how</u> it has been said. Freeman (1994, 79) argues that the role of language has been overlooked in the analysis of data gathered. So far, data analysis has mainly relied on the techniques of content analysis, alternating reading and interpretation, use of metaphors, grounded theory, etc. (Freeman 1994; Husu 2002; Kansanen et al. 2000; Kansanen & Uusikylä 2004).

In the so-called representational approach employed so far, teachers' words have been taken as isomorphic to their thoughts. In a way, it has been assumed that teachers think the way they speak. This view simplifies the role of language:

> *The intuitive representational way in which language data has been used in the study of teachers' inner world vastly simplifies the nature of language.*
>
> (Freeman 1994, 89)

> *By looking at, rather than simply through language data, researchers who study teachers' knowledge can document development and change in teachers' mental lives' and hence build a fuller and more complex view of what teachers know.*
>
> (Freeman 1994, 90)

Freeman (1994, 78) calls for an integrated approach to analysing language data. In addition to the widely used representational approach, he suggests a presentational approach, which focuses on the intralinguistic and interlinguistic relationships in the data.

The linguistic data analytic methods employed in this research are based on the relationship between thought and language. Thought and language are closely linked, but words are not thoughts. Through analysis of interview data in this research, an attempt is made to integrate the linguistic approach with the conventional representational analysis. Course manuscripts were analysed using the representational approach, whereas in the analysis of the interview data, both representational (the utterance dimension) and linguistic approaches (the enunciative dimension) were employed.

Freeman's (1994) view of the presentational approach draws more heavily from structural linguistics than the analysis method in this research; the two dimensions of text and the actantial model. Yet, his argument about the benefits of an integrated analysis of language data applies here as well:

> *The two approaches complement each other and increase the validity of the study.*
>
> *Integrating representational and presentational analysis can show not only <u>what</u> is being learned or what is changing, but how it is being learned and <u>how</u> it is changing.*
>
> (Freeman 1994, 78)

With its choice of research instruments and methods of analysis this research illuminates the process of "how," i.e. the conceptual change process of experienced polytechnic teachers in a way that increases our understanding of learning as a process of change, and the role that existing beliefs and prior assumptions play in it. At the same time, my research makes its contribution to development of qualitative research methodology.

1.3.1 Research questions

Although the use of Information and Communication Technologies (ICT) in instruction is central in this work, the research focus was not on online teaching and learning as such, but rather, on a conceptual change process and development of polytechnic teachers' pedagogical thinking, as they were working on their first online courses. Thus the main research questions were:

1. What conceptions do polytechnic teachers hold about teaching and learning?
2. How do polytechnic teachers' preconceptions affect their views of teacher and student roles?
3. How do polytechnic teachers' conceptions of teacher and student roles show in their online instruction?
4. What kind of conceptual changes occur among polytechnic teachers engaged in ICT training and online instruction?
5. How do polytechnic teachers' entrenched beliefs affect their conceptual change?

To answer these questions, teachers' prevailing conceptions about teaching and learning were surveyed, and their baseline knowledge of the use of ICT identified. Emerging sub-questions were:

a) How do polytechnic teachers make use of ICT in instruction?
b) What learning needs do polytechnic teachers attach to online instruction?

The Phase I survey, conducted among all teachers' of the polytechnic, already sheds some light on teachers' conceptions of teaching and learning in general and their own perceptions of their learning needs. Also, teachers' use of ICT in instruction is investigated in the Phase I survey (Chapter 3.1). Teachers' learning needs are again addressed in Phase II intervention (Chapter 3.2). Finally, the Phase III study on teachers' conceptual change process attempts to provide answers to the main research questions (Chapter 3.3).

ICT serves as an example of a new method that motivates teachers to change and triggers learning. ICT was chosen, because it was of interest to teachers as well as the researcher. In public discussion, ICT is commonly perceived as a means to develop

education and training. ICT in instruction also makes teaching more transparent, as most of what teachers and students do remains visible in the virtual learning environment. It renders itself subject to research more easily than other methods that might have similar effect on teachers' conceptual change, e.g. Problem Based Learning, or Discovery Learning.

1.3.2   Theoretical frame of reference

The theoretical frame of reference in this work is **constructivism**. Theoretical underpinnings of the research also include **transformative learning**, which is considered essential to enable the paradigm shift from the traditional teaching approach to a more constructivist one. Constructivism would seem to better meet today's working life requirements and, similarly, the need for vocational teachers' professional growth.

Transformative learning is dealt with in the context of **conceptual change**. The key concepts inherent in constructivism, which are also very much in the centre of this research, are the teacher's new role as "facilitator," "student-centredness," and "social interaction." Cohen, Manion and Morrison (2000, 13) define a concept as follows:

> *Concepts enable us to impose some sort of meaning on the world; through them reality is given sense, order and coherence. They are the means by which we are able to come to terms with our experience.*

Concepts available to teachers, to a great extent, determine their pedagogical choices and their interpretation of the teaching and learning experience.

Constructivism constitutes the theoretical frame of reference, partly, because the author has adopted a constructivist orientation to teaching and learning, and because the constructivist perspective is congruent with many prevailing learning theories and is "*well-grounded in current scientific thought*" (Ruohotie 2000c, 8). The research process itself made an attempt to follow the principles of constructivism, first in establishing the baseline knowledge and assumptions of the target population, then in the organization and objectives of the intervention, and in the choice of research methods. The focus was always on the process of learning as a change rather than on the mere outcomes. This principle was pursued in the gathering and analysis of data, as well as in the interpretation of findings.

In literature, terms "constructivism" and "constructionism" are often used as synonyms. In this work, "constructivism" is used, because it is common in educational research. "Constructionism," on the other hand, is understood to refer to "social constructionism" (Tynjälä 2002, 38). Constructivism is seen here as an overall orientation to teaching and learning, a transformed habit of mind, not as an array of teach-

ing techniques which teachers apply. Therefore, it is believed possible for teachers to make flexible use of different techniques, even traditional, behaviourist ones as part of their teaching, and still maintain a constructivist view of the learning process as a whole. Ontological questions, constructivism as a wider view of the world and reality, as discussed, for instance, by Puolimatka (2002, 38–39, 43) are beyond the scope of this study.

The juxtaposing of the two, in a way, extreme orientations to teaching and learning – behaviourism and constructivism – serves to bring out the differences in teachers' pedagogical thinking as clearly as possible. At the same time, it is important to acknowledge in passing that behaviourism has a significant position in the evolving educational science, and, for instance, its principles of contiguity and reinforcement are still considered important today (Ruohotie 2000b). Further, constructivism is not regarded as the only acceptable alternative to behaviourism; therefore, it is recognized that "*everyone who is not a behaviourist is not necessarily a constructivist, either.*" (Puolimatka 2002, 82). Vice versa, everyone who is not a constructivist is not considered to be a behaviourist.

1.3.3   Research process

This longitudinal study extended across five years. This was necessary due to the nature of the research questions; the kind of changes and learning that were in focus here require a timeframe of many years (Kohonen 2000, 140; Beairsto 2000, 61).

This research proceeded in phases so that the subsequent phases were always built upon the results of the previous phase. Thus, a preliminary literature review prepared for the Phase I survey, whose results then served to inform the planning of the Phase II intervention: an in-house training programme. The intervention, in turn, produced research data, course manuscripts and online material for the Phase III research. This report follows the structure of the research process. The following diagram shows the different phases of the research process.

Preliminary literature review	Phase I Starting point	Phase II Intervention	Phase III Main research	Phase IV Follow-up
Theory: ICT enables a new way of learning that meets the new professional qualification requirements in working life.

Previous studies: Online courses are electronic transmission of knowledge or technology-led | Survey to whole teaching staff of Lahti University of Applied Sciences

Theoretical frame of reference: constructivism, behaviourism

Data: questionnaire, interviews

Methods: quantitative, qualitative

Results:
> Interest in online teaching
> Teaching approach mainly traditional
> Lone experiments | In house training for 20 teachers of Faculty of Technology.

Theoretical frame of reference: constructivism, transformative learning

Results:
> Course manuscripts
> Online materials | Research on teachers' conceptual change process.

Theoretical frame of reference: constructivism, transformative learning, conceptual change

Data: course manuscripts, online materials, interviews

Methods: qualitative

Results:
> Teachers' entrenched beliefs
> Teacher and student roles in online courses
> Teachers' conceptual change process | Follow-up discussions with five teachers

Validation of results
> Critical self-reflection
> Pedagogical changes
> Practical changes |
| 2000–2001 | 2000–2001 | 2002–2003 | 2003–2004 | 2005 |

Figure 1.   A step-by-step description of the research process

About the author

My aim here is to "reveal myself" as a researcher and a participant in the collegial development process reported in this paper. As Cohen, Manion and Morrison (2000, 141) note "*…researchers are inescapably part of the social world that they are researching.*" This undermines the notion of objective reality. In qualitative research, however, the aim is to understand the phenomenon under study in depth, and this often means direct personal experience and engagement (Patton 2002, 47). So, instead of objectivity, qualitative research aims at credibility through authenticity (Cohen, Manion & Morrison 2000, 108; Patton 2002, 51).

Patton (2002, 49) encourages investigators to get personally engaged and to use all of one's senses and capacities including experience. In so doing, however, "*the investigator needs to be aware of and deal with selective perception, personal biases, and theoretical dispositions.*" (Patton 2002, 51). By disclosing my own disciplinary sympathies, beliefs and values, as well as issues of advocacy I acknowledge factors that may affect this research. Through this reflexivity, I try to become aware of ways in which my past, selectivity, perception, and paradigms shape or bias my research (Cohen,

Manion & Morrison 2002, 141). At the same time, my aim is to provide readers with sufficient information about my background to make their own judgements.

I teach English at Lahti University of Applied Sciences, Faculty of Technology. This is the school where I have worked for my whole teaching career since 1981. In addition, I took part in the intervention phase of this research, the in-house training programme, producing my own online material together with a language-teacher colleague. Therefore, I identify with the members of the group being studied, and want to "advance their cause," which, in this case, is to be heard about the challenges involved in new technologies and new pedagogies. Thus, my role in this research was twofold; I was a participating teacher in the training programme, and an observer/researcher. I had my own experience of online instruction and the intervention. Wearing two hats made it possible for me to be part of the process that I was observing, analysing, and interpreting. At the same time, I could step back and look at my own learning.

From personal experience...

The first time I heard about the paradigm shift from teaching to learning was at a staff meeting at the Faculty of Technology some ten years ago. The news was delivered to us teachers in a form of an announcement that, from then on, all texts describing curricula should be changed. We should not write or talk about objectives and contents of **teaching** anymore. Instead, we should describe objectives of **learning**.

This *"shift from a focus on what is to be taught, and thus on who is teaching and how they are teaching, to what is being learned, and thus who is learning and how they are learning."* (Beairsto 2000, 60) remained for many years on the level of terminology change. It seemed odd at the time, even ridiculous, and seemed to fit the analogue suggested by Grimmett (2000, 72) of "progressio ad contrarium," changing the name of doing something without any changes in the real content. In light of this research, however, it seems to make perfect sense. Terminology changes first. This change in the language is then followed by changes in thought, and finally in action.

My own change began in 1998 when I was faced with two new challenges simultaneously: I started my post-graduate studies in Vocational Education and my first experiments with online teaching. The former were empowering and emancipating, the latter mostly frustrating. The frustration was due to my dissatisfaction with my own inability to produce something new, to use the new technology in a new, innovative way. I embraced the constructivist ideas of self-directedness and student-managed learning. Yet, my online course turned out to be traditional grammar exercises.

At the outset, it was this personal experience of helplessness in the face of new pedagogies and new technologies that inspired this research. I did not then realize that my distress was necessary for my professional development:

When learners are going through the transformative learning process, they often do so without fully recognizing that they are engaged in such a process. Their equilibrium has been upset by the advent of a dilemma, and they are in a state of readiness to learn anything that will ease their distress.

(Brookfield 1990, 364)

There were other factors, too, that seemed to call for research. In 1997 a self-evaluation report had revealed that the most urgent problem in the Faculty of Technology was that of failing students. Too many students failed in exams, they could not finish their coursework, and, subsequently, they failed to graduate within the set time limit.

…towards collective growth

As part of my post-graduate studies I conducted a small-scale study based on attribution theory (Weiner 1985) on teachers' and students' perceptions of success and failure at the Faculty of Technology in 1998. Findings indicated that the students were not altogether happy with what they were getting in the way of teaching. This raised questions about the quality of teaching and the role of the teacher. Findings were supported by school effectiveness literature at the time. There was plenty of evidence to support the conclusion that apart from the student ability factor, it is the classroom and what teachers do that matters (Reynolds & Cuttance 1992).

In 1999 the school decided to introduce a web-based course management tool, WebCT (Web Course Tools), in a new online education project funded by the European Social Fund. The project aimed at staff development of the local small- and medium-sized companies. From the faculty's point of view, the aim was to gain experience of Information and Communication Technologies (ICT) in instruction, then use this experience in basic undergraduate education to enhance classroom teaching, thus addressing problems revealed the previous year.

Meanwhile, in my frustration, I had turned to literature and research reports for help. I was concerned to find out that the first online courses produced at the time seemed to be material-heavy and technology-led, mere electronic versions of transmission of knowledge. As the general pressure to increase the use of ICT in instruction grew, it seemed important to provide the support and education that the polytechnic teachers needed in order to produce online courses.

By then, I had become acquainted with the theory of transformative learning (Mezirow 1990b; 2000), understood my own learning process better, and finally succeeded in implementing some of my new constructivist ideas in my online instruction, which I had pursued all along. To my surprise and delight, what I was doing online successfully started to seep into my classroom teaching as well.

It was as if I could not go back to my old practices anymore. "Reflection-in-Action" and "Reflection-on-Action" (Ruohotie 1999, 31) had become automatic. Gradually, all the theory I had been studying and my own concrete experience of trying to accomplish in practice what I felt was a better way of learning for my students, started to combine on the conceptual level. The theoretical knowledge I had gained had started to work from within, and its workings were reflected in practice.

This was the learning experience I wanted to share with and effect in my colleagues as well. I was also interested in discovering, whether my own experience could be of a more general nature. After mapping out polytechnic teachers' baseline knowledge of ICT and its use in instruction, an in-house training program was designed in co-operation with The Research and Education Centre of the University of Helsinki (Palmenia). The programme was designed to provide teachers with "emancipatory" education that would foster transformative learning (Mezirow 2000, 10). The research that followed aimed at a better understanding of the process of learning in the participating individuals.

Ultimately, assuming that the kind of professional development that was now called for, involved a paradigm shift in teaching and learning to better meet the requirements of society and the working life, how could this development be initiated and maintained? Would a dilemma such as ICT in instruction trigger transformative learning with participating teachers, if provided with an opportunity and support? How do conceptions of teaching and learning change, and does this change in pedagogical thinking automatically change the teaching approach – in virtual as well as physical classrooms? These were questions that seemed central in polytechnic teachers' professional growth. These very same questions are addressed in the present paper.

1.3.4   Research methodology and reporting

Within Lahti University of Applied Sciences the intervention took place in the Faculty of Technology, partly because the researcher works there (which made the arrangements easier), and partly because, at the time, technical support for the use of ICT in instruction was only available at the Faculty of Technology. In addition, Technology held the largest number of students in all polytechnics, and offered most virtual studies in 2003 (AMKOTA-tietokanta 2005).

As the objective was to understand conceptual change in general, teachers at the Faculty of Technology were not considered special due to their science background. Recent research evidence indicates that teachers from varying disciplines need support in adopting new orientations to learning (Aarnio & Enqvist 2004; Luukkainen 2004b; Pulli 2003; Sinko & Lehtinen 1999). It is, however, recognized that empiricism – on which behaviourism was based – is more innate in science than in humanities.

Also, teachers in polytechnics differ from school teachers in that they were first experts in their professional subjects before becoming teachers of those same subjects and may tend to emphasize expert knowledge over pedagogical skills.

The research was qualitative and interpretive in design. The aim was to interpret the subjective meanings that participating teachers placed upon their actions and to increase understanding of the process of learning as a conceptual change. In this sense, the approach was subjectivist and hermeneutical (Cohen, Manion & Morrison 2000, 9).

As this research focused on professional growth and utilized data gathered from an extended period of time, it could also be characterized as developmental. Cohen, Manion and Morrison (ibid., 175) further define a developmental, longitudinal research as a "cohort study", which is a term used in British literature. The participants were all teachers of Lahti University of Applied Sciences and the Faculty of Technology and thus formed a cohort. In a cohort study, "*a specific population is tracked over a specific period of time but selective sampling within that sample occurs.*" (ibid., 174).

Triangular techniques and qualitative and quantitative methods were applied depending on the purpose and nature of data gathered. Several types of collection instruments were utilized to capture as representative data as possible. The analysis methods also varied according to the depth of analysis. Individual and group interviews took place in each phase of the research, but the data gathered were treated differently depending on the purpose of the interview.

This methodological pluralism is typical of a mixed research paradigm (Johnson & Onwuegbuzie 2006): "*…where the researcher mixes or combines quantitative or qualitative research techniques, methods, approaches, concepts or language into a single study…*" and "*… collects multiple data using different strategies, approaches and methods in such a way that the resulting mixture or combination is likely to result in complementary strengths and non-overlapping weaknesses.*" According to Johnson and Onwuegbuzie (2006), mixed research can add insight that might be missed if only one method were used.

Reporting of the interviews also varies. Direct quotes have been reported in Finnish and English in Phase III, where the focus is on the language, and it seemed important to provide Finnish and foreign readers with as accurate examples of data as possible. However, when the focus is on the message only – the interviewees' experience and feedback in Phases I and II – the quotes have been translated into English, and Finnish equivalents have not been included. This solution seemed more reader-friendly. The length of quotes was also a concern.

The following table introduces the data collection instruments, analysis methods, and form of reporting.

Table 1. Data collection, analysis, and reporting in different phases of research

	Data collection	Analysis method	Reporting
Phase I	questionnaire	frequency counts	bar charts, tables, grid
	interviews	summarising	salient points
Phase II	interviews; diaries; journal notes	reading and interpreting	salient points
	manuscripts; online material	content analysis	classifications; summaries
Phase III	interviews	Transcripts; structural and linguistic narrative analysis	actantial models; quotes from interviews in Finnish and English
Phase IV	follow-up discussions	summarising	salient points

In the Phase I survey, a proportionate stratified random sample (Heikkilä 1998, 36–38) was drawn from the whole permanent teaching staff of Lahti University of Applied Sciences. The approach was mainly deductive (Patton 2002, 56), since the survey made use of a questionnaire, in which the items were operationalized from the behaviourist and constructivist learning theories.

Data thus gathered were analysed by means of simple frequency counts, and complemented by open-ended interviews with those teachers who had some experience in online instruction. This was considered sufficient to give rough information about polytechnic teachers' orientation to teaching and learning in order to inform the planning of the intervention. The results of the quantitative analysis of the questionnaire answers are reported in the form of bar charts and tables, and summarised in an online paradigms grid (Coomey & Stephenson 2001, 41). Summaries of interviews are reported.

In the Phase II intervention participating teachers were first asked about their expectations regarding the training and their reasons for joining. These short interviews served to involve the participants in the planning of the training programme and to increase motivation. Information thus gathered was utilised in the design of the training programme. Halfway through the training, participants were interviewed in groups in order to receive feedback in time to make changes, if necessary. All these interviews served the purpose of adjusting the training to participants' needs. At the end of the training, participants were asked to give feedback in the Discussion forum in Studium (Palmenia's web-based learning environment). Only the main points raised by participants are reported as far as they were considered relevant in the evaluation of the training.

Phase III research was qualitative and inductive. Purposeful sampling (Patton 2002, 45–46, 230) was employed to gather information-rich data from participating teachers. More specifically, the research used criterion sampling: only those teachers were included in the research that had participated in the training intervention, and had produced course manuscripts, and had already piloted the online material or felt confident they would be piloting it before the research was over (ibid., 238–242).

Conceptual change processes were investigated with varied qualitative methods discussed in detail in Chapter 3.3.1. Essentially, this research employed a textual analysis of course manuscripts, online material produced, and data from new individual interviews of participating teachers. First, individual cases were carefully studied to fully grasp teachers' pedagogical thinking. Once that was done, comparing and contrasting data, and the search for patterns and recurring themes became possible. A follow-up discussion with each teacher, after interpretations had been made, sought to verify conclusions drawn and to promote participants' Reflection-on-Action (Ruohotie 1999, 31). Follow-up discussions are summarised in this report with occasional quotes to illustrate a point.

Phase III interviews were based on analysis of course manuscripts and online material. Interviews were transcribed. Lengthy extracts from interviews are provided in this report to allow readers to make their own judgements about interpretations made. Interviews were treated as "*providing access to what is inside a person's head.*" (Cohen, Manion & Morrison 2000, 268.) Additionally, the purpose of interviews was to validate the results of analysis of course manuscripts and online material. This data triangulation – course manuscripts, online material, and interviews – provided a fuller picture of the phenomenon and increased the validity and reliability of the research.

Participants had also been asked to keep a diary of their discussions in the independent workshops, and the author, as one of the participants, took journal notes. These attempts to gather additional data yielded meagre results and could only be utilised as separate raw data for comparing and matching with results to verify inferences made.

2 CONCEPTUAL CHANGE FROM TEACHING TO LEARNING

All teaching is based on some theory of learning. The theory might be the result of active studying of current research, it could have grown out of a teacher's own experiences of what has worked in classrooms, or it could date back to the time when teachers themselves were students (Lehtinen 1997). Obviously, many other possibilities remain. Therefore, even experienced teachers should stop to think whether they are aware of the theories and conceptions that guide their instructional practice. Becoming aware of what we are doing, and why, is the first step. The next step is to critically evaluate one's own practices and conceptions in light of how learning is understood today.

The learning process was traditionally studied in a laboratory. This behaviourist approach, which dominated the research on learning from the turn of the 20th century for over forty years, focused on finding the basic underlining principles of learning. It was believed possible to understand the more complicated learning processes based on the general principles of learning. Thus, animals were studied as often as human beings.

At the end of the 1950s cognitive psychology started to gain ground. It focused on mental processes, memory, and organisation of the mind. People were seen as processors of information. Learning was not regarded as something separate but part of a process comprising perception, memory, thought and decision-making. But, it was not until the 1990s, that psychology of learning and research on teaching started to approach one another.

Scientific evidence has been systematically built so that our understanding of human learning has grown. In each era, some findings have seemed more significant than others, supported by the dominating epistemological theories of that period. Prevalent theories have focused research on issues that have seemed relevant at the time. Only in hindsight, can we recognize the shortcomings of some of that research, and what the theories have perhaps overlooked. In the same way, we may be missing something vital now. On the other hand, each stage in the development of learning science has added something valuable to the database that has been carried on, despite changes in theories and perspectives.

The following chapters describe the change in the paradigm of teaching and learning by looking at two different theories of learning: behaviourism and constructivism.

Behaviourist theories of learning focused on the study of human behaviour and were built on the empiricist idea of knowledge as something external to people. Transmission of knowledge, as effectively as possible, became a central issue in teaching. The constructivist theory of learning was built on cognitive psychology. The central idea in constructivism is that knowledge cannot be transferred from teachers to learners. Rather, learners themselves construct knowledge, based on what they already know.

Constructive orientation is congruent with much of current understanding of how learning takes place (Ruohotie 2000c, 8; Merriam & Caffarella 1999, 262). From students' perspective, the difference between the two views of learning could perhaps slightly exaggerating be summarized as either, "being taught" or "learning to learn."

2.1   Focus on teaching – behaviourism

The strength of the behaviourist theory of learning is in its clarity and simplicity. The basic principles of learning are the same with animals and men, the stimulus – response bonds are formed through reinforcement, and all complex behaviour can be understood if reduced to simple units of behaviour. Learning is mastering the basics first and gradually building the hierarchy of the whole from bottom to top. Knowledge is defined as something fixed and external to students which leaves students more or less unaffected. Students do not change; learning is manifested in the changes in their behaviour. Knowledge thus acquired is like a set of tools that can be taken to a new situation, and used there successfully, provided that the two situations share some common elements. (Rauste-von Wright et al. 2003; Ruohotie 2000b.)

In the following summary, typical features of the behaviourist teaching approach are discussed against the scientific research that underpins them:

Knowledge can be transmitted from a teacher to students. A student's mind is a blank slate, "tabula rasa," waiting to be filled with knowledge. This notion can be traced to John Locke (1632–1704), a British empiricist, who made the first attempts to find a systematic theory of learning. (Axtell 1968.)

The subject matter being learnt is divided into small logically advancing steps that lead to mastery of the whole. Skinner (1968) developed teaching machines that were able to give immediate individual feedback so that students could proceed at their own pace. Using a teaching machine necessitated programming of the subject being taught. Terminal behaviour first had to be defined. The subject was then reduced to a hierarchy of small steps, and the required behaviour for each step was defined. To the critics of this theory, Skinner answered: "*An overall view is something the student is to learn; it is not something he is to pick up by wandering rather aimlessly about in unprogrammed material.*" (Skinner 1968, 224.)

Learning is achieved by shaping behaviour through reinforcement. Skinner called for reinforcing the precurrent behaviour. Talking about hidden mental processes did not explain learning. Thinking could be shaped like any behaviour (Skinner 1968).

Positive feedback on the desired behaviour is the key to learning. The kind of behaviour that is not wanted is ignored. Thorndike, in the late 1800s, had introduced the stimulus-response model, which Skinner later developed into the principle of operant conditioning (Merriam & Caffarella 1999; Ruohotie 2000b; Skinner 1968).

Direct teaching is the foundation of effective learning. Ebbinghaus's experimental studies on memory and learning in the 1800s led to emphasis on effective teaching methods (Bower & Hilgard 1981). Drill and practice are typical examples. Many still agree with Skinner's view that, "*Some recent reforms have swung to the other extreme: In making sure that the student learns how to think, they neglect the transmission of knowledge of what is known.*" (Skinner 1968, 16.)

Differences between different individuals' performance are measured using tests in which answers are either right or wrong. Thorndike gave behaviourism the basis for quantitative tests. One example is multiple-choice questions. (Ruohotie 2000b.)

Differences between individuals are regarded as something rather stable. Character traits or personal skills are not expected to change much. Thorndike's theory of learning was consistent with findings of differential psychology at the beginning of the 1900s. (Bower & Hilgard 1981; Rauste-von Wright et al. 2003.)

Pedagogical implications of behaviourism

My experience is that many a curricula still reflects the step-by-step teaching of subjects. The subjects themselves are steps towards certain competencies defined by educational authorities, school boards, or teachers. These competencies in turn make up, for example, an engineer's qualifications. The terminal behaviour has thus been defined: What does an engineer need to be able to do? This behaviour has been reduced to different subjects and assignments for students to master before they are expected to see the "big picture," and make all the parts they have been taught fit together.

This kind of curriculum is relatively stable. Every year different students go through the same steps. Somebody else has decided what they should be able to do in order to graduate. This may lead to superficial learning techniques; correct responses and marks become more important than the learning process, or understanding.

Teachers possess the knowledge and decide how much of that knowledge students need to learn. They arrange the knowledge into small hierarchical steps that logically lead towards the goal. They then use drill and practice to activate students and give feedback to reinforce learning. Finally, they measure in a test how much of that

knowledge students master. The behaviourist view of knowledge is fixed. Knowledge is a bulk outside students' minds until teachers manage to transmit some of it into the minds of their students. Effective teaching methods play an important role in the transmission of knowledge. In the same way, the behaviourist view of students is fixed. Students remain basically the same, although they may gain a certain amount of knowledge. In the behaviouristic model the teacher does a major part of the work that, according to the constructivist theory, students should do in order to learn.

2.2   Focus on learning – constructivism

Constructivism draws heavily from cognitive theories, but also shares some principles with humanistic psychology and social learning theories. Cognitivist research was mainly concerned with the study of memory and processing of information. Initially, cognitivists were not interested in learning. They explained learning as a result of the learner's mental processes.

Where cognitivists focus on the structure of the mind in dealing with new information, humanists emphasize the affective aspect of learning and the subjective experience. The learner's "self" is more than cognition. Learning is not merely an automatic function of the mind in processing new information and linking it to the existing knowledge structures. Humanists place learners' need to learn and their own responsibility for learning at the centre of the learning process. Social learning theories, on the other hand, look at learning in its social context, and the interaction between the learner and the context. Therefore, learning can also take place by observing others rather than experiencing everything first hand. (Merriam & Caffarella 1999; Rauste-von Wright et al. 2003; Ruohotie 2000b.)

According to the constructivist theory of learning, knowledge cannot be transmitted from a teacher's mind to students' minds. Nor does the information in books or on web sites turn into knowledge automatically. Learning involves a conceptual change. Learners change. They do not acquire a bag of knowledge that they can either take along or leave behind, but their knowledge networks change permanently.

Learners process new information to form new meanings and new knowledge structures and, in this way, their understanding increases. Learning is a knowledge-building process and it is different for every learner. In a way, knowledge itself can be seen as a process that gradually evolves as understanding grows. Therefore, learning cannot be measured by merely measuring outcomes, which may be different for different learners. Assessment should focus on the learning process, and increased understanding of the phenomenon under study. (Lehtinen 1997; Merriam & Caffarella 1999; Rauste-von Wright et al. 2003; Ruohotie 2000b; Tynjälä 2002.)

Although constructivism can be characterized in general terms as above, it is, by no means, a unified theory. Rather, constructivism has divergent approaches. Tynjälä (2002) finds two main categories: individual and social constructivism depending on where the focus of interest lies – on the individual as described by Piaget (1988) or social construction of knowledge as outlined by Vygotsky (1978). Within the two approaches there can still be made finer distinctions depending on the perspective taken. A case in point is radical constructivism that falls into the category of individual constructivism. Radical constructivism is generally advocated to von Glasersfeld (1995/2002). Tynjälä (2002, 39) refers to it as cognitive constructivism when the focus is on the psychology of learning and not the philosophical paradigm.

Radical constructivism adheres to the pragmatic epistemology; knowledge is only true and valuable if it can be applied to practice successfully. We cannot be certain of the truth of any knowledge that we have, since all our knowledge is based on our subjective interpretations (von Glasersfeld 1995/2002; Mezirow 1999; 2001). Knowledge can be validated by its viability and, for example, the consensus of the scientific community (Tynjälä 2002).

As this study examines, on one hand, the individual teachers' conceptions and, on the other hand, learning together with colleagues, the theoretical frame of reference mainly draws from radical/cognitive constructivism, while recognizing the importance of social interaction in constructing and testing knowledge.

Learning to learn

The difference between the constructivist and the behaviourist approach to teaching and learning is most evident in their respective definitions of knowledge. Where behaviourists define knowledge as a fixed entity (parts of which can be successfully transmitted to students' minds through direct teaching), constructivists regard knowledge as subjective (constructed by students' themselves). Since students' prior experiences and resulting conceptions play such an important role in their interpretation of new information, knowing students as individuals is the starting point for teaching. The following summary lists the main principles of constructivism.

Learning is based on experience. One of the foremost philosophers who emphasized the importance of connecting subject matter knowledge with learners' present life experiences was Dewey. Learners, Dewey suggested, should have a genuine situation of experience with an activity in which they are interested. Secondly, a genuine problem should develop within this situation, for which learners could discover a solution. Thirdly, learners should be active in searching for information. (Dewey 1929; 1944.)

Learning is understanding the whole and the relationships between its parts. Gestalt psychologists were first to focus on the whole, patterns, rather than parts of the whole ("Gestalt" is German for "pattern"). Learning is solving problems. The

solution to the problem comes from reorganizing the parts of the whole, seeing the problem in a new light. This new insight is learning (Bower & Hilgard 1981; Rauste-von Wright et al. 2003).

Learning takes place inside a learner's mind. It is a mental process, not merely a change in behaviour. It is making meanings based on existing knowledge structures and assumptions, which may either promote or prevent new learning. The locus of control is with the student, not the teacher or the environment (Ruohotie 2000b). Because learning depends on learners' existing mental models, learners focus their attention on different aspects of the new information, and thus may learn different things in the same situation.

Abraham Maslow (1970) explained motivation with the hierarchy of needs. If lower level needs are not met (for example, security), the learner cannot engage in activities that are on a higher level (such as cognition). Alderfer (Ruohotie 2000b) added to the theory of motivation the subjective experience of success and failure. For example, how learners experienced failure if they failed in their cognitive goal, determined their later goal setting and motivation. A negative experience could lead to regression.

Social interaction enhances learning. Both Piaget and Vygotsky emphasized the importance of linguistic interaction with other learners. Piaget saw learning as a result of conflict between the learner's understanding of the problem and that of other learners. Conflict is the driving force that makes learners reconstruct their own knowledge networks. In Piagetian terms, the learner is trying to achieve equilibrium (von Glasersfeld 1995/2002).

Vygotsky emphasized socially-formed cognitive structures that are then reconstructed internally. Knowledge is, in a way, built together, whereas in Piaget's view, every individual constructs their own knowledge as a result of discussions with other people (Rauste-von Wright et al. 2003). A central concept in Vygotsky's pedagogical thinking was the concept of the zone of proximal development. It is the distance between what learners can do independently and what they could do with the right kind of support and guidance. Because Vygotsky viewed learning as a social process, "*The mere exposure of students to new materials through oral lectures neither allows for adult guidance nor collaboration with peers.*" (Vygotsky 1978, 131.)

Learning can be learnt. Learning to learn is a fundamental skill in the changing work processes (Nevgi 2002; Ruohotie 2002b). Students can develop learning skills by practising different strategies for different learning tasks. Becoming aware of their own assumptions is as critical as reflection on their own progress (Tynjälä 2002). This self-regulation ability is central in all learning. Ruohotie defines self-regulation as follows:

> *Self-regulation refers to an individual's active participation in his or her learning process. The key factors in this process that support learning are the metacognitive, motivational and behavioural processes, such as planning of the learning*

process, setting personal learning goals, outlining the material to be learned, self-monitoring, efficacy beliefs, expectations of outcomes, the reconcstruction of belief systems, constant practicing and the refining of personal skills, and working patterns/models.

(Ruohotie 2003, 251)

In assessment, the focus is on the change in understanding rather than the outcome. This is accomplished by continuous assessment of the process of learning and open learning tasks that do not have one correct answer but allow various answers. (Rauste-von Wright et al. 2003; Tynjälä 2002.)

A teacher's role is to facilitate student learning and to mediate the learning environment for students (Brooks & Brooks 1993; Lehtinen 1997; Rauste-von Wright et al. 2003; Tynjälä 2002). Here constructivism draws from humanism. Roger's concept of client-centred therapy has been carried over to student-centred learning. Roger's view was radical at the time – in the 1950s – since he emphasized the client's role in the healing process (Rogers 1951/1994). Previously, clients had been seen more as objects. In teaching and learning, Roger's principle has been metaphorically described as "teaching the hungry to fish instead of giving them a fish." Little (2004, 22) points out that the teacher's role is, "*to initiate, support and direct the processes of negotiation that help learners at every stage to identify new learning goals, new learning activities and materials, and thus new areas of responsibility.*" Hence, facilitating entails initiating and supporting students' own learning process.

Pedagogical implications of constructivism

Constructivist views of knowledge and learning radically change the traditional instructional approach. In a learning situation, all students share only the framework of the subject area, and a general idea of the goal. What individual students learn depends on their prior knowledge, their motivation and interests, and many other personal factors. This cognitive diversity explains how different students appear to be learning different things, although the learning situation is the same.

In a way, students construct their own learning environments according to their interests and needs. A prerequisite for the kind of cognitive difference in students and their personal development, which is central to the constructivist approach to teaching and learning, is curriculum flexibility. The curriculum cannot be fixed in advance. The constructivist teaching approach has no fixed contents or fixed students.

In teaching, the process of learning is more important than covering the predetermined content (Brooks & Brooks 1993; Merriam & Caffarella 1999; Ruohotie 2000c). Understanding a new phenomenon, or a new concept, requires seeing it as a whole, not broken down into parts which are dealt with separately. In contrast to the hierar-

chical order of presenting the basic things first as steps towards the whole, constructivist teachers start their subjects from the top, and then introduce general principles that can be applied to a variety of situations. Seeing the relationships between parts of a whole is considered vital to learning.

Student-centredness

In a constructivist classroom, students themselves break the wholes into parts, rather than the teacher doing it for them. Lehtinen (1997) suggests that to really acquire theoretical knowledge, students should go through the same kind of idea construction as the great thinkers who formed those theories. The necessity of seeing the whole as the starting point in learning requires curriculum to be clustered around central concepts (Brooks & Brooks 1993).

Students are seen as individuals having different needs and different experiences. In a constructivist learning environment, students' perceptions of the world and the subject at hand are the starting point, not the teacher's idea of the curriculum to be covered. Brooks and Brooks (1993, 60) call this approach "*seeking and valuing students' points of view.*" Learning is enhanced if learners can relate the new information to what they already know about the subject. Therefore, teachers first try to find out students' prior experiences and knowledge of the subject as well as their suppositions and possible misconceptions that might prevent learning. A constructivist teacher finds ways to help students change their minds (ibid., 42). This process can also be referred to as conceptual change.

It is also important for teachers to be aware of their students' learning strategies, because they have a great impact on what students learn. For example, students may be used to behaviouristic step-by-step learning and may tend to memorise facts instead of trying to understand the whole (Mällinen 2005, 65). Teachers can introduce better learning strategies through model performance and provide tasks that encourage the use of different strategies (Rauste-von Wright et al. 2003).

In a constructivist class, students take an active role in the learning situation by first finding out what they already know and what they do not know, deciding on the best learning strategies, and then setting their own objectives. The teacher should, therefore, have a deep understanding of what is essential in the subject for students to master and a clear view of the overall goal. The constructivist approach may take more time than traditional frontal teaching; therefore, it is vital that the teacher is able to focus on topics that are central and which have transfer to other contexts and other disciplines (Kolari & Savander-Ranne 2000).

Students should be provided with learning situations where they are encouraged to reflect on their own learning, weigh different solutions to problems, find analogies, etc. Brooks and Brooks (1993, 30) emphasize the importance of not giving students more information than they need. "*Helping students or groups of students to*

clarify for themselves the nature of their questions, to pose their questions in terms they can pursue, and to interpret the results in light of other knowledge they have generated is the teacher's main task." This requires high professional competence from teachers as they must be able to respond to a wide array of student queries. At the same time teachers must be capable of providing a model for problem-solving and utilization of different learning strategies (Mällinen 2005).

Social interaction

Social interaction in learning calls for teaching methods that encourage dialogue (see Chapter 2.5.2) between students, and between students and teachers. To create the kind of atmosphere that allows students to express opinions freely without fear of being ridiculed is a great challenge for the teacher. Having the opportunity to test their ideas in public helps learners become aware of their own thinking processes as well as others'. In this way, the possible misconceptions are brought into the open and can be dealt with so that true learning can take place.

In dialogue, tacit knowledge comes into the open and is added to and changed by the input of others. The Vygotskian principle of the zone of proximal development applies: the more advanced students support the ones who cannot yet perform the task on their own. All this promotes metacognition with students as they become aware of their cognitive processes; knowing that I know, or knowing what I do not know (Ruohotie 2003, 268).

In assessing students' progress, the teacher, rather than seeking for the "right" answer, leaves room for students' individual interpretations of the subject matter. All students cannot be expected to learn all the same things in the same way. Thus, rather than testing the contents in detail, the teacher should try to find out what kind of qualitative changes have occurred in students' conceptual thinking. Brooks and Brooks (1993, 96–97) call for authentic context-bound assessment, where assessment focuses on meaningful tasks that promote learning, while the teacher is able to see how students apply prior knowledge to new situations. Authentic assessment:

- is an essential part of all learning;
- is continuous and takes place over a long period of time;
- focuses on learning outcomes and the learning process;
- focuses on an individual's performance in relation to their own goals;
- enables individual choices and supports student-managed learning;
- collects information in many ways;
- enhances learning;
- supports the learner's reflexivity and self-assessment skills;
- develops critical thinking;
- promotes collaborative work.

(Jaatinen, Mällinen, & Scheinin 2004, 15)

Facilitation

Metacognitive skills can be learnt (Ruohotie 2000b; Ruohotie 2003, 268). Students who come to polytechnic may not possess the metacognition required to self-directedly (Ruohotie 2000c, 16) plan, monitor and assess their learning, and they may not have the self-regulation abilities (Ruohotie 2003, 256–257) to stay focused, maintain motivation and reflect on their successes and failures.

Teachers as facilitators of learning try to promote metacognition and self-regulation in their students and help them gradually become more self-directed in their learning. Ruohotie (2000c, 14) describes this "cognitive apprenticeship" as having five stages:

- Modelling, which is followed by
- Scaffolding and coaching, i.e. the facilitator provides support when needed. Gradually the facilitator decreases coaching, and
- Students approximate the real thing while working individually or in small groups. When students reach the level of self-directed learning,
- The facilitator provides assistance only when requested.
- The final stage is generalizing of what has been learnt.

An example of language teaching may shed more light on the five stages. Students studying authentic texts often come across terminology that is new to them and possibly to the teacher as well. The goal here is to teach students to become autonomous readers of authentic texts. Traditionally, the teacher might have prepared a wordlist beforehand, or at least could give a translation there and then. Students would expect the teacher to know the word and so might the teacher, the result being mutual frustration when that is not the case.

In modelling, the teacher shows how a language expert would go about solving the problem, trying to deduce the meaning from the context, for instance. Scaffolding, in turn, could mean giving students concrete tools to proceed when they are stuck. In this case, this would mean, for example, introducing printed or online dictionaries and giving advice on how to use them. In stages three and four, students work on texts more and more independently, making use of the new skills they have acquired in stages one and two. Finally, in stage five, they can apply what they have learnt to new texts in the same language, and in all foreign language texts that they read (Mällinen 2005).

Another example in a polytechnic context is the PDEODE-method (Predict – Discuss – Explain – Observe – Discuss – Explain). In this method, a worksheet is used for scaffolding and making the learning process more transparent for students (Kolari & Savander-Ranne 2000; 2002).

This change in teachers' and students' roles from traditional classroom practice is central in constructivism and, as suggested in this paper, requires a conceptual change in both teachers' and students' frames of reference.

To summarise, the central concepts in constructivism that pose the greatest challenge for the traditional teacher are:

- The student's role as an active learner.
- The teacher's role as a facilitator of learning.
- Social interaction that promotes learning.

For the online teacher, creating a learning environment and learning tasks that encourage and support social interaction, even though students do not meet face-to-face, is especially challenging.

2.3 Summary of differences between traditional and constructivist pedagogies

The main differences between traditional and constructivist teaching approaches are summarised in the table below (see also Brooks & Brooks 1993, 17):

Table 2.   Differences between traditional and constructivist teaching approach

Traditional approach	Constructivist approach
Curriculum is fixed and remains the same for all students.	Curriculum is negotiated with students. It is flexible and reflects students' needs.
Subject matter is presented from part to whole, with emphasis on basic skills.	Subject matter is presented from whole to part with emphasis on big concepts and problem-solving.
Students are viewed as fixed in their abilities, 'blank slates' onto which teachers transmit knowledge.	Students are viewed as thinkers who construct their own subjective knowledge about the world.
All students are taught the same material the same way.	Students' prior knowledge is the basis for learning new information.
Lessons are teacher-led. Direct teaching and teaching methods play an important role.	Lessons are student-centred and interactive. The teacher is a facilitator of learning.
Students are motivated through external reinforcement.	Students are motivated by their own interpretation of reasons for success or failure.
Teachers call for correct answers to validate student learning.	Teachers seek students' points of view in order to bring out and understand students' present conceptions.
Assessment is separate from teaching and occurs almost entirely through testing at the end of the course.	Assessment is continuous, interwoven with teaching and occurs through teacher observations of students at work and through self and peer evaluation.
Students primarily work alone.	Students are encouraged to work in pairs and groups and help each other.

Transition from a traditional approach to a more constructivist approach to teaching and learning is neither swift nor easy, and does not take place on command. For many teachers the paradigm shift in teaching and learning presents a radical change from their conventional practice. How they deal with it, and how they learn to apply the new approach to their own teaching, depends on what meanings they make in these changed circumstances. This study is based on an assumption that a new teaching approach requires a conceptual change in teachers' meaning schemes, i.e. transformative learning. Teachers need to start questioning their assumptions about their role as a teacher and about the ways students learn.

2.4   What is conceptual change

The core concepts in radical constructivism are schemas, and learning through assimilation and accommodation. The concept of schema can be traced back to the work of Kant, Bartlett and Neisser. Assimilation and accommodation are central in Piaget's psychology (Bower & Hilgard 1981; Neisser 1976; Piaget 1988; Rauste-von Wright et al. 2003; Tynjälä 2002). Today's literature also refers to schemas with varying terminology either as frames of reference or meaning structures (Mezirow 1990b; 2000), mental models (Chi & Roscoe 2002; Vosniadou 1992), conceptual frameworks (Jonassen et al. 2005), or conceptual schemes (von Glasersfeld 1995/2002).

Concepts that are embedded in mental structures are defined by Cohen, Manion and Morrison as follows:

> *Concepts enable us to impose some sort of meaning on the world; through them reality is given sense, order and coherence. They are the means by which we are able to come to terms with our experience.*
>
> (Cohen, Manion & Morrison 2000, 13)

According to Carey (1992, 89) "*concepts are constituents of beliefs.*" And, "*Beliefs are mentally represented propositions taken by the believer to be true.*" On the other hand, conceptual knowledge can be understood to be organized hierarchically and laterally into categories, and learners categorize novel concepts based on similarities to existing concepts (Chi & Roscoe 2002, 13; Slotta, Chi & Joram 1995). "Plant" and "animal," for example, belong to different lateral categories. However, they are both within the same more superordinate category of "living things." Concepts inherit the attributes belonging to the same category. Thus, animals all move, plants do not. Any concept that is placed in the category of animals is, therefore, conceived to be mobile.

Saussure (1972, 66–67) defines concepts as ideas and language as an arbitrary collection of signs that we use to refer to those concepts. Conceptions are individuals'

understanding of concepts. Conceptions are the result of one's experiences, cultural background, education, etc. Thus, conceptions of the same concept may be very different, and, hence the need to try to define, for instance, scientific concepts in research papers such as this one to ensure that the scientific community understand them in the same way and are talking about the same thing.

This research deals with polytechnic teachers' conceptions of teaching and learning. Let us, however, consider a more concrete example to examine the definitions provided above: "House" is an English word describing the concept of a building in which one or more families may live. The word is different in different languages but, at least in Western societies, we understand the concept in much the same way. The mental image of a house may vary slightly, but most people would picture it as built of wood, concrete or brick, and to be of certain height. If we, however, were to translate "house" into, for instance, a native African language, we would have to consider that not only their word for "house" would be different, but also the concept behind it.

Conceptual change occurs when learners' understanding of the concepts they use changes, often resulting in the transformation of their conceptual frameworks. "*Conceptual change is a process of constructing and reorganizing personal conceptual models.*" (Jonassen et al. 2005). It is in this broad sense that conceptual change is understood in this paper.

The following section discusses schema theories and changes on the conceptual level. It starts from the work of Kant and Piaget, and then looks at the more recent research on conceptual change aiming to understand it in the context of teachers' pedagogical thinking.

2.4.1   Schemas

Kant, a German philosopher, sought a resolution to the conflict between empiricism and rationalism. He suggested that knowledge was created as a combination of two earlier views; new sensory data were actually interpreted according to certain forms. These forms constituted a framework of thought relationships, a kind of innate classes of perceptions and knowledge that made sense of the sensory chaos and refined it into knowledge. Kant's a priori forms can be seen as the first attempt towards the cognitive theory of the organization of the mind, the schemas that we use to construct new knowledge. Kant considered these forms permanent, whereas the current view sees cognitive structures as developing and changing. (Bower & Hilgard 1981; Mezirow 1990a; 1990b; 2000; Rauste-von Wright et al. 2003).

Bartlett continued Kant's idea of innate classes, but instead of classes, he wrote about schemas. Knowledge is stored in memory in the form of schemas that change according to new experiences. Recalling is reconstructing the same schemas that were formed during learning. Skills are not merely series of activities connected by

associations but well structured and organized operations. (Rauste-von Wright et al. 2003)

Neisser (1976) elaborated on Kant's schema theories to include the interplay between the environment and an individual's mental structures. Learning is enhanced if learners can relate the new information to their existing knowledge frameworks. However, the schemas that learners already have may either promote or prevent learning, as they direct learners' attention according to their prior assumptions. It is easier to accept new information that is in accordance with one's own assumptions, but information that contradicts one's old beliefs may either go unnoticed or be rejected as wrong.

Recent developments in cognitive science and developmental psychology support Neisser's concept of schemas. These "mental models" (Chi & Roscoe 2002; Vosniadou 1992) or "frames of reference" (Mezirow 1990b; 2000) are central in learning. They consist of deep-rooted assumptions, entrenched beliefs, and expectations that have developed over time, and of which we may not even be aware. They do not change easily because they involve cognitive, affective, and conative dimensions (Ruohotie 2000c; 2000a).

The traditional model of learning is adding new knowledge to the existing knowledge base (Vosniadou 1992). In this study, learning is seen as making meaning of experience, interpreting it (Mezirow 1990b; 2000). Learners' assumptions guide this interpretation of new experiences. They see what they are programmed to see and ignore the rest.

If the frame of reference does not allow new learning, or the entrenched beliefs distort the new information, existing structures must be reorganized or repaired (Chi & Roscoe 2002). Mezirow's (1990a; 1990b; 2000) transformative theory attempts to explain how this happens. Vosniadou (1992, 1996) and von Glasersfeld (1995/2002), on the other hand, refer to the same phenomenon as revision and accommodation respectively. The following section considers the role of assimilation and accommodation in learning.

2.4.2   Assimilation

Piaget is considered a pioneer of the constructive theory of learning. Assimilation and accommodation are central concepts in his psychology. Assimilation is possible if new information does not contradict old schemas but adds to and extends them; mental structure remains unchanged (Chi & Roscoe 2002, 10). Vosniadou (1994, 150) and Chi and Roscoe (2002, 10) call this process "enrichment" of existing conceptual structures. If, however, the new experience is not in accordance with existing schemas, the learner needs to accommodate the schema to better correspond to the

reality of the experience. In accommodation, new information changes the existing framework. The learner understands the world in a new way (Piaget 1988).

Von Glasersfeld (1995/2002), however, claims that this interpretation is partly misleading, and that the misunderstanding is mainly due to errors in the translation of Piaget's work from French to English. Assimilation is not so much bringing new material from the environment into existing knowledge structures, "*as treating new material as an instance of something known.*" (von Glasersfeld 1995/2002, 62). This means that the organism assimilates from the experience what it recognizes as familiar and disregards the rest.

Von Glasersfeld compares the process to an old-fashioned machine that works with punched cards. The machine only recognizes as many holes in the card as it has been designed to recognize. Let us assume that the machine has been designed to accept cards with three holes. It accepts a card with five holes as well as a card with three holes, if the three holes match its programme. The point is that the machine does not see the two extra holes. In the same way, a living organism assimilating new information, "*remains unaware of, or disregards, whatever does not fit into the conceptual structures it possesses.*" (von Glasersfeld 1995/2002, 63).

2.4.3 Misconceptions

Chi and Roscoe (2002, 10) describe assimilation as embedding incoming information into existing mental model, whether the model is correct or flawed. Mental models may be flawed, because existing entrenched beliefs constrain them to the extent that leads to misconceptions. A case in point is children's misconceptions of the shape of the earth (Vosniadou 1996, 16). New information (the earth is spherical) that contradicts the existing belief (the earth is flat) is modified to fit the prior assumption. The result in children's drawings is a ball with a flat platform in the middle on which people are standing. Some children conclude that there must be two earths: one that is flat for people to live upon, and another spherical one which is a planet in space (Vosniadou 1996, 16). These naïve preconceptions – entrenched beliefs – proved to be highly resistant to change and constrained their mental models to the extent that old and new information assimilated into a new misconception. Jonassen et al. (2005) also propose that conceptual change does not necessarily result in meaningful mental models but possibly incomplete and fragmented ones.

Chi and Roscoe (2002, 4) define misconceptions as, "*concepts categorized into an ('ontologically') inappropriate category.*" Concepts thus miscategorized take on attributes from the wrong category and carry wrong assumptions about relations among concepts, thereby, preventing true understanding of the phenomenon being studied. Chi's and Roscoe's examples are derived from science studies where students find it hard to understand the concept of "electricity," for instance. They misclassify it

into the ontological category of "substance" while it, in fact, belongs to a "process" category.

The above is an example of a robust misconception, as it requires an ontological shift, i.e. conceptual change. Robust misconceptions are often theory-like. They have regularities, "*underlining guiding principles or laws.*" (ibid., 11). Carey (1992, 89) also describes learners' theories as complex mental structures with explanatory principles that account for them. It is because of these "laws" and "principles" that seem to apply in most cases that such theories are difficult to change.

All misconceptions are not robust but can be successfully dealt with by instruction. This is because they only require reorganization of concepts within the same category (Chi 2005; Chi & Roscoe 2002; Slotta, Chi & Joram 1995). An example could be classifying "cobra" as a poisonous snake in a category of snakes, whereas it might have previously been classified among non-poisonous snakes.

Vosniadou (2002, 65) agrees with Chi's and her colleagues' explanation of misconceptions, but argues that a conceptual change is not as quick and radical as they suggest. Instead, it is a gradual and time-consuming process. Chi (1992, 134), in fact, agrees, as she points out that the outcome may seem abrupt, but the ontological shift itself is usually a gradual process. Vosniadou (ibid. 65) also states that Chi's ontological categories lack a theory to explain the origin and development of such categories. Vosniadou (ibid., 65) sees conceptual change as a more complicated process involving, "*…a complex knowledge system that consists of network of beliefs or presuppositions that take a long time to change.*"

Whether we should talk about shift at all is addressed in the next section.

2.4.4   Accommodation

Accommodation takes place when the activity that follows assimilation does not produce the expected result (von Glasersfeld 1995/2002, 65). Von Glasersfeld's pattern has three parts:

1) Recognition of a certain situation;
2) A specific activity associated with that situation; and
3) The expectation that the activity produces a certain, previously experienced result.

This "action scheme" may change through accommodation if the result is somehow unexpected. In that case, the organism will review the initial situation more closely, and may now see characteristics that were first disregarded by assimilation. As a result of this review, the scheme may be changed so that it later recognizes these new characteristics as well.

For accommodation to take place after the review of the initial experience, the existing scheme has to change to allow a new interpretation. Thus, conceptual change can be seen to have two successive parts; the processes of change and the outcomes of change.

> *Change processes are those mechanisms that change learners' earlier knowledge and outcomes are the changes in knowledge. Conceptual outcomes can include enrichment, reassignment of concepts, change in the framework theory or the radical restructuring of earlier knowledge.*

> (Ruohotie 2003, 268)

Chi (1992, 129) makes a distinction between conceptual change that occurs within an ontological category and conceptual change across categories. The latter she calls radical conceptual change. A case in point is "*shifting electricity from 'substance' category to 'process' category*" (Chi & Roscoe 2002, 17). Reorganization, on the other hand, takes place within the same category involving hierarchical changes, or a change in perspective (Chi 1992, 142; Chi & Roscoe 2002, 17).

Radical conceptual change refers to the outcome of change, as the concept has been assigned to a new category. Chi (1992, 134) argues, as noted above, that this ontological shift is usually a gradual process, although the outcome may seem abrupt. In fact, concepts develop independently and do not evolve from the existing concepts that would change their meaning in the process. The initial conceptions may remain intact. Thus, what happens is not really a change, although the outcome may seem so (Chi 1992, 133–137). Radical conceptual change is difficult, since it requires (1) learning and understanding the new category, and (2) the realization that the concept does not belong to the category in which the person had assigned it (Chi 1992, 138).

Von Glasersfeld's notion of accommodation seems to agree with Chi's radical conceptual change and Mezirow's transformation theory. Whether or not the organism recognizes the result (3) as something disturbing that triggers the reviewing of the original sensory data, depends on the organism's ability, a preformed pattern, to recognize the results. Jonassen et al. (2005) call this an acceptance factor, ability to interpret the experience. The unexpected result, if recognized, produces a perturbation. Accommodation provides a means of moving away from the perturbation towards equilibrium.

The new equilibrium may be achieved by introducing a concept that itself is incompatible with the concepts in the existing structure. Such an inconsistency, in turn, creates a perturbation on the level of higher conceptual schemes. Thus the reconstruction of schemes may have to follow through the entire system to achieve a satisfactory equilibrium.

There is a wide consensus over the importance of learners' awareness of their need to change their conceptions. They need to recognize their entrenched beliefs before they can reject them and accept new information (Chi 2005; Chi & Roscoe 2002; von Glasersfeld 1995/2002; Jonassen et al. 2005; Slotta et al. 1995; Ruohotie

2003; Vosniadou 1996). According to Jonassen et al. (2005), cognitive conflict alone does not always suffice to trigger conceptual change. The disposition to change is affected by acceptance factors, e.g. ability to interpret the experience, generic factors, for instance prior knowledge, and rejection factors, such as tendencies to exclude, ignore, or reinterpret the conflict.

Apart from lack of awareness and other aforementioned factors that can make conceptual change difficult, learners "*may lack an alternative category to shift into*" (Chi & Roscoe 2002, 18). If that is the case, the need to help learners build a new category must be considered in instruction.

2.4.5   Conceptual change in teachers' thinking

The main difference between the traditional, behaviourist teaching approach, and the new, constructivist orientation to teaching and learning lies in the concept of knowledge; in the way knowledge is acquired, and how information turns into knowledge. Teachers' conception of knowledge determines their understanding of other central concepts in teaching and learning, such as teacher and student roles, and interaction. The conceptual change required, therefore, could be seen as a shift from one etymological category to another.

In Chi's ontological terms teachers with a behaviourist orientation classify "knowledge" into a "substance" category, and see it as a bulk, of which pieces can be transmitted to students. Instead, the nature of knowledge is more similar to electricity in the example (Chi & Roscoe 2002, 17) and belongs to a "process" category, to be created actively by students themselves (see also Poerksen 2004).

Chi (1992, 145), on the other hand, explains paradigm shifts as crossing ontological boundaries. Constructivism and behaviourism per se could, therefore, be regarded as different ontological categories containing different theories about the nature of knowledge, and different assumptions about teaching and learning. Consequently, teachers do not develop their behaviourist conceptions into constructivist ones, but learn new concepts altogether.

Further analogies can be seen in Vosniadou's (2002) research of conceptual change in science studies, where children's preconception of earth as a physical object rather than an astrological one influences their understanding of the day and night cycle. Similarly, teachers' preconceptions of knowledge acquisition may affect how they understand teacher and student roles in a learning situation.

In addition, the entrenched beliefs that teachers may have about teacher and student roles are likely to be theory-like and, therefore, robust, as they are based on the behaviourist theory of learning, with which teachers may have been indoctrinated during their own earlier studies. (See Mezirow 1990b, 3.)

Even if the analogy with Chi's and Roscoe's theory of ontological shift is not taken any further here, it is obvious that there are similarities between learning scientific concepts and new constructivist concepts in teaching and learning. There is also a similar risk for misconceptions occurring. If teachers are unaware of their own preconceptions, incoming new constructivist concepts, if incompatible, may be assimilated into their potentially flawed mental model and result in new kinds of misconceptions. The cognitive conflict that is required for accommodation can only take place if: teachers recognize new concepts as new and do not try to classify them into the old categories of students as rather passive recipients of knowledge, and teachers as in control of and transmitters of knowledge.

The online instruction experience that teachers were offered in the research reported here can be seen to follow von Glasersfeld's (1995/2002) action scheme. Teachers were expected to recognize the similarities and differences in constructivist online instruction compared with traditional classroom instruction, act on that recognition by producing online courses or learning tasks, and finally, interpret their experience: Did the result meet their expectations? This interpretation may lead to accommodation of existing meaning structures. In other words, the frame of reference becomes transformed. Through transformation the frame of reference becomes more inclusive, more flexible, and more capable of change. This process may itself become a new dispositional orientation, thus allowing continuous transformative learning. (Mezirow 2000, 19.)

2.4.6   Conceptual change through instruction

Von Glasersfeld's action scheme seems to have been implemented in Kolari's and Savander-Ranne's (2000; 2002) teaching and learning method that, according to their research, promotes conceptual change. Kolari and Savander-Ranne emphasize the importance of peer dialogue and demonstrations in revealing and challenging students' preconceptions. In their articles, they discuss, for example, dealing with the concepts of "combustion" and "friction."

Students are first asked to predict what will happen in the demonstration of burning iron wool and then discuss their views in pairs. At this stage, students rely on their preconceptions of the phenomenon of combustion. The demonstration follows, and students can actually see how, in most cases, their predictions were not correct. They continue the discussion to better understand where they went wrong in their prediction, and the scientific reasons for the unexpected result.

Here we can see von Glasersfeld's action scheme take place: Stage 1: recognizing burning as a familiar phenomenon, Stage 2; the actual burning of iron wool, and Stage 3; expectations of what the result will be. According to Kolari and Savander-Ranne, the demonstration is an effective way to concretely bring out the contradic-

tion between students' expectations and physical evidence, which will trigger accommodation and conceptual change. (See also Mällinen 2005, 68.)

Jonassen et al. (2005) suggest model building as a semantic tool for learning. Technology-based modelling tools scaffold and externalize internal, mental models which enable learners to see the discrepancies in their own thinking and others'. On the other hand, ongoing model building reveals the process of learning for assessment purposes as well. Such a tool in its simplest form might be a concept map, for instance.

Chi (1992, 145) is sceptical about the recent technological approaches and popular group and paired discussions in fostering conceptual change. In the former case, she doubts that events could be better understood by substance-based models. This should be understood in light of her ontological shift theory in which events and substances are laterally different categories. As regards discussions, her critique focuses on not knowing each individual student's initial ideas as students function as a group. She also claims there is not evidence of how group discussions can promote radical conceptual change.

The role of peer discussions in learning is dealt in more detail in the following chapter on transformative learning and dialogue.

2.5 Transformative learning

Mezirow (1990b; 2000) defines learning as making meaning of our experiences, as interpretation. How we interpret the new experience depends on our previous experiences, which have created our frames of reference. Our interpretation is not objective; instead, it is filtered by different kinds of assumptions and attitudes, by entrenched beliefs. New learning does not take place unless we are able to see what the filters are, and reassess their validity in making meaning of new experiences. According to Mezirow (1990b; 2000), transformative learning involves a change in a person's meaning perspectives. This happens through critical self-reflection.

An example of transformative learning is a woman who abandons her traditional view of her role as a woman after becoming aware of different conceptions of being a woman (Mezirow 1990b; 1998). Similarly, a teacher may be able to change his or her view of what being a teacher involves, and how learning occurs. Such a change requires transforming one's habit of mind regarding teaching and epistemological theories. According to Mezirow, transformations often begin with a disorienting dilemma, a problem that seems impossible to solve by conventional methods. In this study it was assumed that ICT in instruction might present itself to teachers as such a dilemma (see also King 2002).

Teachers are not happy with their rote solutions in solving this new problem. This is where teachers also seem to feel they lack pedagogical skills and expertise. They may not question their beliefs about learning, but suspect their teaching methods may not be appropriate as such to be translated into electronic form. What works in the online environment? How is learning achieved in a virtual classroom? Where should they begin? These are questions teachers ask themselves. According to several surveys, teachers want to learn more about ICT in instruction (Aarnio & Enqvist 2004; Koivisto & Ilomäki 2001; Sinko & Lehtinen 1999). Mezirow emphasizes the importance of "*what learners want to learn*" as a starting point in fostering transformative learning efforts (Mezirow 2000, 31).

In the following section the different aspects of transformative learning are discussed in relation to teaching and learning, and teachers' pedagogical thinking: meaning perspectives, reflection, critical discourse, and domains of learning.

Meaning perspectives

Meaning perspectives, or frames of reference, are a set of deep-rooted assumptions that guide our interpretation of an experience, i.e. the meaning that we give to an experience, "*we filter sense impressions*" (Mezirow 2000, 16). Meaning perspectives develop over time and can change through transformative learning. Mezirow's examples of assumptions that form our frames of reference include, among other things, a person's learning style and his preference to focus on either wholes or parts, fear of change, and thinking conventionally about one's roles. Mezirow goes on to explain how one's frame of reference may include "*intentionally or incidentally learned philosophical, economic, sociological, and psychological orientations and theories…*" (Mezirow 2000, 17).

A frame of reference has two dimensions: a habit of mind, and points of view. A habit of mind is usually stable, developed over time, and resists change. Points of view are the expressions of a habit of mind. They comprise meaning schemes, such as immediate expectations of cause and effect, feelings, and attitudes. People are usually unaware of their meaning schemes and automatically follow the line of action that seems natural. This restricts a person's ability to see objectively.

Points of view are, however, subject to change as we try to understand actions that do not meet our expectations (Mezirow 1997). Critical reflection can bring the meaning schemes out in the open and subject to reassessment. Because a habit of mind also comprises affective and conative dimensions, viewpoints that question the presuppositions are experienced as threatening, and contradicting information may be dismissed as wrong.

Teachers' epistemological views are often found to influence their understanding of how learning takes place. This understanding is reflected in their pedagogical approach (Tynjälä 2002). It seems logical to assume that teachers' epistemological

views, and their conceptions of how students learn, as well as of the roles of teacher and student, constitute the kind of meaning perspectives that Mezirow refers to as part of a person's frame of reference, a habit of mind. Mezirow (1990b, 3) points out that although most meaning perspectives are acquired through cultural assimilation, others, like positivist, behaviourist, etc, may be intentionally learned.

These assumptions determine teachers' approach to teaching and learning, and their interpretation of the outcomes of learning. Similarly, a teacher's pedagogical approach could be seen as their point of view that is expressed in the practical teaching solutions, the choices that a teacher makes, and the expectations of outcomes.

A simplified example of such a cause and effect expectation would be teachers' view that students learn by drilling an exercise. If the desired learning does not take place, teachers are unlikely to start questioning the premises of a drilling exercise, unless they are willing to critisize their own approach to teaching. Instead, they might conclude that the drill was too short, the students were not paying attention, etc.

Mezirow (1997) identifies four processes of learning: elaborating an existing point of view, establishing new points of view, transforming a point of view, and transforming a habit of mind. The fact that a habit of mind resists change, and triggers automatic responses to situations, may help to explain why it seems to be easier for teachers to approve of a new teaching approach or new methods than to actually manage to implement them in their teaching. (Aarnio & Enqvist 2004; Prawat 1990; Sinko & Lehtinen 1999; Wishart & Blease 1999.)

2.5.1 Reflection

Reflection as a mental process is extensively dealt with in educational research (Bolton 2005; Brusling & Strömqvist 1996; Little 2004; Mezirow 1990b; 1997; 1998; 2000; Rogers 2001; Ruohotie 1999; 2000b; Schön 1983; Zeichner 1993). Although a multidimensional concept, reflection is commonly defined as a person's attempt to better understand his or her own actions, choices and decisions, those of somebody else, or one's own work or learning. Reflection is triggered by an atypical incident or experience. In addition, a person should have the readiness to engage in a reflective process (Rogers 2001).

The concept has been so widely used in recent pedagogical discussion that, in collegial talk, teachers seem to have grown tired of the term. As Bolton (2005, 1) notes: "*The term has lost some credence, becoming a catch-all name for a wide range of activities…*" With teachers this may also be the case, because the concept sounds too academic and has not been really understood. Little (2004, 22) points out that "reflection" basically means thinking about what you are doing. If, for instance, students are to take more responsibility for their learning, it is necessary for them to think about it. Also, it seems safe to assume that all teachers think about teaching when

they are planning it, while they are actually teaching, and even afterwards. Mezirow (1990b, 6), however, would call this thoughtful action, if it is drawing on what one already knows. What makes thoughtful action reflection is critical assessment of assumptions. The following looks at the different forms that reflection can take and how it contributes to transformative learning.

Self-reflection (Schön 1983) is seen as a vital part of all teaching and learning. Bolton (2005, 9–10) seems to discuss this using the term "reflexivity":

> *Reflexivity is making aspects of the self strange: focusing close attention to upon one's own actions, thoughts, feelings, values, identity, and their effect upon others, situations, and professional and social structures.*

Although self-reflection can help teachers see their own work more objectively, reflection alone is not enough to develop professional competence or effect change. It should be seen as one form of professional development complemented by dialogue with colleagues, for instance (Kauppi 1998; Ruohotie 1999). Change necessitates "otherdirectedness" (Ruohotie 1999, 32), ability to *real-time reflection* on others and their needs, i.e. interdependence (Ruohotie 2000b, 215).

Ruohotie (1999, 30) defines real-time reflection as becoming aware of what is actually happening during an experience, what it means, and what should be done about it. Based on this reflection a decision can be made on subsequent action. Expert professionals are capable of real-time reflection (Ruohotie 2000b, 149). Thus, an experienced teacher is able to make quick pedagogical decisions in real time and change the lesson plan if the situation in class so requires. This could also be called *reflection-in-action* as opposed to *reflection-on-action* that takes place afterwards (Schön 1983; Ruohotie 1999, 31).

In Mezirow's transformative learning theory, reflection has a key role. Mezirow (1990b; 1998; 2000) makes a fine distinction between *reflection* as such, *critical reflection and critical self-reflection*. Critical reflection of assumptions questions conventional practices, the established definitions of, for example, being a teacher. Critical self-reflection questions the validity of one's own beliefs, own frames of reference. Teachers who are engaged in critical self-reflection begin to challenge the validity of their presuppositions of teaching and learning. They start asking questions like, "What is learning?" and "Why do we use these teaching methods?" These questions soon lead to questioning one's own beliefs: "How do I think students learn?", "Why do I think so?", "Am I right?" Through critical self-reflection, teachers become aware of their entrenched beliefs and do not take them for granted anymore.

Transformative learning requires critical self-reflection. Transformation begins when a person becomes aware of their own frame of reference. It is a process, "*by which we transform our taken-for-granted frames of reference (meaning perspectives, habits of mind, mind-sets) to make them more inclusive, discriminating, open, emo-*

tionally capable of change, and reflective so that they may generate beliefs and opinions that will prove more true or justified to guide action." (Mezirow 2000, 7–8).

Mezirow points out the importance of reflection with adults to question the validity of what they have previously learnt in today's changed circumstances. A case in point could be teachers who themselves were mainly taught according to the principles of behaviourism, and now find themselves in a world that seems to call for a more constructivist approach to teaching and learning. Thus, reflection is, for example, reassessing one's teaching strategies and procedures, or stopping to think in the middle of a classroom situation why a method is, or is not, working. In teachers' work, transformative learning empowers teachers in a new way (see also King 2002). Teachers are able to free themselves of beliefs and assumptions that have restricted their thinking and actions. This, in turn, enables them to plan online teaching with a more open mind to new concepts and innovative solutions.

2.5.2   Critical discourse and dialogue

Transformative learning is fostered in discourse; a rational dialogue, which is a special form of interaction where the participants as openly and objectively as possible try to present and assess arguments, and reason together to solve a problem. In critical discourse the participants seek, "*consensual validation of assumptions.*" (Mezirow 1999, 10; 1997). To achieve this, participants need to be able to bring their hidden beliefs and tacit knowledge out in the open for validation. They also need to be able to critically view each other's assumptions as well as their own. This necessitates critical reflection (Mezirow 1998). Instead of trying to win an argument, the goal is to generate new shared knowledge, to better understand different ways of thinking, and to reach a broad consensus, a new understanding that is more flexible and more inclusive than one's own. (Aarnio & Enqvist 2004; Mezirow 1998; 2000; Tella 1998; Turjanmaa 2005). Tella and Mononen-Aaltonen (1998) point out that dialogue is an essential part of any education, the key concept of the teaching/learning process, especially in technology mediated learning environments.

Critical discourse thus defined does not seem to be unlike "dialogue," which has been extensively dealt with by i.a. Isaacs (1999) and Burbules (1993). Isaacs (1999) points out that dialogue is more than social interaction; it involves an ability to really listen to others and to be ready to change one's own opinions. This could perhaps be described as "interdependence" (Ruohotie 2000b, 215), a term that seems to capture the essence of dialogue.

Aarnio and Enqvist (2004, 14) define dialogue as thinking together based on people's equal participation in trying to understand a matter or action. Burbules (1993, 36–41) lists six emotional prerequisites of dialogue: concern, trust, respect, appreciation, affection, and hope. In true dialogue you are concerned about others, not just

yourself, you trust others, respect their views as well as your own, and appreciate the uniqueness of others. Thus, trustful relationships are, on one hand, essential conditions for dialogue (Taylor 2000, 307). On the other hand, true dialogue brings about feelings of affection and intimacy, and it is characterized by hope of mutual understanding (Burbules 1993, 36–41).

It is this emotional aspect of dialogue that McLaughlin (2000) emphasizes. Her research shows that students find learning enhanced if the teacher is capable of true dialogue with the class. True dialogue is a joint construction of meaning between the teacher and the students, and between students and students. The interpersonal qualities that this calls for from the teacher are respect, understanding and ability to listen to students. From the students' point of view, dialogue is different from being talked at. Listening, in particular, is central, although also difficult; as teachers may hear something they do not want to hear. McLaughlin (2000) concludes that listening and dialogue are closely linked to control issues. Fear of losing control may prevent true dialogue.

Dialogue is not easy. Merriam (2004) draws attention to the high level of cognitive development that critical reflection and reflective discourse require. Her views are supported by Mezirow (2004) in that learners should have reached the capacity to engage in transformative learning in their cognitive development. Once learners have the capacity, educators may help them to realize that potential.

Too often in pedagogical talk dialogue is confused with discussion as the basic form of social interaction. Discussion and debate aim at winning an argument, analyzing things. This often leads to different points of view (Bohm 1990). Aarnio and Enqvist (2004, 28) describe the differences between a monologue and a dialogue. Monologue is about oneself, one's own ideas presented as a product of one's own thinking, one-way communication. If you are not quite sure of something, you prefer to keep quiet about it. In dialogue, however, thoughts and views are discussed and developed together; things are left open as long as possible as in planning, for instance, to allow new ideas to contribute to the end result.

Mezirow (2004) states that there may be cultural differences in how people engage in critical reflection and dialogue, and these should be considered in education. Could Finns perhaps be more disposed to an exchange of monologues rather than a mutual dialogue? Finnish students do not easily engage in discussing half-baked ideas but prefer to contemplate ideas on their own, and express only a well formulated thought. This may also explain their poor performance in argumentation skills (Lehtinen 1997; Marttunen & Laurinen 2001; Steffensen 1996).

Dialogue promotes communicative learning. The following section looks at the two domains of learning as defined by Mezirow (1997; 2000), instrumental and communicative learning.

2.5.3   Domains of learning

Mezirow (1997; 2000, 8–10) differentiates between instrumental learning and communicative learning. Instrumental learning aims at improved performance, whose results can be empirically tested; learning to do. One example is teachers' desire to master the technology of online instruction and to find the best practices that result in enhanced learning. Learning takes place through modelling and is based on experience (Turjanmaa 2005, 68). Previous experience and knowledge is applied in a new situation. This is why teachers may want to repeat good classroom practice in their online instruction (Mällinen 2001). However, accepting old forms of thinking without questioning them may also prevent true learning, for instance, seeing the new possibilities for meaningful online learning.

Communicative learning, on the other hand, is not as much learning to perform well in changed circumstances as it is understanding the meaning of what other people communicate concerning values, feelings, moral issues, etc (Mezirow 1990; 1997; 2000). Communicative learning tries to look beyond the words of the persons who are communicating with you, and really understand what they mean. The aim is not to find one right solution, but to understand different ways of defining and approaching the problem. At the same time one is being critical about the very premises of one's own and others' assumptions.

Frames of reference can be transformed in either domain through critical reflection (Mezirow 2000, 9). In instrumental learning, critical reflection focuses on the content and processes of problem solving; e.g. how to grade students, how much weight to give to the final test as opposed to written assignments, participation, etc. In communicative learning, critical reflection focuses on the premises of defining the problem; e.g. what to grade, what is the purpose of assessment in the first place, what is the best form of assessment.

2.5.4   Experience-based knowledge and transformative learning

The tacit knowledge that a person may have acquired through experience is generally considered an asset in learning (Dewey 1938; Janik 1988; Knowles 1980; Kolb 1984; Ruohotie 1996; 2000b; Zeichner 1993). It seems, however, that experience alone does not necessarily promote learning. How we make meaning of the experience and what filters our interpretations determines what we learn (Leino 1999; Mezirow 1990b; 1997; 2000). The question of experience in learning is dually important for teachers, since they are dealing with students' experiences and their own, and both have a bearing on the learning outcome.

A case in point is online instruction. Teachers, new to online teaching, are likely to draw from their classroom experience (Pulli 2003). In this study, all teachers who

participated in the in-house training programme and created online material had many years of teaching experience. Therefore, it is logical to assume that these teachers based their pedagogical decisions in online instruction on the experience they had acquired in classroom teaching.

Kolb (1984, 36–38) points out that experiences do not produce learning, unless something is done with the experience; "*knowledge is created through the transformation of experience.*" Transformation takes place through abstract conceptualization and reflective observation. Engeström (1987, 217–218) goes even further in questioning the value of experience. In his view, more experience can, in fact, strengthen rigid and biased routines and thus prevent true learning. This is because practitioners learn from outcomes. Marsick (1990, 24) also sees the danger of repeating the same mistakes in relying on personal experience, but points out that coupling reflection with experience reduces error.

Engeström's example of practitioners can easily be applied to teachers. Rigid routines are the pedagogical decisions teachers make every day based on their entrenched beliefs of teaching and learning, which may make the routines biased as well. Teachers may then decide on the effectiveness of certain teaching methods based on the learning outcomes of their students. In reality the methods may not have had anything to do with student learning. A learning situation is so complex that determining the true cause of learning would require a thorough analysis of the whole situation and factors affecting it. Even if the method worked in that particular case, the reason why it worked may have been very different from what the teacher thought it was. Engeström draws from Brehmer's (1980) research on learning from experience:

> When we learn from outcomes, it may, in fact, be almost impossible to discover that one really does not know anything. This is especially true when the concepts are very complex in the sense that each instance contains many dimensions. In this case, there are too many ways of explaining why a certain outcome occurred, and to explain away the failures of predicting the correct outcome. Because of this the need to change may not be apparent to us, and we may fail to learn that our rule is invalid, not only to particular cases but for the general case also.
>
> (Brehmer 1980, 228–229, according to Engeström 1987)

The problem with generalizing from similar experiences, induction, is that the practitioner may develop deterministic causal rules which are not valid.

Kohonen (1999, 58) describes transformative learning with teachers as follows:

- Seeing oneself as a life-long learner;
- Reflecting on own assumptions, pedagogical choices and the results;
- Observing own work to get new perspectives;
- Discussing one's beliefs in collegial interaction;
- Integrating new knowledge into experience;

- Facing the uncertainty when realizing the discrepancy between own practice and pedagogical thinking;
- Having courage to change routines and try something new, and observing and reflecting on the results;
- Realizing the importance of interaction in professional development and seeing oneself as a resource for others' professional growth.

There is plenty of evidence to support the fact that the dilemma alone, ICT in instruction, is insufficient to trigger transformative learning. Research shows that too many online courses are material heavy and technology-led, because they are merely translations of lecture notes into html-format, or experimentations of the exciting things that the technology can be used to produce (Coomey & Stephenson 2001; Sinko & Lehtinen 1999). These are electronic versions of transmitting knowledge.

2.5.5   Unresolved issues in transformative learning

This chapter discusses some critical perspectives of transformative learning. The theory has been challenged about 1) the educator's role, 2) lack of context, 3) its over-reliance on rationality, and 4) disregard of relationships and social action

The question that has not been answered in the transformational theory to the satisfaction of many educators is how to facilitate transformative learning (Ruohotie 2000b, 198; Merriam et al. 2007, 154). Brookfield (1990) suggests critical questioning and critical incident activity, Cranton (2000) offers various methods from role-play and simulations to journal writing and life histories. The educator's right to tamper with people's minds has also been questioned (Merriam et al. 2007, 154). Mezirow (1990a, 361) is aware of the ethical implications in fostering transformative learning. He, however, defends the theory on the grounds that emancipatory education enables learners to critically reflect on, not just their own, but also others' assumptions, and this way become less susceptible to indoctrination.

More attention to the context of learning, such as the learner's biographical history and sociocultural factors has also been called for. These seem to account for individual differences in transformative learning and explain why a disorienting dilemma may trigger the change process with one learner but not with another (Taylor 2000). Merriam et al. (2007, 150) list several studies that draw attention to the importance of context in the transformative learning process, which previously may have been neglected in the theory. Mezirow also recognizes the biographical, historical, and cultural factors in learning in his later work and emphasizes contextual understanding (Mezirow 2000, 3).

The theory has been criticized for relying on critical reflection and rationality on the expense of other ways of knowing, such as emotions, for instance (Taylor 2000,

303). Kohonen (1999) draws attention to the feelings of frustration and uncertainty when one's deep-rooted beliefs are questioned. Although Mezirow (2000, 3) briefly acknowledges intuition, imagination, dreams and feelings in the transformation process, other transformative learning scholars pay more attention to affective factors in learning (Meriam et al. 2007, 151; Taylor 2000, 303). In fact, "*affective learning plays a primary role in the fostering of critical reflection*" (Taylor 2000, 305).

Closely related to feelings and emotions are relationships and relational knowing. Building trustful relationships, where information can be shared in a non-threatening environment is crucial in learning. The original theory gave little attention to the role of relationships and their impact on transformative learning (Taylor 2000).

Finally, Mezirow has been criticized for focusing too much on the individual change (Merriam et al. 2007) which he sees as a prerequisite for social action (Mezirow 1990, 363). Social action in many examples refers to liberating the oppressed. Brookfield (2000, 143) summarizes the critique that some adult educators have expressed about transformation theory and social action:

> *Without consequent social action, critical reflection is castigated as liberal dilettantism, a self-indulgent form of speculation that makes no real difference to anything.*

Mezirow (1998) obviously disagrees and claims that a changed way of understanding the world represents a significant form of mental action. The educational task of critical reflection is different from political mobilization. Societal questions aside, this author agrees with Brookfield (2000) on that critical reflection at its best is a social process, where peers act as sounding boards to each other, supporting each other and reflecting back assumptions and beliefs in a way that make one aware of the disturbing contradictions in learning.

2.6   Towards online pedagogy

The use of Information and Communication Technologies in instruction has produced an array of terminology, which can be very confusing. It is common to talk about "online learning," "web-based learning" or "web-based instruction" and "eLearning" when referring to learning arrangements via the Internet. The term "Information Technology" (IT) refers to technology per se, whereas "Computer Aided Instruction" (CAI) is used to refer to the earlier applications of computers in instruction without the Internet connection. M-learning, making use of wireless, mobile technologies is the newest development to enable learning everywhere, for instance, while travelling (Alexander 2006; Tella et al. 2001).

In this study, the terms "online course" and "web-based course" are used to refer to learning arrangements that can be accessed through the Internet by a particular

group of students on a subject or subjects that correspond to the courses in their curriculum. "Virtual learning environment," "online learning environment" or simply "online environment," or "virtual classroom" refer to teaching arrangements that can be accessed via the Internet, and can comprise several courses. In this case the online learning environment was a WebCT platform, on which all the online courses under study were produced.

Participating teachers in their interviews and manuscripts referred to this online environment as a "Net" for short. This informal expression is retained in the interviews, analyses, and subsequent discussions in order to be true to the data and the experience of the participants. "Net" has connotations that are not necessarily the same as with other terminology, the Internet or WebCT.

Finally, "online pedagogy" is used to refer to such pedagogical solutions that enable the utilization of information networks in the most purposeful way. The term refers to the teaching approach and the methods aimed at enhancing learning in an online environment. It is recognised, however, that no new pedagogy has yet been developed for online learning.

In the following section, development of the use of computers in instruction is briefly summarised. The prevailing learning theories are reflected not only in teaching practices and the use of available technology, but also in research conducted at the time.

New technologies in instruction

New technologies do not automatically inspire new pedagogies. Technology can be used to reinforce the existing teaching approach as well as to enhance or change that approach. It all depends on how the teacher decides to use this technology. Skinner developed his teaching machines to effectively implement the behaviourist theory of learning. A great deal has happened in the field of teaching technology since then, and before the emergence of the World Wide Web and virtual learning environments.

Cuban (1986) discusses use of technical innovations in education from the 1920's to the 1980's. Though his report preceded the Internet's influence, there seems to be a pattern in how teachers' take new technologies into use. Usually, innovations are introduced by policy-makers and school authorities hoping to make education more cost-effective. Radio, television, overhead projector, film, and computer have each been seen as a promise of something greater than they could deliver. Cuban quotes Edison from 1922:

I should say that on the average we get about two-percent efficiency out of school-books as they are written today. The education of the future, as I see it, will be conducted through the medium of the motion picture…where it should be possible to obtain one hundred percent efficiency.

(Cuban 1986, 9)

The printing technique seems to be the one technological innovation that has lastingly impacted education. The motion picture has not revolutionized it. From the viewpoint of the present research focus, however, Cuban's findings on how teachers used these new technologies are more interesting. In most cases, teachers were not able to utilize the novelty of the equipment in any way, and often the result was a worse lesson than before. The TV was wheeled in, switched on and a programme was watched. A question was finally raised, whether children, after all, learnt better from a live teacher than from a TV instructor.

The overhead projector provides another example of a technological innovation often misused. We are all familiar with lectures that are based on transparency after transparency featuring too-small text. The overhead image became an extension of teachers' lecture notes in transmitting knowledge.

More recent technical innovations that have raised great expectations are, for instance, artificial intelligence and wireless devices, which were expected to enable learning even while on the move. It soon became evident, however, that technology had its limitations in modelling and reproducing human cognitive processes, let alone the affective and conative constructs that contribute to learning. Similarly, the tiny display of a mobile was badly suited to long textual material (Järvelä, Häkkinen & Lehtinen 2006).

Experiments in the use of computers as a teaching aid were conducted in universities as soon as computers were developed. In the 1970's when the first microcomputers were introduced to schools they quickly became a natural part of teaching. According to Sinko and Lehtinen (1999), experiences from the late 1960's and early 1970's concluded that computers seemed to help in training basic skills. Since the dominant theory of learning at that time, behaviourism, relied on repetition and reinforcement in learning, primarily drills and practice programs were developed. The programs were not designed for teaching higher-level cognitive processes.

Results from 1970's through early 1990's confirm earlier findings of the effectiveness of CAI. In addition, positive changes in the attitudes of students towards school, and higher motivation, were also detected. (Cotton 1997.)

Until the 1990's, the focus of research had been on the effects of Computer Aided Instruction. Gradually, there was a shift towards different ways of using computers and the computer technology know-how of teachers. Ryan (1991) categorized the different uses of computers in instruction into drill and practice programs, tutorials, simulations, programming language, discovery programs and utilities. His findings suggested that a combination of uses was generally more effective than any single

method. Ryan also analysed the effects of teacher training in computer use. The longer the training, the more effective the experiment proved to be.

Recent studies show quite the opposite results when compared to earlier findings. Instead of drill and practice, programs demanding more autonomous active problem-solving from the learner are seen as the most effective. In fact, there is evidence that the effects of drill and practice are relatively small and do not last long (Sinko & Lehtinen 1999).

As controversial as the conclusions of earlier and recent studies may seem, they can be understood against the prevailing theories of learning at each time of study. The studies conducted in the 1960's through 1980's were still influenced by behaviourism and the ideas of programmed instruction. Electronic learning environments based on the constructivist theory of learning were only developed at the end of 1980's and during the 1990's. With the new learning theory and new software studies have also focused more on processing information, metacognition, problem-solving skills, and collaborative learning. State-of-the-art technology alone has proved insufficient in promoting learning. The focus now has shifted from sophisticated hardware on pedagogical principles that should take precedence such as how to promote social interaction through wireless solutions (Järvelä, Häkkinen & Lehtinen 2006).

2.6.1   ICT in instruction

At the moment there seem to be two basic approaches in the use of ICT in instruction: 1) to use the Internet as a source of information, and to deliver teaching materials or automated drills and quizzes; 2) with the help of advanced software to create virtual learning environments. The first approach aims at transferring knowledge in a more effective way and making it available for a larger number of students. The virtual learning environment approach aims at promoting problem-solving skills, critical thinking, and knowledge construction by generating social interaction and collaborative activities for the students.

A new, revolutionary concept in teaching and learning worldwide is said to be a "learning object" (Jaakkola et al. 2004; Nirhamo & Lehtinen 2004). The learning objects can be part of any teaching and learning situation, but their advantages in online learning are especially emphasized. The idea is for teachers to use entities of digital learning material that can be shared via the Internet. Although learning objects can be used to support different orientations to teaching and learning, researchers see their strength in enhancing distributed teaching, which provides an opportunity to promote new pedagogies (Ilomäki & Paavola 2004).

Teacher collaboration in producing and sharing common online teaching and learning materials also provides opportunities for professional growth. Aarnio and Enqvist (2004) report on a model (DIANA) of how to support teachers in their ef-

forts to create meaningful online learning experiences for their students. Teachers are brought together to discuss their problems in online solutions, which promotes critical discourse.

The following literature review examines how teachers have used the different opportunities that the Internet offers.

Paradigms of online learning

The results of the multitude of studies conducted on the benefits and shortcomings of online learning may be inconsistent, because of the way ICT has been used in each case. An example of the transmission of knowledge via the Internet is the study by Faux and Black-Hughes (2000). Faux and Black-Hughes came to the conclusion that traditional lectures are more effective in teaching social work history than web-based instruction.

In their study, the Internet was used to offer video recordings of live lectures to present the course notes on the Web sites, and to suggest useful links for students to browse. The biggest problem for the instructor was to make sure that the links were current and that the information was reliable. In short, the web-based instruction did not offer anything new. The teacher was doing most of the work on behalf of students. The Internet, compared with classroom teaching, seemed to merely complicate instruction.

On the other hand, Lehto and Terva (2001) give an example of an ideal self-directedness and autonomy of students on an online course, where students introduce themselves and form groups on the basis of common interests, define their learning goals collectively, and create and share learning material via the Internet. There is plenty of evidence of successful use of ICT in instruction to create authentic problem-solving tasks, and to promote students' metacognition and self-directedness (i.a. Bonk et al. 2001; Ilomäki 2004; Kallila 2002; Niemi 2002; Tella et al. 2001).

The majority of cases of ICT in instruction at the turn of the millennium, however, seem to have fallen between the two extremes, showing features from both traditional and constructivist approaches. A review of 100 research reports and journal articles on the experience of online learning and teaching (Coomey & Stephenson, 2001) indicates that teachers' epistemological beliefs and theories of learning determine what kind of courses they produce on the Internet. Coomey and Stephenson have described in grid format the different paradigms of learning and teaching, which surfaced from their analysis of online courses. The online courses they studied seem to fall in four categories that Coomey and Stephenson describe as North West, North East, South East, and South West.

Specified tasks

NW   NE

Teacher controlled   Learner managed

SW   SE

Open ended, strategic
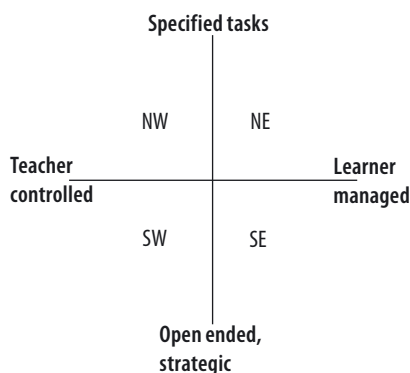
Figure 2.   Online paradigms grid (Coomey and Stephenson 2001, 41)

The NW sector of the grid represents the most traditional teaching with a lot of teacher control and teacher specified tasks. The online content is often text- based leaving the learner with little initiative. The reading material as well as assignments could all be set in advance. The SE sector, on the other hand, seems to include the constructivist teaching approach with open-ended, strategic assignments and learner-managed learning. Students can have personal goals and a lot of freedom of choice. The NE and SW sectors have something of the both extremes in varying degrees.

On the basis of their research, Coomey and Stephenson have also been able to create a framework of four common features that seem to play a key role in online learning. The features are Dialogue, Involvement, Support, and Control (DISC). Dialogue must be carefully structured in the course. It can take place between students themselves, students and the instructor or the students and an expert. Dialogue can be made possible with Web tools like e-mail, bulletin board, realtime chat, asynchronous chat, group discussions, etc.

Involvement refers to students' active engagement with material, student collaboration and motivation. Students also need support from each other, from the teacher, from experts, and from technical personnel. Control refers to the extent to which students have control of their own learning activities such as pacing and timing, choice of content and goals, etc. According to Coomey and Stephenson, all of the above features can be present in various degrees and in different variations depending on the paradigm that the online course represents.

The strength of Coomey's and Stephenson's grid is that it does not attempt to give a norm as regards the best approach to online teaching. The authors recognize the different teaching approaches and, based on research evidence, are able to give practical suggestions on how the DISC features can be implemented within each paradigm. For example, a teacher in the NW sector can create dialogue by making online participation a requirement and create reasons to participate. A specific task could be introducing oneself in a discussion forum with everybody commenting on

each other's introductions. On the other hand, in the SE sector the teacher can make a variety of discussion groups available and let students choose in which to participate. On a course in the SE sector, students lead discussions, seek external specialist assistance, etc.

Coomey's and Stephenson's grid provides a useful means for teachers seeking self-improvement through heightened insight into their own teaching/learning beliefs and practices. Often one may agree with the constructivist approach and regard oneself as a constructivist. A closer look, however, reveals that over time, teaching practices have not significantly changed. This discrepancy in teachers' ideas about teaching and their actual teaching practices seems to be surprisingly common (Prawat 1990; Sinko & Lehtinen 1999).

2.6.2   Online constructivism

There is no scientific evidence that Information and Communication Technologies in instruction would automatically convert traditional teaching practices into constructivist pedagogies. The paradigm change and the introduction of ICT into teaching are not interdependent. They merely coincided (Ilomäki & Paavola 2004, 51; Pantzar 2002, 105). Nevertheless, it may be safe to say that the two are interrelated, since so many researchers agree that ICT in instruction enables the promotion of the constructivist teaching approach that helps to meet the new requirements in working life (Bennett & Lockyer 2004; Bonk et al. 2001; Brown 2004; Jonassen 1995; 1999; Lehtinen 1997; Marttunen 1997; Macdonald 2004).

Pantzar (2002, 110) points out that perhaps the most significant improvement that ICT has brought into instruction has been the possibility to promote collaborative learning through electronic networks. Searching for information, liaison with experts all around the world instantly and in real time, production of one's own material and making it easily available for others, as well as collaboration in constructing knowledge independent of time and place are also typical features of online learning (Haasio 2002, 15).

The freedom of time and place is somewhat relative, however; the student as well as the teacher is always bound by time and place, and other circumstances, when they access the Internet (Tella et al. 2001, 35). Students do not always have an Internet connection in their student flats. Teachers may not want to work from home at odd hours. Usually, an online course is also rather strictly scheduled with deadlines for student assignments. Still, time and place are less binding as in the traditional classroom allowing both students and teachers to find the best slot in their otherwise busy timetables to concentrate on online learning.

Tella (1998) also notes that ICT may have deep going impact on our sense of time. There is a risk that immediacy that networked technologies provide and seem to de-

mand may not leave us enough time for reflection and deliberation. We are expected to respond without delay. This urgency that may linger from students' and teachers' other uses of ICT (e-mail, realtime chat) should be considered when planning computer-mediated learning.

Jonassen sees use of ICT in instruction as a means of changing direct teaching into indirect teaching. He emphasizes that there is a difference between learning with technologies and learning from them (Jonassen 1999, 12). Technologies should not be used as delivery vehicles but rather to promote the principles of meaningful learning which describe learning as active, constructive, intentional, authentic and co-operative. Technologies serve as tools for knowledge construction, accessing information, simulation of real-world problems, collaboration with other learners, and for helping learners to show what they know (Jonassen 1999, 16).

The information network as a learning environment is still relatively new to students and teachers, perhaps especially to teachers. Young people may surf on the Internet more and learn its special characteristics. They use instant communication tools (i.a. Messenger, Skype) and play Internet games. For many teachers the Internet may still be somewhat unfamiliar as a networking tool (see also Bennett & Lockyer 2004; Mällinen 2001).

Ihanainen (2002, 154–157) discusses the different characteristics of the Internet as a learning environment. It may come as a surprise how restless it is, how instant the communication. At the same time it is very revealing; everything we say is documented and can be reviewed later. Communication is fragmented, it does not seem to have a real beginning or end, and it is full of surprises. This is because all other means of communicating are missing (facial expressions, gestures, tone of voice). Therefore, it is difficult to anticipate others' reactions. The Internet is also distant, which affects communication. You are not in the same place with others and you cannot be sure who are there with you.

The Internet can also be very addictive, or just the opposite – annoying and frustrating. Frustration may arise from the layered quality of the Internet; several things are happening at the same time. This creates information overload which can be difficult to cope with.

Social interaction

The potential of the Internet to connect people across space and time is considered the most significant advantage of online learning, and many researchers see it as a fundamental part of online courses (i.a. Aarnio & Enqvist 2004; Bonk et al. 2001; Brown 2004; Jonassen 1999; Mannisenmäki 2000; Matikainen 2001; Mäyrä 2002; Niemi 2002; Nevgi & Tirri 2003; Pantzar 2002). In this study, online social interaction is understood, on one hand, in a constructivist sense as a means to enhance learning, and on the other hand, as a means to promote work-related skills.

The function of social interaction in practising work-related skills is here seen as important as its function in constructing knowledge. New professional qualifications call for teamwork skills, networking and collaboration; positive interdependency, communication skills, tolerance, ability to introduce one's own work, and motivate and explain decisions made, and ability to give and take constructive critique (Jäppinen 2005; Ruohotie 2000b).

In addition to these two functions, social interaction has an entertainment value in creating a friendly, unthreatening and nurturing environment (Bonk et al. 2001; Manninen & Nevgi 2000; Matikainen 2001; Susimetsä 2006). Online cafés for casual conversations, pictures of participants, informal introductions, and activities that are fun and only loosely (or not at all) related to course contents help create a welcoming atmosphere. If students want to access the course because they enjoy being online, they are also more likely to perform tasks with enthusiasm as opposed to only accessing the course because the assignment deadline is approaching, and they feel they must study.

 Tella (1998) describes the feeling of belonging to the same virtual community and being present on the Web as "virtual togetherness." It makes students want to work together and share ideas (Aarnio & Enqvist 2004, 72). Tammelin (2004, 49–51) also discusses social presence in mediated environments such as online courses, and emphasizes its function in creating a feeling of community. Feeling of community and social presence are crucial in promoting collaboration and cooperation (Susimetsä 2006, 89).

Susimetsä (ibid.) also draws attention to new challenges that mediated communication brings to interaction compared with face-to-face interaction. A case in point is lack of social presence and social indication stimuli, as learners do not necessarily know who has read their message and benefited from it. Even if they receive a response, the non-verbal clues are missing, making it more difficult to understand the other learner's reactions.

Making social interaction happen requires a special effort from the teacher. Dialogue must be carefully structured into the course. Students will not "*jump into group discussions*" just because they are told to (Coomey & Stephenson 2001, 39). Because of its mediated nature, online interaction is slower. Students still make themselves visible in an online class mainly through written communications. However, speaking to each other via the Internet is becoming easier with new software such as Skype and Team speak, for instance.

The very fact that typing takes time and the asynchronic quality of discussion forums seem to enhance reflection and learning (Manninen & Nevgi 2000; Mannisenmäki 2000; Nevgi & Tirri 2003). In order to be reflective people need to be able to take their time. This basic human right, to be slow, should be respected (Tella 1998).

Still, the mere amount of communications, the number of messages in the discussion forum or e-mails, does not contribute to learning, if the participants remain un-

affected by them (Matikainen 2001, 18). Thus, although the entertainment value of social interaction is important in attracting students to access the online course, its function in learning should be carefully planned. Discussions for discussions' sake only render meagre learning results (ibid., 124).

Topper (2005) investigated how teachers can facilitate interaction through discursive moves; i.e. techniques to stimulate student participation. To increase student involvement in threaded discussions, he 1) played devil's advocate challenging students' viewpoints, 2) revoiced students' comments to encourage other students to pick up the topic for discussion, and 3) in general endeavoured to promote an environment where ideas were questioned and challenged. He found that once the instructor had modelled these different discursive moves, students started to use them themselves. Students' overall experience was that they were learning more having been more involved.

Macdonald (2004) found it useful to allow students participate in the assessment process. Also, when collaborative activities were linked to assessment, they gained prominence, since students usually prioritized assessed assignments.

Ihanainen (2002, 162) looks at different forms of communication and interaction that materials can provide. He divides online materials into five categories according to the communication possibilities that they have: presentation communication, performance communication, interactive communication, and creative communication (translations all mine).

Printable lecture notes and video-recorded lectures are examples of presentation material, the purpose of which is to give information. Tasks that students are required to work on are typically performance material. They can have hypertext properties that guide students to interact with the material more than in presentation communication. The last two material types enable most social interaction online; interactive material stirs ideas and challenges students into discussions around central themes, which can be a beginning for creative material. At its best creative material is something produced during the learning process in collaboration with other learners.

Concrete forms of online social interaction could be sharing views and experiences to articulate preconceptions, reflection comments, exchanging information in collaborative tasks such as producing common documents, showing students' own work, assessment, etc. Social interaction does not only take place between students themselves and students and teacher, but outside experts can be brought in.

Undoubtedly, there are subjects, situations and learning goals where social interaction is not of primary importance. One should not, however, make that conclusion without careful consideration. Mathematics, for instance, may not seem like the easiest topic for social interaction. Lehtinen (1997), however, reports on an experiment where students using a computer-aided algebra program (DERIVE) were able to communicate with each other silently by showing their ideas on the screen. This

kind of non-verbal communication is also possible with graphic programs working, for instance, on a design project.

Finally, students can learn from social interaction without actually participating but "lurking" instead. The term is used to refer to learners who only read other students' comments, but do not make themselves visible. Probably, they still feel part of the learning community to some extent.

Whether social interaction is included to enhance learning, practise work-related skills or for mere entertainment, the teacher's role is critical in making it successful (Bonk et al. 2001; Manninen & Nevgi 2000; Matikainen 2001; Mäyrä 2002; Topper 2005). What that role is and how it is realised in an online course is discussed in the following.

Teacher's role in an online course

Research evidence shows that the teacher's role in an online course is critical (Bennett & Lockyer 2004; Jonassen 1999; Koli & Silander 2002; Manninen 2003; Mannisenmäki 2003; Mäyrä 2002; Susimetsä 2006; Tella 1997; Tella et al. 2001). The teacher creates the feeling of community and his/her personal commitment is a prerequisite for, and reflected in, students' participation in an active, changing learning situation (Mäyrä 2002, 22).

The change in a teacher's function from a disseminator of information to a facilitator of learning may be interpreted as a change from active to passive. Teachers may feel they ought to step back to allow students' independent work and only wait for students to contact them (Tella 1997, 55–58; Tella et al. 2001, 241). In fact, online courses require teachers to be much more active than before. For real learning to take place online the focus is on really good teaching (Manninen 2003, 31; Tella et al. 2001, 250).

The teacher designs the learning process and chooses the methods that best enable learning. The focus is on what makes learning possible, not on how to control it (Tella et al. 2001, 250). In designing learning tasks, consideration should be given to learning outcomes, not covering curriculum. There is necessarily no discrepancy here as long as delivering content does not take precedence of what is actually learnt.

In Bennett and Lockyer's (2004) example, the focal tasks for learners are knowledge construction, authentic activity, ownership by the learner, opportunities to choose/tailor to personal interests, sustained engagement and collaboration, co-operation, and sharing ideas. Non-assessable activities provide scaffolding for assignment preparation.

Following the Vygotskian principle of the zone of proximal development, the teacher offers support merely as much as is needed and in an appropriate way for students to progress. In this support, the methods chosen play an important part (Koli & Silander 2002, 10–12). Again, this is not the same as waiting for students to

ask for help but active monitoring of students' progress and anticipating their difficulties. Novice learners may not have the metacognitive skills or enough domain-specific information to ask meaningful questions (Susimetsä 2006, 93). This is where the teacher as a facilitator can help draw students' attention to central topics, help probe their minds, tease out their preconceptions, and encourage reflexivity (see also Topper 2005; Bolton 2005).

Manninen (2003, 31–34) distinguishes between two kinds of online instruction, one that facilitates studying, another that facilitates learning. Both are important, but the latter may be easily forgotten as many of the methods tend to facilitate studying only. Timetables, ground rules, studying methods such as group work, pair work, individual tasks, are all examples of facilitating studying. Learning is facilitated by organising the material in a meaningful way, by questions that promote learning and focus on understanding, by checking understanding, and so forth. Similarly, Silander and Koli (2003, 12) call for instruction in the learning process and information processing. The online instructor's role is basically to help students find answers to their own questions and achieve the objectives that they have set for their own learning (Mannisenmäki 2003, 43).

An online teacher's different roles have received a lot of attention in research (see i.a. Bonk et al. 2001; Bennet & Lockyer 2004; Manninen & Nevgi 2000; Mannisenmäki 2003; Matikainen 2001; Mäyrä 2002; Nevgi & Tirri 2003; Koli & Silander 2002; Tammelin 2004; Tella et al. 2001). Four or five roles appear to be central. Tella et al. (2001, 226–249) and Mannisenmäki (2003, 41–48), when discussing an online instructor's role, both place the *facilitator* in the centre. The *facilitator* leads students to sources of information that they need, fosters in them a critical attitude towards information, encourages collaborative learning, and enables students' meaning construction.

In addition, an online teacher is an *organizer*, who designs the course, decides on the timetable and the modes of study in ways that promote learning. As an organizer the teacher's responsibility is again to support the feeling of community.

Both Mannisenmäki (2003) and Tella et al. (2001) also emphasize the role of a *communicator*. The teacher communicates with students via e-mail, discussion forums, group work tools, etc. The teacher here is an example to students of interaction and dialogue (Topper 2005). Tella et al. (2001, 239) point out that the teacher's major communicative role is to facilitate online discussion that is related to learning. For Mannisenmäki (2003, 48) creating and maintaining learning networks between students themselves as well as with experts is another function of a *communicator*. Tella et al. (2001, 229) describe the same function under a separate role of a *network builder*.

Finally, the teacher has the pedagogical role as an *expert* in his/her field (Mannisenmäki 2003, 47) and a *motivator* for learning (Tella et al. 2001, 226). Being an *expert* also involves an ability to critically reflect on own practices and, if necessary,

to change own views on teaching and learning. Bennett (2004) adds to the instructor role a role of a researcher who is concerned with producing new knowledge relevant to the content area. As a motivator the teacher creates an active environment where the teacher is active, students are active and the environment becomes active as a result. The teacher does this by being very much visible and present in an online course. The teacher's social presence in a mediated environment has also been found to highly correlate with favourable learner outcomes (Tammelin 2004, 48).

Teachers' technical skills are an important part of their different online roles (Bennett & Lockyer 2004). As organizers teachers need to understand which tools to choose that best fit the purpose of learning in each learning task, as communicators they must be able to use the most effective medium for communication. Being technically knowledgeable makes it easier for teachers to adjust the online course for their students' needs flexibly, and to support the students in their technical problems.

Nevgi and Tirri (2003, 16–17) sum up the characteristics of good online teachers as follows: they master the subject, are kind and supportive, tutor and participate, are individually oriented, are good communicators, keep timetables, and have technical skills.

Student's role in an online course

Students can be seen as active producers of their own learning in an online course (Tammelin 2004, 64). In online learning students' metacognitive skills become critical; awareness of one's own learning, self-regulation, and monitoring and control of learning. A web-based course should provide students with tools that encourage and enable them to make their prior knowledge visible, to pose their own questions, and to produce their own explanations and answers. Mere search for information and for correct answers to preset questions is inadequate in learning (Jonassen et al. 2005; Mäyrä 2002, 14).

A web-based learning environment can be so designed that it provides students with possibilities to set their own goals, search for and critically evaluate information available, collaborate, and follow and assess their own learning. Nevgi and Tirri (2003, 36–37) discuss concrete ways of how a web-based learning environment can be used to realize the principles of meaningful learning (see also Mannisenmäki 2000). The following table is a modified version of Nevgi's and Tirri's (2003) discussion based on Jonassen's (1999) principles of meaningful learning:

Table 3.   Meaningful online learning and tools to realize it

Meaningful learning		Online tools
Active	Students interact with the environment, process information	Electronic notebooks to record own notes and texts
Constructive	Learning is based on prior knowledge and interpretation of experiences	Discussion forums for exchanging views, self-tests, questions to tease out preconceptions
Intentional	Students set and articulate their goals, and monitor and assess progress	Tools to plan and assess own learning, e.g. learning journal, "my record" in WebCt
Authentic	Students face real-life, work-related, complex problems	Simulations, videoclips, Internet links
Co-operative / Collaborative	Learning is based on dialogue and social interaction	Realtime and asynchronic discussion and communication tools, shared documents, group work areas

Learners can record their own texts and notes in electronic notebooks and plan their studies using a drawing programme or some special application such as Mind Manager, for instance (see also Jonassen et al. 2005). They can be provided templates for self-assessment, electronic learning diaries for reflection, and discussion forums and chats for sharing ideas and experience. These synchronic and asynchronic communication tools as well as group work areas can also be used to manage common files and documentation to enhance collaboration. Video clips and Internet links provide for authenticity.

Similarly, Manninen (2001, 67) shows how web-based learning environments support adult learning by providing possibilities for self-directedness (choice of time and place, search for information), collaboration (discussion forums, networks), reflection (asynchronic interaction, written communication), emancipatory learning (reflection on and sharing of experiences), work related learning (the possibility to study at work), etc.

In sum, web-based learning environments provide teachers and students with tools that can be utilised to bring about meaningful learning, and to empower students in their learning process. The question, therefore, is not whether this is possible but rather whether this opportunity is fully appreciated and exploited.

3 LONGITUDINAL RESEARCH ON TEACHERS' CONCEPTUAL CHANGE PROCESS

This chapter reports on a longitudinal research carried out in 2001–2005. The research consisted of four phases: 1) A survey to investigate teachers' conceptions of teaching and learning and their use of ICT in instruction, 2) a subsequent in-house training intervention based on the results of the survey, 3) a study on the conceptual change process of teachers participating in the training, and 4) follow-up discussions with teachers.

3.1 Phase I: Survey on teachers' readiness for online instruction

The Phase I survey originated from a concern in the Faculty of Technology about the quality of teaching, and teachers' reluctance to use ICT in instruction. A question was raised, whether teaching methods met the requirements of the information society and the working life. Also, introduction of an online courseware (WebCT) had failed to attract teachers' interest as a new tool to enhance or change their classroom teaching. There was also a danger evident in research literature that under pressure of introducing online elements to their teaching, teachers might simply transfer their lectures into an electronic form, or resort to the kind of drill and practice that seemed familiar without seeing new possibilities offered by new technologies.

According to Prawat (1990), the only way to change education is to change teachers' beliefs about learning. Thus, the objectives of the survey were to investigate: 1) What conceptions teachers held about teaching and learning, 2) how teachers made use of ICT in instruction, and 3) what learning needs teachers attached to online instruction.

Based on the results of this survey, relevant research literature, and the theoretical framework, guidelines for an in-house training programme for teachers were formulated.

3.1.1   Population and sampling

The population under study was the permanent teaching staff of Lahti University of Applied Sciences. Although the study originally followed from the experiences in the Faculty of Technology, it was felt that a study based on a larger population might be more useful for the development of teaching in the whole polytechnic. A proportionate stratified random sample (Heikkilä 1998) was drawn from the whole population, the 194 permanent teachers in the polytechnic. The stratified sampling method was chosen, because the population was naturally divided into more or less homogenous groups, the seven faculties. The aim was to ensure that the sample would contain teachers from every faculty, not only from the bigger faculties.

The different faculties were considered as relatively homogenous groups, because each faculty tends to have its own organisational and educational culture. This seemed the simplest and most effective way to make the sample as representative as possible. Dividing teachers into groups according to what they teach would have guaranteed even more homogenous groups, but that would also have required a great amount of extra work in finding out their teaching subjects. The time available for the survey was a limitation.

A random sample was drawn from the staff of each faculty so that the final sample size was 65, approximately a third of the whole population. A third of the staff of each faculty was randomly selected. This way, it was felt, each faculty was represented in proportion to its size, the final sample including more teachers from bigger faculties.

3.1.2   Methodology

Data were collected using questionnaires and interviews. The questionnaire consisted of multiple-choice questions, dichotomous questions, rating scales, and one open-ended question. Closed questions were chosen mainly because they were quick to complete. In the past few years the staff of the polytechnic had been subject to several different surveys and at the time a kind of survey fatigue could be detected. The reason for frequent surveys was the ongoing development work in the polytechnic as well as the fact that many of the teachers were pursuing Ph.D. studies. The questionnaire was formulated together with the Head of Continuous Training at the Faculty of Technology.

The aim was to draw from her experience in arranging continuous training courses plus to ensure that the questionnaire would provide the kind of information she needed for planning a new course for teachers. An IT teacher was also consulted in order to formulate questions that would best serve as indicators of teachers' computer know-how. Finally, the draft questionnaire was piloted and submitted to a col-

legial critique in a seminar for a group of PhD students. All post-graduate students in the group were teachers in Lahti University of Applied Sciences. None of them participated in the final survey. On the basis of the group's comments and responses, the questionnaire was further modified. Most changes concerned the ambiguity of questions, which in many cases asked more than one thing.

The questionnaire was taken to each respondent personally either by the author or her assistant. The idea was to ensure as big a response rate as possible. Also, it was easy to clarify the questions, if necessary, in a face-to-face situation. Respondents' reactions and comments were all noted down and included in the qualitative analysis. However, some respondents could not be reached. Questionnaires were left for them on their desks with a request to send them back completed in the school mail.

The quantitative analysis of the survey was carried out with the Statistica computer program. Frequency analyses were run of all variables of the quantitative data. Answers to the open-ended question as well as all the other comments that the respondents had given were recorded and treated as additional information.

In addition to the questionnaire answers, three respondents were interviewed. These three had some experience of online teaching and had volunteered for an interview. The interview data were summarised to bring out the main points. No coding scheme was considered necessary, since the data was limited and the questions probed into factual information and concrete examples of the interviewees' online experiments.

The purpose of this methodological and investigator triangulation was to increase the validity and reliability of the survey.

Questionnaire

The purpose of the questionnaire was, on one hand, to help determine teachers' level of computer know-how and their use of ICT. On the other hand, questionnaire items tried to tease out these teachers' conceptions of learning, their teaching style, satisfaction with their teaching and attitudes towards change.

The questionnaire began with contextual information about the research and the investigator's purposes. The introduction also stated that the respondent's identity would not be known to anyone but the investigator (Cohen et al. 2000; Foddy 1993). This was considered important since some teachers might have considered the topic too sensitive to provide truthful answers. ICT in instruction is such a popular theme in schools today that teachers who are either not interested in or, for some other reason, not involved in it might fear becoming labelled old-fashioned or accused of obsolescence.

Questionnaire items focused on two separate issues; ICT and teaching. Questions about ICT (1–9) investigated teachers' access to ICT at home and at work and their computer know-how. Teachers' computer know-how was probed, for example, with

questions like "*Can you save files in folders?*" or "*How do you edit text?.*" Their general use of ICT was asked in questions like "*Do you know how to make an attachment to your email message?,*" and "*Can you find train timetables on the Internet, if necessary?.*"

These may seem as rather simple computer and ICT skills. Yet, questions were formulated together with an IT teacher, according to whom, surprisingly many teachers who came to IT training courses at the turn of the millennium did not have these skills. Teachers' experiences of ICT in instruction were asked in questions (10–14) like "*How do you use information networks in instruction?.*"

Questions 15–17,18e, 18i, 18k, 18l, 18m, 18n, and18o tried to tease out respondents' conceptions of teaching and learning. These questions were formulated to reflect either the principles of the behaviourist theory of learning or the constructivist theory of learning:

> "*Which of the following statements best corresponds to your teaching style?*
> *a I start with a complicated problem.*
> *b I proceed from the simple to the more complicated.*
> *c I use both styles depending on the situation.*
> *d Other*"

Another example is from the Likert scale, where respondents could choose from "strongly disagree" (1) to "strongly agree" (5):

> "*Students do not know themselves what they need to learn.*   *1 2 3 4 5*"

> "*The starting point for teaching should be the students'*
>   *conceptions of the subject.*"   *1 2 3 4 5*"

The structure of the questionnaire followed Cohen et al.'s (2000) advice on questionnaire design; from clear, simple, factual questions to more challenging closed multiple-choice questions and ratings, to open-ended questions about opinions, attitudes, etc. The questionnaire contained multiple-choice questions, dichotomous questions, Likert scale ratings, and one open-ended question.

The first questions asked for simple, factual information and were easy and quick to answer. The questionnaire began with questions about respondents' age, subject they taught and the Faculty where they taught. The age was not categorised in advance in the fear of losing information. These general questions were followed by questions about access to and use of computers and ICT. They were all multiple-choice questions with one alternative always left open for respondents' own comments to avoid irritation due to not finding an appropriate alternative.

The first multiple-choice items also included questions that were hoped to have high interest value (Cohen et al. 2000) and, therefore, encourage participation. Such questions were, for example, those that enquired about the availability of hardware at work and its age. It was hoped that teachers would see the survey as a means of letting

the administrators know, if they felt they were required to produce online courses without proper equipment.

After the simple, factual questions, more difficult multiple-choice and dichotomous questions followed. These dealt with teaching style and conceptions of learning. To achieve intensity (Cohen et al. 2000), a Likert scale was used to measure respondents' degree of interest in online teaching as well as their attitudes towards it. Some statements also focused on conceptions of learning in an attempt to validate respondents' earlier answers to similar multiple-choice questions.

The questionnaire was broken down into subsections with headings. The purpose of the headings was to help respondents see the foci of the questions and the reasons for including the items (Cohen et al. 2000).

Finally, the questionnaire ended with an open-ended question about the kind of support and training respondents felt they would need in designing and teaching online courses. According to Foddy (1993), most methodologists accept that answers to open questions indicate what issues are salient in respondents' minds as respondents are allowed to express themselves in their own words. Another reason why it was decided not to suggest answers to this last question was that this question, too, might reveal something about respondents' conceptions of learning. As all the other questions about learning focused on teachers' conceptions of how students learn best, this one was asking teachers to consider how they would learn best themselves.

In formulating questions, attempts were made to pay attention to wording so that questions would not be ambiguous or misleading. Leading questions, as well as, too complex or highbrow questions were also avoided. The questionnaire did not contain questions with double negatives, either. These are all considered basic rules of formulating questionnaires (Cohen et al. 2000; Foddy 1993; Payne 1986). Instructions guided respondents as to where one alternative was to be circled and where several alternatives could be selected.

Interviews

Based on results of analysis of questionnaire responses, theme interview questions were formulated. Only those respondents who had taught web-based courses or part of such courses were interviewed. The main purpose of the interview was to inform the future planning of the in-house training programme. Interview questions also probed successes and difficulties that these respondents had experienced in their experiments of online teaching. Answers were recorded manually in the interview situation.

The original idea was to interview all respondents who reported having taught parts of their courses (3) or entire courses (4) via the Internet. However, one of them had not volunteered for an interview, and three could not be reached for different reasons. Ultimately, three teachers were interviewed on the phone. They all repre-

sented different faculties. Interview questions dealt with a) what kind of web-based courses/parts of courses interviewees had taught, b) what experiences they had had, and c) what kind of support, if any, they felt they needed. The interview took a form of an informal chat. Interviewees told about their courses in their own words. All three seemed eager to volunteer information and share their experience. The main points raised in the interviews were summarised and presented as such.

3.1.3   Results

Teachers of Lahti University of Applied Sciences were randomly selected to receive questionnaires. The sample was altogether 65 teachers. Two of them were on a leave of absence and could not be reached. Out of the remaining 63 teachers, 49 returned the questionnaire giving a response rate of 78%. All seven faculties and a variety of subjects were represented by respondents, 30 of whom were female and 19 male. The youngest of respondents was 29 and the oldest 62 with most respondents falling into the age group of 45–55.

The majority of respondents (30) reported having a computer with an Internet connection at home. At work most of them (33) had their own PCs in their offices, while the rest either shared a computer with a colleague (14). Only one reported not having a computer in their office at all. Computers were from one to four years old on an average.

Teachers' computer know-how and the use of ICT

Almost all respondents (41) seemed to master saving files in their own folders. 19 used formatting definitions under "styles" to modify text, 22 changed fonts. Using styles in the Microsoft Word program is a more advanced method of text processing, generally preferred by teachers instructing word processing. A large number of respondents used other advanced computer programs such as Power Point (29), Excel (38), and FrontPage (7).

It must be noted that the numbers exceed the total of 49, because many respondents reported mastering more than one program.

Table 4 below shows the number of teachers who reported using the Internet with ease and IT or ICT in instruction.

Table 4.   Teachers' use of computers and ICT in instruction.

	Frequency	Valid Percent	Total
Reads email once a day	36	73	49
Adds attachments to email	43	88	49
Finds information on the Internet	46	96	48
Uses computers in instruction	30	63	48
Uses the Internet in instruction	38	79	48

Nearly all respondents indicated they were conversant with the Internet. 30 respondents reported using computers in instruction either sometimes (16) or frequently (14).

In addition, a great number (38) also used the Internet in instruction. To the question "*How do you use the Internet in instruction?*" 36 reported asking students to search for information on the Internet, 21 said they sent and/or received assignments via the Internet, and eight had made teaching material available on the Internet. Respondents were able to select more than one alternative. Four teachers reported having conducted an entire web-based course or web-based courses, three having supplemented their course/s with web-based modules. Seven respondents had taken an online course.

Teachers' conceptions of learning

Figures 3–5 show results of frequency analysis of teachers' answers to multiple-choice questions, the purpose of which was to investigate how much student control teachers allowed in determining goals and contents of courses and in assignment completion (questions 15 and 16), as well as teachers' views of their own teaching style (question 17). Each chart shows the number of responses to the four alternatives in the question. Alternatives have been reduced to keywords due to the limited space available for value labels. Each question is placed above the chart.
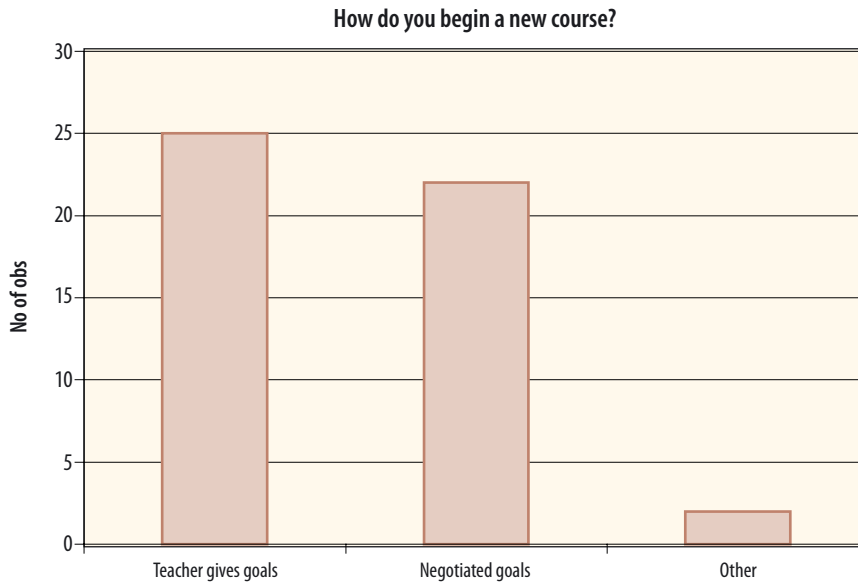
Figure 3.   How the goals and contents of courses are determined

Figure 3 shows teachers' answers to the question, "*How do you begin a new course?*"
25 teachers answered that they told students what the goals and contents were going
to be, and 22 answered that the decision about the goals and contents was made to-
gether with the students. The third alternative, "*I let the group decide on the contents
and the objectives,*" was not selected by anyone. The alternative "*Other*" was selected
by two teachers, who explained that the start depended on the situation.

How do you give assignments?
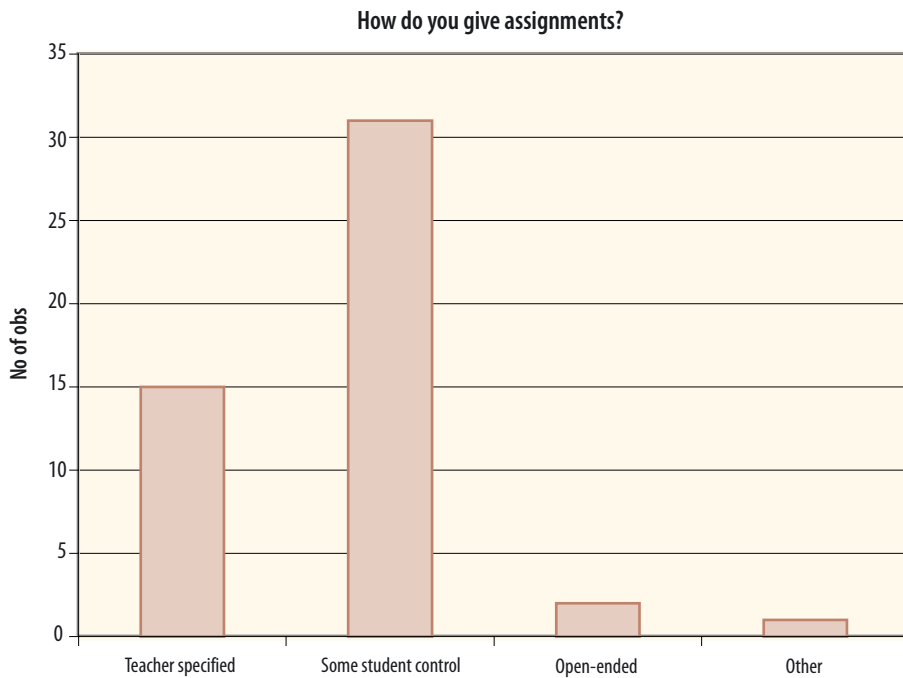
Figure 4.   What kind of assignments teachers give

Figure 4 shows the results of the analysis of teachers' answers to the question "*How do you give assignments?.*" Most respondents (31) answered that they specified the assignment but allowed individual freedom to some extent. 15 answered that they used teacher-specified assignments, whereas only two reported giving open-ended assignments. Again alternative "*Other,*" was answered with "*it depends on the situation.*"
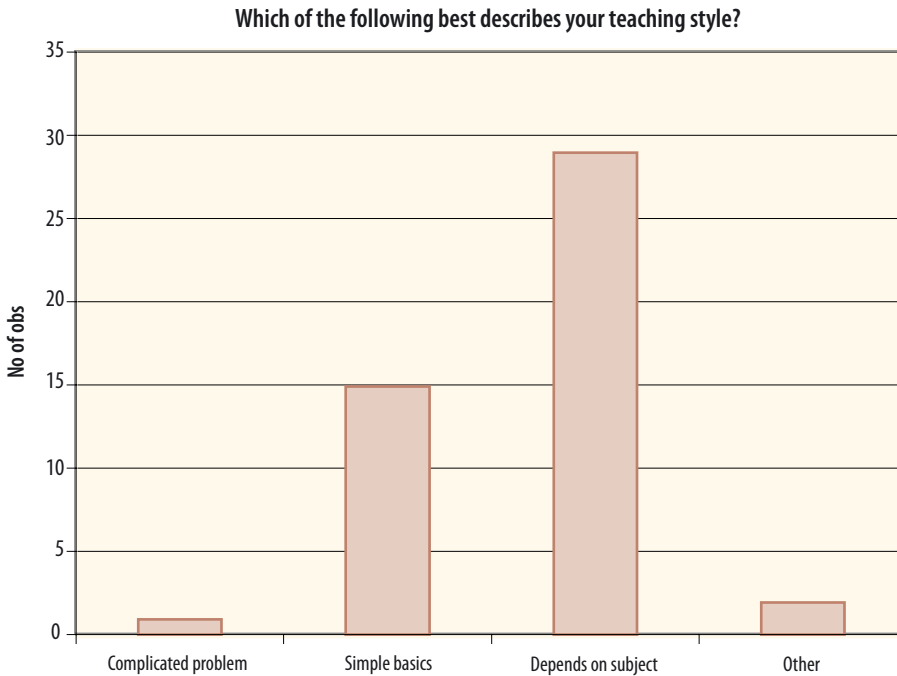
Figure 5.   How teachers introduce a new subject

Figure 5 shows answers to the question "*Which of the following best describes your teaching style?*." One respondent answered that they introduced a complicated problem right at the beginning, while 15 reported they started from basics and then proceeded to more complicated problems. 29 respondents answered they used both methods depending on the situation. Those who answered "*Other*" explained that the method depended on the subject.

Appendix 3 shows results from analysis of teachers' answers to the Likert scale statements 18i, 18k, 18l, 18m, 18n, and 18o in the original questionnaire. These statements focused on teachers' views and beliefs about learning. Respondents were asked to agree or disagree with statements on the scale of 1 to 5, where 1 stood for "*strongly disagree*," 2 for "*disagree*," 3 for "*neither agree nor disagree*," 4 for "*agree*," and 5 for "*strongly agree*." In the bar charts label number 3 has been changed to "*no opinion*" because of the limited space available. The original statement is placed above the chart.

Many Likert scale statements proved problematic, as so many respondents selected the "*neither agree nor disagree*" alternative. This was especially true about statements dealing with direct teaching, dividing the subject into small steps, and importance of students' own goals and prior knowledge (18i, 18k, 18l, 18m). The inability of respondents to give an opinion on these issues could perhaps be interpreted as not

being aware of the theory of learning that underlies their teaching approach. Comments that respondents made when answering these statements were often about not finding the statement applicable to their own subjects.

The statements were very straightforward and not ambiguous. It is difficult to see why they could not be applied to any teaching. However, answering these particular questions required somewhat more thinking, reflecting on one's own work, rather than just giving an opinion as with other statements. Perhaps respondents simply did not have time to stop to think, and "*no opinion*" was an easy choice.

Responses to multiple-choice questions 15–17, and Likert scale statements 18i, 18k, 18l, 18m, and 18o, are placed on Coomey's and Stephenson's grid (2001). "*No opinion*" answers to Likert scale statements are not included. "*Agree*" and "*strongly agree*" are coupled to show agreement, as are "*disagree*" and "*strongly disagree*" to show disagreement. Figure 10 illustrates how the responses were scattered in the axis of traditional teaching approach – constructivist teaching approach.

Specified tasks

43
25   15   31
15
26
22   18   13
Teacher controlled ———————————————— **Learner managed**

1
29   22   0
2   18
10   8   22
3

Open ended, strategic

Figure 6.   Frequencies of teachers' responses (n=49) scattered according to teaching approach in Coomey's and Stephenson's (2001, 41) online paradigms grid

The numbers in the northwest section of the grid show frequencies of responses that were interpreted to reflect behaviourist views of learning. Thus, for instance, 43 teachers agreed with a statement "*I try to cover the same curriculum on every course.*" This answer was interpreted to fall in the North-West sector of the grid and reflect a teacher-controlled teaching approach and teacher-specified tasks. The corresponding multiple-choice alternatives and Likert scale statements in the original survey were as follows (the number shows the frequency of responses):

25 answered: I tell the group what the contents and the goals of the course are.
15 answered: I specify the assignment.
15 answered: I proceed from the simple to the more complicated.
26 agreed: Direct teaching is the most effective in my subject.
22 agreed: Dividing the subject into small logical steps makes learning easier.

18 agreed: Students do not know themselves what they need to learn.

13 disagreed: The starting point of teaching should be students' prior assumptions about subject.

43 agreed: I try to cover the same curriculum on every course.

Numbers in the southeast section of the grid show frequencies of responses that were interpreted to reflect constructivist views of learning. Corresponding multiple-choice alternatives and Likert scale statements in the original survey were as follows:

0 answered: I let the group decide on the contents and the goals.

2 answered: I leave the assignment as open as possible.

1 answered: I start with a complicated problem.

10 disagreed: Direct teaching is the most effective in my subject.

8 disagreed: Dividing the subject into small logical steps makes learning easier.

18 disagreed: Students do not know themselves what they need to learn.

22 agreed: The starting point of teaching should be students' prior knowledge about subject.

3 disagreed: I try to cover the same curriculum on every course.

Number 31 in the northeast section of the grid shows how many teachers chose the multiple-choice alternative, "*I specify the assignment but allow individual freedom to some extent.*" Numbers 22 and 29 in the southwest section of the grid show frequencies of responses to multiple-choice alternatives, "*We decide together what the contents and the goals will be,*" and "*I use both 'a' and 'c' depending on the situation,*" respectively.

It is easy to see that the northwest sector, which represents the traditional, behaviourist teaching approach, holds the biggest number values. It could be assumed, therefore, that these are the kind of online courses that respondents might produce. Direct teaching, dividing the subject into small steps, and the fixed curriculum idea surface as prominent features. Although the northwest sector seems to be dominating, there were also some answers in the southeast sector, and quite high response rates to questions that fell in between the two extremes.

Teachers' need for support and training

Over half of respondents expressed interest in online teaching and learning (26) and wanted to have some training in it (27). Most respondents either did not have an opinion (12) or disagreed (30) with the statement, "*Information networks in instruction are best used for the delivery of materials.*"

Quite a few respondents (26) were happy with their teaching methods, 17 did not know, and a minority (8) expressed dissatisfaction with their current teaching. Still, many wanted to learn more about new theories of learning (27). The open-ended

question, "*What kind of support and training would you like to have for designing and teaching web-based courses?*" was answered by 17 of 49 respondents. Two could not specify their needs, but expressed interest in receiving some kind of training. Five wanted training in technical skills, practising the use of web-course tools, creating homepages, and using the hardware in general. Nine respondents wished to learn more about good practice experiences, demonstrations and examples of successful courses taught via the Internet. Their answers emphasized a practical approach:

> "*How it works in practice.*"

> "*Practical training, demonstrations.*"

> "*Through concrete examples I might become even more interested.*"

The need for support in designing and creating the contents of an online course was specifically mentioned by three respondents. What they felt they needed was not necessarily technical advice on how to make pages look attractive, or in what form material should be presented, but what to include in an online course:

> "*…knowledge about the criteria for creating the contents. Let the experts plan the web pages…*"

> "*How to realise the contents.*"

Interviews

The first interviewee was a professional subject teacher. He had conducted two different kinds of web-based courses. The first one was on teamwork skills aimed at a company personnel. The course was offered in the WebCT learning environment and consisted of materials on Web pages, as well as quizzes. Learners also sent in their assignments through WebCT. Some assignments were dealt with during contact lessons. Problems in this course were caused by the fact that the company personnel did not necessarily have access to computers as often as necessary.

The second web-based course, with which this teacher gained experience, was aimed at regular students of the polytechnic. Students spent four weeks at a time in practical training in local industry. During the practical training period their link to school was the WebCT learning environment. The learning task was always some project work that they did for the industry. Students worked in teams of two or three. The teacher had prepared instructions regarding the project. The instructions were on WebCT. Students were required to make a project plan, report on the progress of the project, and write a final report. All of these were uploaded to WebCT for everybody to see. When students returned to school they presented their projects in class using material they had prepared for WebCT.

According to the first interviewee, there was no obligation for students to read each others' reports. However, the teacher was under the impression that students had gone to see what their classmates had written. The teacher was also very happy with some of the student reports, which had contained video clips and pictures. On the other hand, for some students the technology had been more of a complication than a useful tool.

This interviewee was quite satisfied with how the course ran. He was also keen on finding new ways of utilising WebCT. His latest experiment was to give a written test on WebCT. Students took the test at school under supervision, but they did it on computers. Earlier the test had consisted of essay questions, where students had been required to discuss relevant topics. With WebCT tools the teacher had been able to include pictures about key ideas, machines or production solutions. Questions partly consisted of WebCT multiple-choice quizzes and short answers checked by the computer. The essay was reduced to one long answer, which the teacher read and marked.

The main problem with this kind of testing proved to be students whose typing skills were not adequate for a long answer. In the feedback, which students were able to give immediately after the test, they often complained about having to remember trivial things, facts and figures, which were easy to test with WebCT quizzes.

Regarding possible support or training, the interviewee first acknowledged technical support which was always available. Also, he felt that his teacher training was so recent that he felt safe with the pedagogy. However, he realized that social interaction was missing on this kind of course. He was not very happy with the new computer-based test, either, since it did not succeed in measuring understanding. This is where he felt most need of support; finding ways to bring about social interaction and to measure understanding.

The second interviewee was a lady, who had not yet taught online. She had, however, planned a course to be carried out within the WebCT environment the following academic year. The course was to be conducted as an international co-operation project involving two polytechnics in Finland and two universities abroad. The idea was to transfer experts' lecture notes into an electronic form to be easily accessible to students in all three countries. Students would also receive assignments via the Internet, and make their project work available on WebCT for other students to read.

This interviewee expressed desperate need for technical support. She was also surprised at finding no centralized system for producing web-based courses in the polytechnic. She felt she had wasted valuable time finding out herself who could help her, and how much the help would cost. She did not feel she needed any more pedagogical studies, since she had attended several methodology courses recently. What she wished for was a course on the use of WebCT, and a possibility to create an online course with technical support nearby.

The third interviewee had run the same web-based marketing course five times. The course included a fair amount of student-managed learning, as students were required to find advertisements, analyze them and send in their analyses to the teacher. The teacher gave each student individual feedback via e-mail, but also compiled model answers as examples on the course web page. This course was not set in the WebCT learning environment, but utilised web pages and e-mail. This teacher did not want any training. Instead, he wanted to learn what measures, if any, the polytechnic was going to take to address the issue of online learning.

3.1.4   Conclusions

Participating teachers seemed well equipped for online teaching if the criteria are access to computers and the Internet, and general computer know-how. The main uses of the Internet were sending and receiving assignments via e-mail, and asking students to search for information on the Internet. Sinko and Lehtinen (1999) report similar findings in their studies of the use of ICT in instruction across the whole educational field in Finland. Ilomäki and Lakkala (2006, 190) refer to several international studies confirming the same tendency of rather limited and unsystematic exploitation of information technology in teaching.

Few respondents had any experience of either online learning or teaching. However, over half the teachers reported being interested in online teaching, and as many wanted more training in it.

To find out what teachers' current instructional approach was, the survey set out to investigate teachers' conceptions of learning. As Cohen et al., put it, "…*crude data can only yield crude interpretation.*" (2000, 255), no conclusive interpretations can be made about teachers' conceptions on the basis of analysis of questionnaire responses. However, assuming questionnaire items were successful indicators of the principles of the two theories of learning, behaviourism and constructivism, those selections that favoured one or the other could perhaps cautiously be interpreted as reflecting behaviourist or constructivist views, respectively. Consequently, findings seem to indicate that respondents were a little more inclined to use the behaviouristic approach than the more student-centred, constructivist approach.

Results imply that teachers' conceptions of learning were in transition. In some respects, traditional views seemed to dominate teaching; the teacher was mainly in control of goals and contents, and open-ended tasks were few. On the other hand, there was a wide consensus over the importance of students' prior knowledge of the subject as well as students' ability to determine their own goals. These are some of the basic principles of the constructivist theory of learning.

Interviews chosen to inform the future intervention revealed that there were enthusiastic teachers at Lahti University of Applied Sciences, who were willing to take

a risk and try something new, even though they could not have a guarantee that the new was always better than the old. Interviews showed that one does not necessarily need complicated courseware to use ICT in instruction. Web pages together with e-mail can be used quite effectively to enhance learning and increase student control.

Interviews also suggest that there should be a strategy on the polytechnic level of how to develop online learning and provide the kind of support, technical and pedagogical, that is needed. Finally, all three interviewees seemed to be alone in the polytechnic with their experiments. One had sought co-operation elsewhere, the other two had independently developed their own material. There are probably more teachers like these three in the polytechnic fostering good ideas to enhance their teaching with the help of ICT, and experimenting with their own courses. Spreading the experience and knowledge that enthusiastic and innovative teachers already have remains a problem with successful experiments throughout the educational field (Sinko & Lehtinen 1999).

3.1.5   Validity and reliability

Findings about teachers' use of ICT in instruction and the dominating role of traditional teaching methods are supported by current literature on online learning, or teaching and learning in general (Bonk et al. 2001; Brown 2004; Prawat 1990; Rauste-von Wright et al. 2003; Sinko & Lehtinen 1999).

Efforts were made to ensure the validity and reliability of the survey, partly by methodological and investigator triangulation, partly by sampling. Different methods were used to gather data: a questionnaire with closed questions, one open-ended question, and interviews. Since interviews were conducted over the phone, the accounts of the interviews as they appear in the paper were checked by each of the three interviewees. The interviewees received the extracts of the text by e-mail and sent them back with their comments or corrections. The purpose was to minimise investigator bias that might have affected the manual recording of the interviews on the phone.

Although the sample was rather small for a quantitative analysis, it was randomly drawn and represented all faculties of the polytechnic in proportion to their sizes. The response rate was as high as 78% adding to the reliability of the study. The questionnaire was formulated in co-operation with colleagues, piloted and modified before use. With a few exceptions, respondents received the questionnaire personally with written and oral instructions. Respondents were also encouraged to ask for clarification should they not understand the question.

There is always a risk, however, that questionnaire items do not measure what they purport to measure (Foddy 1993; Cohen et al. 2000). Questions that focused on factual information were short and simple. In an attempt to find the right indicators

of behaviourism and constructivism, special attention was paid to selecting the key ideas in the two theories of learning. These served as the basis for formulating the questions about teachers' conceptions of learning and their teaching approach.

In spite of the careful wording, it must be recognised that there is a possibility that some respondents may have understood the questions differently from what was meant, or differently from each other. They may not have been answering the same questions (Foddy 1993). Thus, for example questions such as "*I specify the assignment*," or "*I try to cover the same curriculum on every course*," may have been interpreted as something every good teacher should do. Respondents may have understood the opposite in the first case to be a teacher who leaves students on their own wondering what to do. In the second case, the imagined opposite could have been an inefficient teacher who does not even try to cover the curriculum. When these selections are interpreted as indicators of a behaviourist teaching approach, it is done with the greatest reservations.

3.2 Phase II: In-house training programme

The 2001 survey investigated polytechnic teachers' baseline conceptions of learning, i.e. their pedagogical thinking. This was considered important in order to build new learning on the participants' prior knowledge. As a result of the survey, an in-house training programme was designed for teachers in the Faculty of Technology.

At the time, as the findings of the survey implied, teachers were quite happy with their teaching methods, which were more or less traditional. Their computer and ICT skills were fairly good, but use of ICT in instruction was limited to searching information on the Internet and sending and receiving student assignments by e-mail. There was a great interest in online teaching and some lone experiments. Teachers felt they mainly needed practical examples and hands-on training in how to construct an online course.

A subsequent survey (Tieto- ja viestintätekniikan opetuskäytön strategia 2003) by the polytechnic the following year confirmed these results showing even more clearly that teachers mastered the basics of the new technology better (although not many had experience of using the more advanced software) than new student-centred pedagogies. Few had any experience of teaching online or producing online material. This study also revealed teachers' willingness to share ideas and the need for collegial collaboration, and the lack of such sharing and collaboration in practice.

Koivisto and Ilomäki (2001) arrived at similar conclusions. Their research confirmed teachers' general interest in online teaching and the lack of pedagogical skills required. They point out that teachers must make a fundamental change in their conceptions of their work, if they want to become innovative users of ICT in in-

struction. Bennett and Lockyer (2004) investigated how teaching and teachers' work changed over the period of five years, when campus-based programmes were converted into online education. They note that dependency on technology affects all aspects of online teaching.

Since there already were teachers in the polytechnic who were using ICT in teaching, making them aware of each other seemed like an obvious first step. It was assumed that some of the interested teachers would be willing to join forces in the development work by sharing ideas and experiences. For all the above reasons it was decided to organize an experiment group within the Faculty of Technology, as this was the only faculty where technical support was available.

So far, polytechnic teachers had been offered short training courses in IT and ICT skills. In addition, technical support for producing online courses had been available at the Faculty of Technology since 1998. Therefore, it was decided to shift the focus of further training away from skills in IT to pedagogical support, in order to promote the transition from traditional to more constructivist teaching approaches. Long-term support had proved more effective than short training courses (Leino 1999; Sinko & Lehtinen 1999).

It was understood, however, that a more student-centred approach could be a challenge for traditional teachers. Teachers might find new demands conflicting with their current conceptions of learning and teaching practices. Previous research showed that teachers were possibly not even aware of some of their assumptions that prevented them from seeing new solutions. Resulting teaching practices may in turn have become so automatic that changing them required transformative learning (Kauppi 1998; King 2002; Kohonen 1999).

Therefore, the corner stone of the in-house training was the understanding that before any change was possible teachers had to become aware of their own assumptions concerning teaching and learning, and they had to be able to reflect on them critically (Martti 1996; Ruohotie 2003). Prerequisites for change are 1) individuals' dissatisfaction with their existing beliefs, 2) identifying what is problematic about the existing beliefs, 3) finding the alternatives both intelligible and useful, and 4) finding a way to somehow connect new beliefs with their earlier conceptions (Mezirow 1990b; 1997; 1998; 2000; Prawat 1990; Tynjälä 2002).

However, understanding and accepting new concepts and a new approach to teaching does not necessarily lead to a change in teaching practices, because old routines are too automatic to give way. It is only through continuous critical reflection and collegial interaction that discrepancies between new thinking and old practices are revealed and can be eliminated (Prawat 1990; Ruohotie 1999; 2000b; 2003; Tynjälä 2002).

Based on their research Sinko and Lehtinen conclude that, "*new practices cannot be established if teachers cannot adapt them to their own thinking and activities*" (1999, 90). They suggest organizing an official experiment group as the best means

of helping other teachers join in. This might lead to development of a community of teachers whose goal is pedagogical reflection and development.

Martti (1996) also writes about a cognitive dissonance required for revising one's beliefs. One way is to bring about a situation where two or more teachers' beliefs clash. Martti suggests that this kind of corrective reflection is best accomplished in a group where teachers can discuss and compare different teaching approaches using concrete examples from their own teaching. Ruohotie (1996), on the other hand, warns about expert defensiveness, which is not uncommon among teachers. It may be difficult for a teacher to accept a different view of teaching, if it is imposed on them from the outside.

All this supported the idea of creating a situation where teachers could test their own conceptions against others' conceptions and come to their own conclusions about the possible need for change. Group discussions with colleagues on a common dilemma, online instruction, were hoped to produce the kind of discourse that would foster critical self-reflection and enable transformative learning.

3.2.1   Objectives and design

To foster transformative learning and to support the Faculty of Technology teachers' experiments with ICT in instruction, an in-house training programme was designed. The purpose was to produce online courses and to develop participants' pedagogical skills, as well as to increase interdependency and collaboration between teachers. The design drew from different learning theories but was mainly based on the constructivist theory of learning, Mezirow's theory of transformative learning, the results of the 2001 and 2002 surveys (ICT Strategy 2002), and a review of relevant literature. The 2001 survey provided some guidelines regarding what was needed. Participants were also interviewed to find out their expectations and to involve them in the planning of the programme.

Participants all had own concrete goals related to subjects they taught. This is the kind of hands-on work that many respondents of the 2001 survey wished for. As in the Ford Project (Elliot 1991; Elliot & Adelman 1996), this programme did not attempt to convert teachers into using a new method, in this case ICT in instruction, but to support those who were already interested and had an idea of what they wanted to do. What they did not know was how to realise their ideas in practice.

As a learning experience, the programme was based on principles of the constructivist theory of learning with learners' own goals and a lot of control over their learning. Social interaction in solving concrete problems, critical thinking, self-evaluation, reflection on one's work and progress were all parts of the learning process. Participants were given a first-hand experience of something else than traditional learning methods. It was hoped that through modelling the participants might not

merely be able to apply constructivist principles to their own teaching in the future, but would also become aware of their own, perhaps, different views.

As suggested by Sinko and Lehtinen (1999) an outside consultant was brought in to provide new perspectives and pedagogical support; the programme was designed in collaboration with Palmenia, The Research and Education Centre of the University of Helsinki, which provided the consultant and the guest lecturers.

3.2.2   Structure and contents

The programme started in March 2002 and finished in October 2002 with a break for the summer holiday in June–July. Through seminars and instructed, as well as independent group work sessions, participants gained deeper understanding of the use of ICT in instruction and were instructed in their own online projects. Participants produced online learning components to their existing courses or created whole courses to be studied online.

Teachers were also provided an opportunity to interact in solving pedagogical problems together. The 20 participants were divided into working groups according to their interests and topics that they had chosen for their experiment. Some participants came with a common project plan and paired up within their workshop group. Participants held a workshop every week, either on school premises or in the specially designed virtual learning environment (Studium).

Twice a month, in two consecutive weeks, the workshops started with a seminar, during which Palmenia provided the most recent information on online pedagogy. The same themes were then addressed during ensuing workshops. Participants were applying the new information to their own projects and discussing their ideas within their own group as well as all together. The consultant met with each group once during distance-study periods. During workshop sessions participants were asked to support and challenge each other. They were asked to present and defend their teaching solutions. By including these weekly workshops in the programme, an attempt was made to foster transformative learning and to promote development of interdependent relationships (Ruohotie 1999).

Thus course structure followed principles of transformative learning according to Kauppi's model.

Construction of knowledge base

Theoretical / discourse
knowledge

Reflection ——————— Transformation

Collaborative
reflection of
activity

Creating new through
learning tasks and
projects
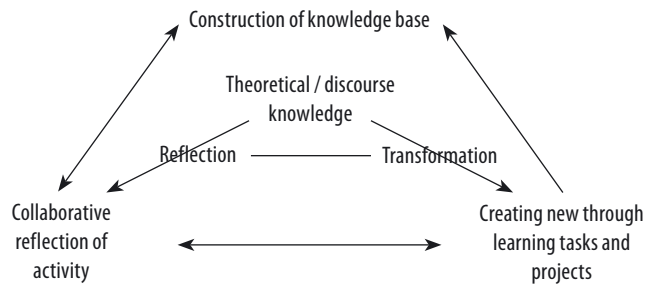
Figure 7.   Transformative learning model (Kauppi 1998, 57)

Training took place on the school premises partly during school hours. This was in contrast to many short-term seminars that are held outside the school, and whose effectiveness is seen as questionable. Leithwood (1999, 53) emphasizes the importance of gaining new knowledge and skills in contexts where they are going to be needed and within a community of practice.

Participants' timetables had been cleared from teaching from two to six p.m. every Wednesday. Sandwiches, coffee and tea were available free of charge. In this way, an effort was made to attend to the basic physiological needs (Maslow 1970), food and time, so that reaching higher levels in the hierarchy of needs would be possible. Participants also received two books on web-based instruction as part of the programme.

To summarize, the in-house training programme included:

- Lectures and seminars on special features of online learning for the whole group together, followed by discussions and problem-solving tasks;
  Instructed and independent workshops in small groups where new information was processed and applied to practice in planning web-based instruction;
- Independent reading and reflection plus face-to-face and asynchronic web-based discussion groups;
- Individual instruction and guidance as the online projects advanced.

At this stage, teachers used their concrete experience from classroom teaching to make pedagogical decisions about the online course. Lectures and seminars provided concepts to promote reflection and comprehension. In workshops and discussion groups, participants had an opportunity to reflect on their own as well as their colleagues' former practice and new ideas. This provided an opportunity for conceptualizing the classroom experience in light of the new understanding. In a way, teachers became observers of their own classroom practice.

The aim was to promote abstract conceptualization as in Kolb's (1984) learning cycle. The next step in the cycle, active experimentation, took place when all partici-

pants produced a written course plan before uploading material on the learning platform. Writing the course plan was a reflective process where participants attempted to apply what they had learnt into a new kind of problem, instruction in a web-base environment instead of a classroom.

Contents of the training programme were in accordance with Fletcher's (1996) relational practices that promote interaction and interdependence, and "enable" participants:

- Information was available for the group and its members. Information was provided by the outside consultant, by learning material made for this group in their virtual learning environment, and by two books on online teaching that participants received at the beginning of the programme;
- Information concentrated on recipients' needs with relevant examples, in this case good practice examples of online teaching and learning, as well as theory on learning;
- The mode of work was mutual and reciprocal assistance that benefited all participants;
- An attempt was made to raise the team spirit in collaborative workshops (Ruohotie 1999, 41–42).

The main themes covered in the programme were:

- Open learning environments as opposed to closed tasks and teacher control;
- Quick review of theories of learning;
- Teacher's role;
- Tutoring and instructive material;
- Language of online material;
- Copyright.

The following example illustrates the structure of the programme:

13 March   *Theme: Open learning*
          Lecture: planning an online course
          Workshop: discussing ideas for your own course
          Reflect: Examine your own teaching. Which open or closed solutions do you use? Do you see a need to increase openness? If so, how?

14 March –10 April
          Independent workshops: planning your online teaching
          Task: produce a synopsis of your online course and post it to the Studium environment for the other participants to see.

10 April   *Theme: Tutoring*
          Lecture: instructive material and tutoring
          Workshop: planning the instructive material to your own course
          Presentation of ideas and general discussion

17 April   Theme: Teacher's role
*   Lecture: social interaction online*
*   Workshop: looking at your own role on your course*
*   Discussions: ideas for social interaction on the participants' courses*

For more details of the programme, please see appendix 4. The online learning environment was Palmenia's own Studium environment. However, all online courses were designed for WebCT (Web Course Tools), which was in use in the polytechnic at the time. WebCT is briefly introduced below.

Web Course Tools

WebCT was developed in the University of British Columbia, Canada in 1997. It is basically a Learning Management System for creating a virtual learning environment. Apart from presenting teaching material, the program includes communication tools for students and teachers, possibilities for students to present the results of their work, tools to support learning and follow their own progress, quiz tools, and different tools for teachers for student management.

WebCT has many functions that support meaningful learning (see Nevgi & Tirri 2003, 36–37). It is possible for students to save their own work in their own files, or take notes while studying with *My notes* (active). *My progress* tool allows students to follow and plan their studies (intentional). There is a variety of *Quizzes* that can be used to self-study. *E-mail*, *Chat* and *Bulletin board* provide possibilities for exchanging beliefs and ideas (constructive) as well as working together on solving a common problem (collaborative). *Student presentations* area is another tool that enables students to work on a common document, e.g. in process writing, and also to present the results of their work to other students (collaborative, constructive). WebCT accepts different kinds of data, so uploading video clips or simulations made with other programs is possible (authentic).

Students can also keep a learning journal, which encourages reflection (intentional). Bringing experts to a WebCT classroom is possible by making them *Teaching assistants* thus providing students with opportunities to seek expert opinions about real-world problems (authentic).

Apart from educational purposes in the polytechnic, WebCT was also used as a communication tool between the faculty, all other personnel and students. It could be accessed via the Internet, and thus provided the most up-to-date information about school activities, cancellations, and last minute changes in lesson plans. The WebCT *Bulletin board* was used, among other things, to encourage interaction and discussions on chosen topics.

WebCT was in use in Lahti Polytechnic during 1999–2005. It is safe to say that its basic use became familiar to all teachers and students. Most teachers used it to com-

municate with students about changes in lesson plans, or to check the calendar for upcoming events. In educational use, however, WebCT becomes slightly more complicated; most teachers needed the assistance of a technical support team to upload course material on WebCT, and to learn to manage their course while it was running (see also Piukkula 2002).

In sum, WebCT allows either a traditional or constructivist teaching approach. Its *Quizzes* and multiple-choice questions can be used to produce behaviourist programmed teaching; at the same time, it has several tools to provide students with a constructivist, meaningful learning environment. It must be noted, however, that if teachers are not conversant with the technology, they become dependent on advice from technical support personnel. In such a case it is possible that the teaching approach is influenced by the way WebCT with its possibilities is introduced to the teacher.

3.2.3   Expectations, experience, and results

The training programme was full two days after being advertised. The rapid response from staff confirmed findings of the 2001 survey, in which over half of the informants expressed interest in online teaching. The school provided funding for 20 staff members.

The programme was designed to meet participants' expectations and needs, while providing ample research data regarding training and learning processes. Experience was gained on two levels: practical experience of the usefulness of training in producing online courses, and pedagogical experience of constructivist learning.

Throughout the intervention the aim was to adjust the training to participants' needs. For that purpose, all participants were asked to answer three questions before the programme was designed:

- Why are you participating in the training?
- Why do you want to teach online?
- What are your expectations regarding the training?

Halfway through training, two groups were interviewed to find out if they wanted any changes in the programme before training ended. The groups were also asked to evaluate the programme: the learning environment, lectures, workshops, and their own work. At the end of the programme, all participants were encouraged to give feedback in the discussions forum of the Studium environment.

In order to gather research data and to promote reflection, the author took journal notes, and the groups were asked to keep a diary of their workshop discussions. To help structure the diary and to encourage reflection some prompts were provided in advance:

- The main things covered today.
- What questions arose?
- What felt nice? Why?
- What seemed difficult? Why?
- What are we going to do next?
- Other

Following is a summary of participants' expectations and experiences followed by a discussion on data that the journal notes and diaries yielded.

Expectations

There seemed to be two reasons for teachers to participate in the training: they had experimented with online instruction before and were not satisfied with their own performance, and/or they saw this as one form of professional development.

> I have made an online course. I want to correct mistakes.
>
> The online course I've made is not pedagogically to my satisfaction. There's a lot to improve.
>
> For my own development, I'm interested in the subject.

Participants saw online instruction as a change from routine offering new, flexible, more versatile ways of learning. Some emphasized the support that could be given to distant learners via the Internet, especially now that contact lessons were so few. They also thought students might find online studies more motivating and interesting. Some regarded online instruction as a necessity in today's changing society:

> The world has changed so much. It has become so visual and "instant". Lectures do not meet the practices that people have in their everyday lives

Participants mostly expected to see good practice examples of online courses, to get ideas of what can be done online, what is different from classroom teaching, and how the course should be planned to make it interesting and many-sided utilising different possibilities that the web environment offers. The main concern of teachers was that they did not know how to best use the Internet for everybody's benefit – teachers' as well as students'. Although most participants seemed to emphasize the pedagogical content, there were also those who said they needed technical, more than pedagogical, support. Summarizing, teachers seemed to expect concrete support, advice, and examples for their hands-on work with online material.

Journal notes verify the enthusiasm with which teachers launched into the project:

12.2. People have been absolutely great about the training. In a week, 21 persons signed up. All of those that I've interviewed so far have been very keen to participate. Expectations seem to be high. People have also offered to help in a most amazing way: Liisa said she would be happy to observe the groups, Laila promised to keep a learning diary, Lassi will buy books for everybody. Lilli pays for the coffee and sandwiches. It really feels that this is our mutual project.
(All names have been changed. Lassi and Lilli were project managers and could, therefore, find project money for books and coffee.)

Participants' experience

Eight course manuscripts were completed by the end of May 2002, and six online courses were produced by the end of October 2002. Most courses were designed and produced as a collaborative effort of two or more teachers. Out of the 20 participants five failed to produce a manuscript, and one dropped out of the programme altogether. In addition, five of those who had designed a course and written a manuscript did not produce online material. One participating teacher was no longer working at Lahti University of Applied Sciences in the autumn of 2002 and another teacher made the online material based on her manuscript.

The teacher who dropped out at the very beginning had, for some reason, teaching in his timetable on Wednesday afternoons when the training took place. The reason might have been the fact that he signed up only after somebody had cancelled, and that is why there had not been time to clear his timetable for training. Some participants claimed a lack of time prevented their production of manuscripts and/or material. One teacher, however, was not satisfied with this explanation and asserted that time could have been found if there had been a real demand for an online course and a compensation for preparing it:

> *Well, I can say from experience that one can find time, if there is a reward or an obligation. We usually press on, when a course is beginning… We do what must be done, or what we've promised to do. That's when we press on and we just have to find the time. And I think here it's like, there wasn't that… I guess. Although we had our own plan and the deadline for the manuscript, but it doesn't feel so concrete, when there's no real reward in that way…. And if the employer had set that demand that it had to be completed, and there would've been compensation, we would've tried to do it during the summer. If we put it very strongly, at its crudest in a way ….*

Workshops started off well. Journal notes show that after the first month all groups were still having their independent workshop meetings on Wednesday afternoons. After the second month, however, participation seemed to dwindle. Only two groups met at the end of April. At the beginning of May there was another short training course on the use of Internet arranged at the same time with the ongoing programme. This pulled many participants away from their workshops. The last seminar day co-

incided with the final assessments deadline, when grading of polytechnic students had to be ready. Consequently, this impacted attendance.

Messages in the discussion forum following the first seminar reflected confusion:

> *I'm still confused…*
>
> *Can I ask a stupid question?*
>
> *This is all very confusing…*
>
> *Chaotic!*
>
> *I've got like thousands of questions in my mind right now.*

Participants were still optimistic about working through their initial difficulties, which had to do with not understanding the instructions in the Studium environment.

Group interviews at the end of the spring term revealed that teachers were happy with the opportunity to work together on such a project. Work, they felt, was possible because they had been given the time on Wednesday afternoons. They also recognized the value of peer support and the sharing of ideas that generated new ideas.

> *In my opinion, our own workshops were really good and efficient. That was, I think, one of the best parts of this whole thing.*
>
> *I felt the atmosphere was very supportive in our group, and many times there were new ideas that I would never have thought of on my own.*

Journal notes also focus on collaboration:

> *We have a wonderful group! I find it much more fun to do this together than alone. Now I also feel that we can give and take feedback on each other's writing without scruple. Collaboration gets easier with time.*

Neither group was totally satisfied with the Studium environment. It did not accept different formats or documents made with different software. Instructions were sometimes difficult to understand.

Regarding lectures and seminars, opinions differed. One group was satisfied with everything so that the interviewer had to point out that it was quite alright to also criticize something. Another group was generally dissatisfied with the lectures and the lack of concrete support that they had wished for:

> *Yes, the lectures have been good, an integrated whole. On the first lectures we were encouraged to ask questions, and we got a lot of good answers.*
>
> *The lectures felt a bit like forced feeding. As I didn't feel I got so much out of them, I had to sort of drag myself there, although I would have had other things to do…*

> *I expected more practical tools for the actual making of the online course. In a way, I'm a bit disappointed.*
>
> *I thought this was going to be a practical tool, and this has been theoretical and with an emphasis on pedagogy.*

The second group mostly expected concrete examples of different kinds of online courses and more support in their own planning. They also suggested more workshop consultation.

Only two teachers gave feedback in the discussion forum at the end of the spring term. Both felt training had met their expectations. The lack of online interaction was mentioned as the only shortcoming in one message. The same concern was expressed by the second interview group, and in the journal notes.

This feedback was forwarded to the consultant. As a result, more time was reserved for feedback on work done during the last seminars in the autumn. In the final session the participants presented their own online courses, which served as examples of different solutions.

Research experience

As mentioned at the outset, the goal was to gather research data in all possible ways: by interviewing individual participants as well as groups, by keeping diaries, and by taking journal notes. The purpose was to access discussions that groups had in their workshop meetings. Ideally, it was assumed, groups might have engaged in critical discourse and critical self-reflection, which would have shown in their diaries.

In actuality, most groups failed to maintain their diaries. If individuals made entries, they only mentioned the coffee and sandwiches. In the end, apart from the group, in which the researcher herself kept a diary, only one other group recorded their discussions – the group for which a separate secretary had been invited in anticipation of otherwise weak results. The secretary recorded discussions almost verbatim, only sometimes summarising the main points.

The journal notes as well as the two diary entries confirmed what had already become apparent in group interviews; ideas were shared and new ideas generated, but no critique was given. Teachers were reluctant to criticize each other's work. This is especially evident in one group interview:

> *Everyone has their own courses and their own projects, so why interfere. They must know how to teach, what's needed. We've just looked and listened like: 'ahaa, you've got that kind of course, I see.'*

Diaries did not reveal any critical discourse, either. The teacher who had promised to keep a learning diary did not do so, for lack of energy. As a result, the only evidence

of reflection was in the author's journal notes. The abstract conceptualization of the design was not visible in any of the recorded data.

However, the training programme yielded eight manuscripts and six online courses. Since one teacher had produced three courses (one on the basis of the manuscript written by the teacher who then resigned, another one without a manuscript), there were four matching manuscripts and online courses. Apart from the four, one teacher was quite certain he would be able to produce the online material before the research was over. These five teachers were selected as subjects for the subsequent research, and their manuscripts and online material formed the basis of the research data. The courses under study were Project Work, Wood as Raw Material, Bio and Recycled Fuels, Technical Writing – Thesis Abstract, and Basics of Environmental Analysis

3.3   Phase III: Study on conceptual change of teachers

The aim of the in-house training programme was, on one hand, to support participating teachers in their process of producing online courses, on the other hand, to encourage collaboration, critical discourse and reflection, and to promote transformative learning and conceptual change. This study focused on trying to understand the change in participating teachers' meaning perspectives and answer the five research questions. Because the aim was to increase understanding, qualitative methods were used throughout the study.

3.3.1   Methodology

Course manuscripts and online material that participants produced as part of the in-house training programme provided research data. After analysis of manuscripts and online courses, however, it was considered necessary to conduct a new in-depth interview with each participant to capture the conceptual change that did not show in the outcomes. Thus, these three sources of data were regarded as providing information on participants' pedagogical thinking, pedagogical talk, and their practical teaching approach in general.

Data collection

Both manuscripts and online material existed without special data collection methods. Therefore, only interviews are dealt with in more detail here. Interviews were

based on each teacher's own course manuscript, and took place in the spring of 2003 and the autumn of 2003 and 2004. The aim was to allow enough time for teachers to pilot their courses prior to being interviewed. Interviews covered course plans, online material, and teachers' experiences and reflections on their successes and failures. Consequently, interview data provided evidence of teachers' learning process; gradual understanding of new teacher and student roles, questioning of their own teaching approach, and putting new concepts into practice.

This is a constructivist approach to teaching and learning; we are not merely looking at the results, the online courses, but are considering the whole process of producing the courses involving critical self-reflection and self-evaluation. When learning occurs, changes in a person's meaning schemes and understanding may at first be so subtle that they are not yet visible in the end result, in this case, the online courses. Still, learning may have begun, and that learning can perhaps be detected in the process itself and in the way interviewees make meaning of their experience. Hence, the approach to interviews was constructivist rather than positivist or emotionalist.

Positivists look in interviews for facts about the world. Therefore, questions are often standardized, and all interviewees answer the same questions in the same order. The interviewer remains as detached and objective as possible. This was not the case with this author's research. Moreover, although participating teachers in interviews recounted their experiences, the aim was not to access their emotions, as it is with emotionalists. Research was more "*interested in documenting the way in which accounts are part of the world they describe*," and in "*how interview participants actively create meaning*" (Silverman 2001, 95).

This research interest resulted in what Cohen, et al, call a "guide approach" type of interview (Cohen et al. 2000). It means that the themes of the interview are specified in advance, but the interview itself takes the form of an informal conversation. The interviewer decides on the sequence of questions during the interview. This method made the data collection systematic while also allowing new, important topics to arise in the course of the interview. Themes covered in each interview could be formulated as five questions, although wording was not necessarily the same in all interviews:

- What added value does the Internet contribute to this course?
- How do you begin the course?
- How does it proceed?
- Describe one task in detail.
- How is assessment carried out?

In addition to these common themes, different questions were dealt with based on special features in each teacher's manuscript or on topics that arose in the interview discussion. The atmosphere was relaxed and informal, since interviewer and interviewees were colleagues and had participated in the same in-house training

programme. This shared experience made peers of interview participants and no power relationships seemed to appear that would have hindered free expression of opinions.

Transcribed interview texts were sent to interviewees for comments and for check-up, in case anything had been omitted in the transcription. Interviewees were also encouraged to add to or expand their comments. Similarly, after analysis of interviews, results were discussed together with interviewees to validate the interpretations.

Cohen et al. (2000) warn about weaknesses in this kind of flexible interview approach. Some salient topics may be omitted, especially if sequencing of the main themes is not strict. Also, different responses do not make easily comparable data. Some critics of constructivist interviews blame them for "narrowness", and there is certain justification to this. Constructivist interviews may be considered narrow in the sense that they do not say much about anything else but the interview (Silverman 2001, 97).

In this study, however, the focus was on teachers' conceptions of teaching and learning, their meaning schemes, which consist of assumptions, attitudes and values, not facts about the world. Depth was gained through choice of analysis methods. Interview data reflected *what* teachers said and *how* they said it. The interest was in the world created through language, not the factual reality as such. Therefore, the most important criterion for the data was to include teacher talk about teaching and learning in general and, more specifically, about teachers' own online courses, not answers to preset questions.

Data analysis

Course manuscripts and teachers' interviews were analysed as narratives, i.e. a textual analysis was applied to the data. A narrative is usually defined "*as involving at least two real or fictional events, neither of which presupposes or entails the other logically*" (Törrönen 2000, 83). It is in this broad sense that the term "narrative" is used in this study, which makes it possible to look at transcribed interviews, course manuscripts and online courses as a kind of narratives.

In narratology, text is analysed as having two constituents: the story itself (histoire) and how the story is told (discours). Sulkunen and Törrönen (Sulkunen 1997; Sulkunen & Törrönen 1997a; 1997b) call these two dimensions of text "utterance" and "enunciation," respectively. Some narratologists, Greimas (1980), for instance, have emphasized the role of a subject in a narrative. A narrative has a beginning, a middle, an end, and a continuant subject. Greimas developed a model of a canonical narrative schema which consists of three mini-narratives: the qualifying test, the decisive test, and the sanctifying test. The qualifying test is what motivates the subject to act, the decisive test is the action, and the sanctifying test involves evaluation of

the action (Törrönen 2000). This schema seems to capture the structure of a typical school course; motivation to learn, learning tasks as action, and finally assessment as the sanctifying test.

In analysis of course manuscripts and teachers' interviews, these two together are seen as making up the dual structure of a narrative. Manuscripts describe the story; what happens in the course, and who does what. Interviews are dealt with as discourse; how the story is told. Analysis of course manuscripts mainly considers structure of the course in terms of either traditional or constructivist teaching approaches, and the roles of teacher and student.

Analysis of the interview discourse makes an effort to bring teachers' conceptions of teaching and learning into the open. These include their attitudes towards students and the Internet, possibly entrenched beliefs about teacher and student roles, and the role of interaction. This is achieved by investigating narrative structure of communication, utterance, and enunciation (Sulkunen 1997; Sulkunen & Törrönen 1997a; 1997b; 1997c; 1997d), and by utilising the concept of modality and the actantial model developed by A. J. Greimas. The following chapters first make an attempt to clarify the concepts of utterance and enunciation, and consider how modalities come to play in production of values. Finally, the actantial model and its application to teaching and learning are explained.

Two dimensions of text and production of values

Semiotic structures of text are multi-level and complicated. For the purposes of this study and the research objective, structural analysis of textual data is limited to two dimensions: utterances and enunciation, as defined by Törrönen and Sulkunen (1997a; 1997b; 1997c; 1997d). In addition, modalities are discussed in so far as they are related to producing values in these two dimensions of textual analysis. "Value" in the context of teachers' pedagogical thinking is here understood as something that teachers consider important in teaching and learning; a goal worth attaining.

Utterances refer to what is said. They describe reality and are connected to context. What Sulkunen and Törrönen call "shifters" regulate this connection (1997a, 51). Shifters can be actorial, spatial or temporal.

> The shifters define the relationship between (the image of) the speaking subject to the content of the utterance; therefore they are part of the process that Greimas and Courtés call 'aspectualization': they define the aspect from which the speaker image speaks.
>
> (Sulkunen & Törrönen 1997a, 52)

Actorial shifters reveal the relationship between the speaker and the persons or things in the utterance. In our case, they may reveal the teacher speaker's relationship with students, for example. Spatial (e.g. here, there) and temporal shifters (e.g.

already) place the speaker either close to, or at a distance, from the content of the utterance and the persons and things in it. They may create a feeling of otherness or belonging.

Enunciation refers to the uttering subject, (not the surface level grammatical subject necessarily, although sometimes the two are the same); how the speaker speaks about the world, and what relationship he creates between himself, the text and the reader. Thus, no text is totally objective, since all texts imply a narrator (an enunciator). A case in point is a news report in a daily paper, where the speaker image often remains invisible. Sulkunen and Törrönen (1997c; 1997a) call this degree-zero enunciation or a transparent enunciator. The lack of a visible narrator does not mean that they are not there. On the contrary, their presence is strong; they are omnipotent and omniscient in the world that they are describing.

Sulkunen and Törrönen do not discuss the role of an enunciator in passive structures. It is suggested here that the enunciator in utterances that take the linguistic form of the passive approaches the transparent enunciator. The passive is a typical structure in scientific texts, for example, where the aim is for objectivity (Franzosi 1998), as is also the case in news reports.

Hiding the agentive subject

The passive voice in the Finnish language is somewhat different from other languages, since it can be formed from both intransitive and transitive verbs (a transitive verb takes an object: The boy kicked the ball). The most interesting feature of the Finnish passive as regards enunciation is the omission of the subject altogether.

There are two types of passive in Finnish: "Talo maalattiin" (The house was painted) and "Mennään ulos" (Let's go out/We'll go out). In the former case there is a transitive verb as is normal, for instance, in English passive sentences. In the latter sentence, an intransitive verb takes the passive form. Such a sentence cannot be translated into English in passive. This form is typical in spoken language, and the agent can be determined from the context. This type most often replaces the first person plural indicative or imperative (Sulkala & Karjalainen 1992). Thus the enunciator in most cases is apparent.

It is the passive with a transitive verb that raises questions of the role of the enunciator. According to Hakulinen and Karlsson (1979), the passive implies an indefinite personal agent. It can be used to refer to almost anybody; the writer, the reader or a third person (Viertiö 2000). It is a syntactic means of downgrading the subject. In an active sentence the subject is the primary constituent. The passive is rather common in Finnish and is used when, for some reason, we must "get the subject out of the way" (Hakulinen & Karlsson 1979, 255), or *make the agent disappear* " (Viertiö 2000, 23), or "*hide the agent*" (Kuiri 2000, 13) (translations all mine). Kuiri (2000)

also points out that the passive is a common means of not having to name the agent of unpleasant actions in sentences such as "Hintoja nostetaan" (Prices are raised).

Another way of hiding the agentive subject is to construct the sentences so that things seem to happen by themselves without human interference. Karvonen (1996) has found this type of sentences prominent in economic discourse. Whenever there is a need to hide those who are responsible for an action, a non-person subject is used. Thus, for example, "Hinnat nousivat" (Prices rose). Karvonen (1996, 154) gives a hilarious example of the devaluation of the Finnish mark, for which the government was not responsible – at least on the sentence level: "*Suomen markka pääsi kellumaan, sitten se devalvoitui.*" (The Finnish mark got to float, then it devaluated.) The mark did all this by itself, so there is no-one to blame.

Karvonen (1996, 155) points out that similar sentences are also common when the deterioration of the environment is described: "Vedet saastuvat" (Waterways become polluted), "Meret pilaantuvat" (The seas get spoiled). In these cases the enunciator is unwilling to reveal the culprit.

Modalities in revealing values

Values are produced in texts in both dimensions through modal structures. Modalities are understood as structures that somehow evaluate the state of affairs (Sulkunen & Törrönen 1997d). They also reveal the narrator's/enunciator's attitude towards the content of the utterance. A distinction is made between "*modalities that evaluate the truth or certainty of an utterance and other kinds of modalities, such as obligation, desire, etc.*" (Sulkunen & Törrönen 1997d, 50). The former operate in the enunciative dimension, but both types reflect the attitudes of the speaker and produce values in a discourse.

An utterance such as "It may be raining" is an example of how the subject of enunciation is made visible through a statement that implies uncertainty. The speaker is expressing his own judgment about the likelihood of rain. This is revealed through the use of a modal auxiliary "may." Sulkunen and Törrönen give another example, in which the functions of modalities and shifters overlap. In the following example, both a temporal shifter and modality enhance the value of doing in a simple utterance:

> 1. *John writes.*
>
> 2. *John can write.*
>
> 3. *John can write already.*
>
> (Sulkunen & Törrönen 1997d, 52)

Utterance number one has an actorial shifter "John"; it is not the enunciator that the utterance is about, it is about somebody else. Utterance number two modalizes the

doing as ability (can), and finally, in utterance number three, the enunciator uses a temporal shifter to imply that the doing is unexpected and therefore even more valuable.

Modalities are expressed in different ways: by modal (auxiliary) verbs such as "may," "must," "can;" by principal verbs such as "confirm," "hope," "claim," and also by other lexical categories such as adjectives and adverbs, "useful," "certain," "hardly," "perhaps;" by negations; and morphological structures (Hakulinen & Sorjonen 1989; Sulkunen & Törrönen 1997d). In the Finnish language we have a morphological quasi-structure "on tekevinään" (as if he was doing) that always reveals the speaker's attitude towards the utterance. Salminen (2000) has made a thorough investigation of different quasi-structures in the Finnish language and is able to confirm that a verb form such as above, for example, always implies that the grammatical subject is pretending, or imagining things. Sometimes it may also imply belittling, or minimising the value of doing.

If values and norms are not expressed through the language, they may be revealed through their very absence. Blind spots in a text often reveal norms, i.e. what is not said might be meaningful as well. Similarly, speaking in strong defence of something, or having to explain and give reasons might indicate a norm that the speaker feels s/he has violated (Alasuutari 1994).

Values, norms and attitudes are also revealed in the relationships between the actors in the world described (Greimas 1980). In the actantial model, the different actors are placed in specific actantial positions, and the tensions thus produced in their mutual relationships are made visible. By examining how the actantial model is articulated in the text, "*we can infer why an action is seen as valuable and from whose point of view*" (Sulkunen & Törrönen 1997d, 46).

Actantial model

The actantial model was developed by Greimas (1980) and was based on analysis of folktales. Greimas argued that all narratives can be reduced to the same basic relations between a sender and a receiver, a subject and an object, and a helper and an opponent. These six "actants" reveal the narrative grammar. The actantial positions can be taken by different "actors." (Schleifer 1987.)

In a traditional folktale the sender is the king, who sends the prince (the subject), who wants her daughter (the object), on a quest for a magic ring or to any other adventure in order to prove his worth. The prince may have animate or inanimate helpers: trees, birds, etc., as well as opponents, serpents, witches, or a rival (an antisubject). The receiver is usually the people who celebrate his return and the marriage with the princess (Greimas 1980).

Sender $\longrightarrow$ Object $\longrightarrow$ Receiver

$\longleftarrow$ Anti-subject

Helper $\longrightarrow$ Subject $\longleftarrow$ Opponent
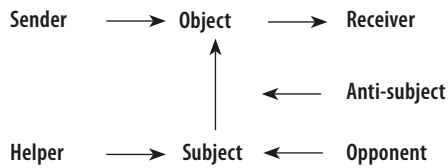
Figure 8.   Actantial model (Sulkunen & Törrönen 1997c, 47)

The actantial model is a conceptual tool in analysis of meanings in a text. Actantial relations reveal norms and values that materialize in the text. The relation between the subject and the object is the most significant one. The object discloses the value of the goal, whose worth all other actors determine (Greimas 1980; Sulkunen & Törrönen 1997b). The goal thus reveals what is considered important. "*Who occupies the position of the sender, what sort of contract is made between the sender and the subject, and how the obligation influences the subject's action, all convey important information about the norms…*" (Törrönen 2000).

Helpers embody abilities and competencies required in achieving the desired goal. At the same time, they show what is appreciated in the story, what are the accepted values. The anti-subject and opponents provide the resistance that the subject has to overcome. They, too, are value-laden revealing the inferior, unaccepted means in the pursuit of the goal. They are the villains in a folktale.

Wang and Roberts (2005) point out that Greimas's originally French term "objet valeur" is frequently translated as "object of value," which they find too positive, and suggest, instead, "value-object." In this work, the object is understood to have "value" in the sense that it is important to the narrator. Greimas named the subject/object axis "desire" or "quest" (Wang & Roberts 2005), which seems to agree with the important object actant; it is something the subject desires, and goes on a quest to attain.

All the actants do not have to be present in the text in order for the actantial model to be utilised. In addition, the same actor may take different actantial positions, or one position may be taken by different actors in turn. Thus, for example, the sender, the subject and the receiver may be the same actor. The actor that seems to be the subject at the beginning of the story may be exposed as an anti-subject, a false hero, at the end (Greimas 1980; Schleifer 1987; Sulkunen & Törrönen 1997a).

Sulkunen and Törrönen (1997a) investigate the qualification of the subject along the modal axes of obligation, desire, ability (being able to do) and competence (knowing how to do). They come to the conclusion that ability and obligation are imposed by another subject, they are "exotactic." They represent external motivation to achieve the goal. Competence and desire, on the other hand, refer to the subject's own internal motivation. They stem from the subject itself and are therefore "endotactic." Veijola (1997) uses the same modal axes to express how strong the subject appears.

Thus, external motivation would produce a weak subject and internal motivation a strong subject. Veijola uses participation in a game as an example of the hierarchy of modalities. The highest category, (denoting a strong subject) is that of desire and the lowest obligation: I want to play – I know how to play – I am able to play – I must play. The negative continuum would be: I don't have to play – I am not able to play – I don't know how to play – I refuse to play (Veijola 1997, 142).

Teaching and learning seem to fit well in the actantial model. Depending on the teaching approach, the teacher/instructor, the subject to be learnt, and the student fall into the roles of a sender, subject, object, and receiver. The teaching material, the learning environment, the methods used, and the student's prior experience, abilities, and present life situation occupy the other actantial positions.

Actantial model applied in teaching and learning

Greimas (1980) showed how actantial interpretation can be applied to a great number of texts quite different from folktales. He argues that a sentence in itself is a kind of a play where the roles are always the same: subject that functions, object that is the goal, etc. Greimas proceeds to analyse our classical philosophers and their search for knowledge in a form of a play, as well; the philosopher is the subject, the world is the object, the sender is God, the receiver is mankind, the opponent is "materia" and the helper is spirit. In the same way he is able to show the actors in Marxist ideology (Greimas 1980, 206–207). Veijola (1997) applies the actantial model successfully to analysing a Finnish floor ball game.

Similarly, it seems teaching and learning, the relationship between teacher and students could be seen as a play that could fall quite easily into the actantial model. Table 5 below looks at the two orientations toward learning in terms of actants and actors:

Table 5.   Actors in behaviourism versus actors in constructivism

	BEHAVIOURISM	CONSTRUCTIVISM
Subject	teacher who transmits knowledge	student who processes information
Object	knowledge that the teacher transmits/student who is taught	knowledge that the student constructs
Sender	school that employs the teacher	teacher/school or society that empowers the student
Receiver	student who receives the knowledge	student who gains the knowledge
Opponent	student's lack of abilities	environmetal factors (life situation), student's lack of motivation,etc
Helper	teaching methods, teaching material	teacher, learning strategies, teaching material, learning environment, peers, employer, etc

While some actors could be questioned; for example, whether the sender in the constructivist orientation is the teacher or the school, the working life or society – or even a highly motivated student, the difference in the roles that the teacher and student take seems obvious. A constructivist teacher becomes a sender or/and a helper while the student himself is the subject. In a behaviourist school play, the student is either an object (to be taught) or a receiver of transmitted knowledge.

Online courses

Online material is analysed in terms of locus of control and task specification, i.e. who can influence course content and who specifies learning goals and tasks – teacher or student. An attempt is made to identify Coomey's and Stephenson's (2001, 38–40) online features, dialogue, involvement, support and control in the online material, and considering realization of these features, to place the courses under study in Coomey's and Stephenson's paradigm grid (2001, 41). The grid is discussed in more detail in Chapter 2.6.1.

Summary of methodology

The table below illustrates how the three kinds of data were treated to investigate participating teachers' pedagogical thinking, pedagogical talk, and pedagogical practice.

Table 6.   Summary of methodology in Phase III

Data	Analysis of	Focus on	Results	Level
Course manuscripts	what happens	story	teaching approach teacher – student roles	pedagogical talk pedagogical thinking
Interviews	what is said how it is said	utterance enunciation	conceptions entrenched beliefs, attitudes	pedagogical talk pedagogical thinking
Online courses	tasks and contents	DISC features	teacher–student roles	pedagogical practice

Results of the analyses reveal teachers' teaching approach, their conceptions of teacher and student roles, possibly entrenched beliefs as well as attitudes and assumptions that guide their pedagogical practice. In this way, the three kinds of data provide answers to the first two research questions:

- What conceptions do polytechnic teachers hold about teaching and learning?
- How do polytechnic teachers' preconceptions affect their views of teacher and student roles?

Additionally, analysis of online courses addresses research question three:

- How do polytechnic teachers' conceptions of teacher and student roles show in their online instruction?

Comparisons of analyses of course manuscripts, interviews and online courses seek answers to research questions four and five:

- What kind of conceptual changes occur among polytechnic teachers engaged in ICT training and online instruction?
- How do polytechnic teachers' entrenched beliefs affect their conceptual change?

Below, results of analyses of course manuscripts, online courses, and interviews are presented to allow comparisons between teachers' pedagogical thinking, practice, and talk, respectively.

3.3.2   Results

The results of analyses of manuscripts, online courses and interviews are presented each in their own section below. Manuscripts represent teachers' good intentions of how they wanted to realize their online teaching. Analysis of online courses then shows the actual realization of teachers' plans. As noted in Chapter 1.2 previous research indicates that the realization does not necessarily compare well with the plan. Analysis of interviews, therefore, makes an attempt to shed some light on the gap between the plan and its realization.

Manuscripts: presenting good intentions

Manuscripts represent the planning stage in teachers' work and, therefore, reveal their pedagogical thinking and teaching approach. Manuscripts are also samples of teacher talk, i.e. the concepts and terms teachers use to describe the plan. In narrative analysis, course manuscripts represent the utterance level. The texts were analysed in terms of what happens in the course; what the teacher does and what students do. First, each manuscript was summarised to bring out the story and the roles that the teacher and the students play in it. The manuscript was then analyzed in terms of its typical features as they fell into the category of behaviourist or constructivist teaching approach.

One of the five manuscripts is a good example of a constructivist teaching approach with new teacher and student roles. Another one is a textbook example of Skinner's programmed teaching and a behaviourist teaching approach. The three

remaining manuscripts have both constructivist and behaviourist features in them in varying degrees. Below, summaries of manuscripts are presented with a short description of the contents and objectives. Next, results of the analysis are presented in a form of a table.

Course 1: Project work, 1 credit

Objectives and contents

Students learn to know the methods of project work and project management. They study different phases of a project through a project of their own to be completed during the course. The course is related to design and production of plastic products.

Realization

Course contents have been divided into 12 parts that must be studied in a predetermined order. After each part there is a test, a WebCT quiz, which students must pass to be able to proceed. The tests consist of multiple-choice questions that have only one correct answer. They are checked automatically by the programme. If students fail any single test, they must go back to the material and study more. The material consists of Web pages that briefly present the information to be studied:

> *Verkkomateriaalissa on lyhyitä tietoiskumaisia sivuja, jotka vastaavat perinteisiä piirtoheitinkalvoja. Näitä voisi tarvittaessa käyttää Power Point -esityksen materiaalina lähiopetuksessa. Sivuilla olevista avainsanoista klikkaamalla saadaan tarkempi selostus aiheesta oppikirjamaisesti rakennettuna.*

> The web-based material has short informative pages that are equivalent to overhead transparencies. These could also, if necessary, be used as material for Power Point presentations in contact teaching. By clicking on the keywords on the pages, you get a more detailed discussion on the topic structured as a textbook.

The teacher compares the pages to traditional overhead transparencies and sees a possibility to use them as slides in a Power Point presentation. By clicking on the keywords on the pages a more detailed account of the topic opens following the structure of a textbook. Students can send a message to the teacher by clicking on a contact button. The teacher can send e-mail to one or more students.

Students are to come up with a project idea in small groups, make a timetable for the project and regularly meet to discuss developments. Minutes must be kept of each meeting and they are to be handed in for the teacher to check.

At the end of the course there is a final test. The course is passed when all quizzes have been passed, all minutes of meetings handed in, and a final test passed. There is a deadline for the project/course, after which the online environment closes. The grade is based on points that students gather from quizzes and the final test. The

grade can be seen directly on a scale that gives the points required for number values 1–5.

Course 2: Wood as raw material, 3 credits

Objectives and contents

Students learn to know the properties of wood as a renewable, natural material, and can take the special characteristics of wood into account in product design. Course contents cover, among others: structure of wood, strength properties, modification and preservation.

Realization

The manuscript begins with a justification for offering a web-based course. Benefits are many, including the timetable, organization of work in the laboratory, etc. The following are directly related to teaching and learning:

> *Tehtävälähtöiselle oppimiselle (konstruismi / PBL) hyvät mahdollisuudet*
>
> *Opiskelijoiden tietämyksen tason parempi hyödyntäminen opiskelussa*
>
> *Oman osaamisen oikeantyyppinen syventäminen mahdollista (puolet käynyt puua-lan ammattikoulun ja monella käytännön kokemusta)*
>
> *Webbikurssin tuloksena syntyy uutta tietoa ja opiskelumateriaalia*
>
> *Opettaja oppii ja tuntee lähtökohtatason sekä oppimisprosessin paremmin*
>
> *Laboratoriossa saadut tulokset saadaan käyttöön opintojakson aikana (nyt työsel-ostukset valmistuvat tavallisesti opintojakson päätyttyä)*
>
> *Työkaluohjelmat ja webbi heti opintojen alussa hyötykäyttöön.*

> Enables task-centred learning (constructivism/PBL).
>
> Better utilization of students' prior knowledge.
>
> Makes it possible for students to increase and deepen their knowledge in the right way (half of them have a vocational qualification in wood technology and many have practical experience)
>
> New knowledge and material is created as a result of a web-based course.
>
> Teacher learns to know the initial level of student knowledge and the learning process.
>
> Results of laboratory work can be utilized during the studies (at present the reports are usually completed only after the course is over).
>
> Application software and the Internet in use right from the beginning.

The course consists of three periods of teaching, the first two of which are mainly contact lessons in the classroom. The third period is web-based. On the first lesson

the teacher describes the objectives of the course and the general structure. Students are also given an overview of papermaking in Finland:

> *ja sitte siihen liittyy semmonen koko Suomen paperintekoon perehdytysjakso ta-vallaan. Asetetaan opiskelija ikään kuin tähän infrastruktuuriin, mitä on puun jalostus suomessa.*
>
> and there is a sort of an introduction to papermaking in Finland. The student is in a way familiarised with this infrastructure, what wood processing is in Finland.

After the introduction the course continues with an initial test, the purpose of which is to give the teacher information about students' prior knowledge of the topic. Results of the test serve as guidelines to teaching. The teacher uses this information, for example, when arranging students into groups and when giving students individual tasks and research projects.

The course proceeds in the form of different themes that are first discussed in the classroom, and then studied in a laboratory through individual or group tasks. Groups are formed according to the interests and prior knowledge of students as revealed in the initial test. The theoretical part of the subject is dealt with on contact lessons but it is also available in the online learning environment. Students utilize the web-based material while doing their laboratory work. The teacher gives advice to students on one-to-one basis on their problems in the research project.

Students present the results of their work partly in class, partly in the WebCT learning environment. Students produce altogether four laboratory reports and one larger 3–5 page research report. One third of the course is distant study but research is done during class hours. In addition to publishing results of the research project on WebCT, students also introduce their work in seminars. The teacher and the class give immediate feedback on work presented in class. In seminars students are experts in the field of their research project and teach each other. New information thus produced is used as learning material, not only by present but also new students.

Apart from the initial test, there are two tests given during the course, and the final test, which is a modified version of the initial test. Results of the final test are discussed in class, at which time students can observe changes in their learning gain with each question. This is accomplished using a computer-generated bar chart created from initial and final test results.

Students give feedback on the course via an electronic feedback form available on WebCT. Assessment is based on laboratory reports, the research project and mid-course and final tests.

Course 3: Bio- and recycled fuels, 1 credit

Objectives and contents

Students learn to know the concepts "bio fuel" and "recycled fuel," their production processes, and their burning properties. They are able to make choices based on the environmental effects of fuels.

Realization

This course was part of the Virtual polytechnic project. The manuscript was written by the teacher's assistants. The teacher had two assistants, her former students, working for her in a project, and these two assistants prepared the web-based material as well as wrote the manuscript for the course. The teacher was, however, responsible for the objectives and contents of the course, and supervised the assistants' work. The manuscript was approved by the teacher.

The course contains both contact lessons and independent work online. For example, an excursion is made to a power plant. Later, however, the idea is to run the whole course via the Internet apart from the initial contact lesson and the final test. The manuscript emphasizes the clarity of the course structure and the ease of navigation in the web-based material. The aim is to develop students' interactive skills and to enable them to search for information independently.

The course begins with a contact lesson, during which objectives and all practical matters are discussed. Students also complete a questionnaire to find out what they already know about the subject. The online material is divided into separate material packs/modules on different subject areas. The modules contain theory, links and pictures. Students can choose in which order they want to proceed. Each module, or unit, contains open-ended questions for students to answer. Answers can be found in material packs in the form of theory or links to different websites. Students work on the questions, send their answers to the instructor, and receive feedback on their answers. They cannot see each other's answers or feedback.

Discussions form an integral part of the course. Students are required to discuss the subject matter with each other during the course in order to learn interactive skills. To stimulate the discussion different roles can be given to students. Students can also talk with the instructor in the discussion forum about matters related to the practical arrangements or course contents.

Assessment is based on the final test, which is administered in the classroom as usual. To pass the course students must have answered all questions and participated in discussions.

Course 4: Technical writing – thesis abstract, 1 credit

Objectives and contents

Students learn to write their own thesis abstracts and develop skills in scientific and technical writing in general. Learning takes place through process writing.

Realization

This course was planned, and the manuscript written, in collaboration between three English teachers, one being the author of this paper. The course was produced as part of the national virtual polytechnic project, partly funded by the EU. The third English teacher was from another polytechnic.

The description of course contents is addressed directly to students and begins with, "*Welcome to this course.*" Objectives of the course are described in "can do" statements:

> "*You can write the abstract of your Bachelor's Thesis.*"
>
> "*You can critically evaluate your own writing as well as others.*"
>
> "*You can search for information…, etc.*"

Students' duties are expressed in the form of short instructions:

> "*Introduce yourself and your topic to other participants.*"

The course begins with a contact lesson during which the purpose and process of writing an abstract is briefly discussed, as are students' expectations of the course. The step-by-step course structure and objectives are explained. During the contact hours the WebCT environment is introduced to students, and they have time to start doing the first online task. This is the only time students and the teacher meet in person. The course takes five weeks, which are strictly scheduled with deadlines for assigned work. Students' primary duty is to create and perfect their thesis abstract that they write and rewrite as the process advances and they learn more.

The online work begins with short introductions in the discussion forum. The course consists of theory and exercises plus useful links to scientific texts and abstracts, online dictionaries and electronic databases. There are also interviews of former students and researchers, who tell about their theses in Finnish. These are provided as working material for students whose own work is not so advanced that they could write their own abstracts. The manuscript suggests visual and audio material to accompany the researchers' interviews.

The theory is in the form of a Mind Map consisting of nine questions on writing an abstract, for example, "*What are the contents of an abstract?*" The theoretical part

also provides sample sentences, a list of technical verbs and a model abstract. Students can choose whether they want to study the theory in Finnish or English.

Each week students study one or two branches of the Mind Map and do exercises related to them. Most exercises deal with grammar typical of scientific writing. All exercises feature the typical language of abstracts. Some take the form of the whole abstract or part of it. The programme checks the exercises and gives feedback. Each week students try to apply what they have learnt to their own work. They send in their abstracts to the teacher for feedback a total of three times, and once to their assigned pair. The teacher gives feedback on peer assessment, as well.

The manuscript also suggests weekly online seminars in the discussion forum, where common problems are discussed; either raised by students themselves or the teacher. A possibility for another face-to-face meeting is left open to be held in mid-course if students so wish. At the end of the course, students are asked to fill in a questionnaire with questions about the course contents, suggestions for improvement, their own evaluation of their progress and opinion on online learning.

The course is assessed on a scale of 1–5. The grade reflects the whole five-week process: exercises, development in students' own writing, feedback they have given to their pairs, and the final abstract they produce. There is no test.

Course 5: Basics of environmental analysis, 3 credits

Objectives and contents

Students learn the basic methods used in environmental analysis and their potential application. In addition, they learn to know the basics of sampling and to use laboratory methods for analysing the environment.

Realization

Online studies make one third of the whole course (1 credit), while contact lessons and laboratory work comprise the rest of the contents. Contact lessons support online studies:

> *Lähiopetuksen tarkoituksena on tukea itsenäistä opiskelua verkossa (aihepiirei-hin liittyvät case-tapaukset ja tehtävät) sekä auttaa soveltamaan opittua teoriaa käytäntöön laboratoriotyöskentelyn yhteydessä.*
>
> The purpose of contact teaching is to support independent studies online (cases related to the topics and tasks) and help apply the theory that has been learnt into practice in laboratory work.

During the first contact lesson the teacher explains the structure, objectives, and procedures of the course, and introduces the WebCT environment. The objective of

the course is to give students a deep insight into the operation principles of different analysis equipment, alternative analysis methods and applications.

> *Kurssi kehittää opiskelijoiden kykyä hyödyntää jo aikaisemmin oppimaansa teoreettista tietoa yhdessä uuden tiedon kanssa käytännössä. Verkko-opetuksen tavoitteena on kehittää opiskelijan vuorovaikutustaitoja ja itsenäistä tiedonhakua.*

> The course develops students' ability to utilize in practice the theoretical knowledge that they have previously learnt, together with new information. The objective of online teaching is to develop the student's interactive skills and independent information search.

The online material consists of theory divided into topics that can be studied in any order. All topics also include a case, for example a link outside the course, pictures, and questions about the theory, and a Test Yourself quiz. Some material is on a CD. Students work independently finding answers to questions and save their answers in a special folder, which other students cannot access. The teacher then reads the answers and gives individual feedback to each student. Participation in discussions is part of course requirements.

The manuscript emphasizes navigation properties and the clear structure of web-based material.

Assessment is based on a final test, online exercises, laboratory work and reports, and participation in online discussions.

Results of analysis of all manuscripts

Results of analysis of manuscripts are collected in three tables in order to bring out the different roles that the teacher and students take as well as typical features of the teaching approach. For more detailed analyses please see appendices 5 and 6.

Table 7.   Teacher's and student's roles in course manuscripts

Teacher's role in course manuscripts			Student's role in course manuscripts	
Teacher	**Course**		**Student**	**Course**
decides on contents and objectives	1,2,3,4,5		works independently	1,2,3,4,5
provides study material and quizzes	1,2,3,4,5		takes quizzes	1,2,3,4,5
gives individual assignments	2		answers questions	1,3,4,5
gives advice	2,3,4,5		has own project	2,4
gives and collects feedback	2,3,4,5		provides study material	2
gives final test	1,2,3,5		interacts	1,2,3,4,5
assesses	1,2,3,4,5		makes decisions regarding own learning	2
			attends seminars	2
			works in laboratory	2,3,5
			learns from other students	2
			takes final test	1,2,3,5
			assesses	2,4

Manuscripts present a more or less traditional teacher, except for the manuscript for Course 2, in which students play a central role in learning. In all other manuscripts, teachers are in control of knowledge in the form of material they have provided, course contents, learning tasks, and assessment. The teacher's role of transmitting knowledge has not changed; only the means are new.

There is more variation in the student role than in the teacher role. Thus, depending on the course, students may introduce themselves in the discussion forum, hold meetings, apply the theory into practice in laboratory work, present their findings, evaluate their own and other students' work, and so forth. There is some effort to encourage students' independent information search, and to some extent this is achieved. However, the search is for information that the teacher wants; the correct answer that can be found in the material provided. In most courses, students are required to take quizzes and answer questions according to the teacher's predetermined answers, and take a final test to show their learning.

Below, the courses are placed in the table of typical features of constructivism and behaviourism according to the teaching approach that surfaced in the manuscripts. The table illustrates which behaviourist and which constructivist features were found in these courses.

Table 8. Teaching approach in course manuscripts

Course	Traditional approach	Constructivist approach	Course
1,3,4,5	Curriculum is fixed and remains the same for all students.	Curriculum is negotiated together with students. It is flexible reflecting students' needs.	2
1	Subject matter is presented from part to whole, with emphasis on basic skills.	Subject matter is presented from whole to part with emphasis on big concepts and problem solving.	2,4
1	Students are viewed as fixed in their abilities, "blank slates" where teachers transmit knowledge.	Students are viewed as thinkers who construct their own subjective knowledge about the world.	2,4
1,3,4,5	All students are taught the same	Students' prior knowledge is the basis for learning new	2,3,5
1,3,4,5	Lessons are teacher-led. Direct teaching and teaching methods play an important role.	Lessons are student-centred and interactive. The teacher is a facilitator of learning.	2
1,3,5	Students are motivated through external reinforcement.	Students are motivated by their own interpretation of reasons for success or failure.	
1,3,4,5	Teachers call for correct answers to validate student learning.	Teachers seek students' points of view in order to bring out and understand students' present conceptions.	2
1,3	Assessment is separate from teaching and occurs almost entirely through testing at the end of the course.	Assessment is continuous, interwoven with teaching and occurs through teacher observations of students at work and through self and peer evaluation.	2,4,5
4	Students primarily work alone.	Students are encouraged to work in pairs and groups and help each other.	1,2,3,5

To remain consistent, the table from Chapter 2.3 was used to present results of the analysis. The table describes differences in the behaviourist and constructivist teaching approaches in general terms and fails to show every detail in the manuscripts. For more detailed analysis, please see appendix 6. Courses where behaviourist features were found are marked on the left, courses with constructivist features are on the right.

Some courses appear to be behaviourist and constructivist at the same time. For example, finding out students' prior knowledge is assumed to be a constructivist feature, but all students having to cover the same material in the same way was found to be a behaviourist feature. Courses 3 and 5 have both these features and, therefore, appear both in the behaviourist and constructivist columns.

If teachers had prepared materials and tasks in advance and also planned how they should be completed, and what the correct answers were, the course was interpreted to be teacher-led even though the manuscript emphasized students' individual work.

In the manuscripts, two constructivist features seem prominent: emphasis on social interaction and discovery of students' prior knowledge. In addition, there are

individual examples of continuous assessment and laboratory work, where theory is put into practice.

All manuscripts, except the second one, are behaviourist in the sense that courses are fixed from beginning to end, and that the teacher has made all choices concerning contents and objectives of the course. The teacher is in control of knowledge, and students do not make decisions on what they want or need to learn. Another common behaviourist feature is the fact that the teacher has made questions to which s/he knows the answers. The questions usually have one right answer. Finding the correct answer in the material provided is an electronic form of knowledge transmission. Although students work independently on the material, they are not expected to make their own questions to the material based on what they already know. The behaviourist features that surface in most manuscripts are:

- Questions are not students' but the teacher's;
- Questions have only one correct answer that the teacher knows and expects;
- Students do not have a possibility to set their own learning goals;
- The course is fixed from beginning to end;
- All students study the same material and do the same tasks;
- Assessment is mainly based on end behaviour, the final test.

All manuscripts show attempts to take a more constructivist approach to teacher-student relationships. A case in point is the questionnaire at the beginning of the course to learn students' prior knowledge. This does not, however, lead to any customization of the course plan. Students' individual differences are not considered. Material and tasks are the same for everybody.

Giving students some choice and emphasizing interaction are also obvious efforts to take a more constructivist teaching approach. These also mainly remain at the level of good intentions. There is no plan on how to implement these ideas. Social interaction, group work or discussion is expected to take place at the instructor's command. Course manuscripts, thus, indicate that, although these teachers seem to be aware of a new approach to teaching, they may not succeed in implementing it in practice.

Online courses: realization of good intentions

Four of the five online courses discussed above were available in the WebCT environment at the time of the study. This chapter briefly looks at different realizations: what kind of material the Web pages contain in terms of Ihanainen's (2002, 168) classification into presentation, performance, interactive, and creative communication; and how the DISC (dialogue, involvement, support and control) features, are present in each course (Coomey & Stephenson 2001, 38–40). As a result of the analysis, the

courses are placed in Coomey's & Stephenson's paradigm grid (Coomey & Stephenson 2001, 41).

Course 2: Wood as Raw Material, 3 credits

Wood as Raw Material course material is available in the students' WebCT classroom. The WebCT environment seems to be both means of communicating with the students and resource of teaching materials. The homepage features several icons for communication: a calendar, timetable, e-mail, discussion forum, and students' contact information. Thus, the environment provides tools and opportunities for student-initiated dialogue, but it is not structured in the course in any way. There are links for laboratory work instructions, information about wood as raw material, and different types of trees, students' research topics and instructions on how to conduct research and report on results, and test results. On the homepage there is also a link to the students' presentation area, where students present their work.
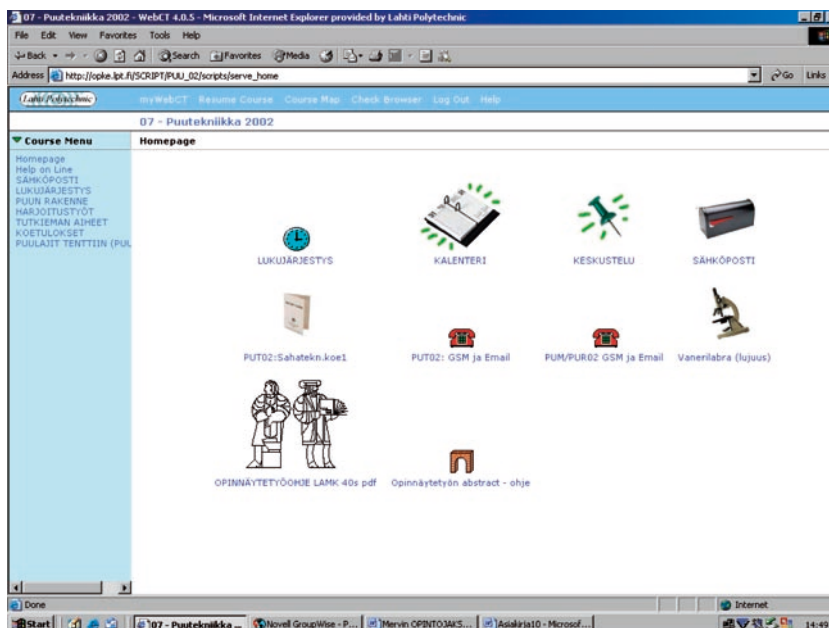
Figure 9.   Class homepage on WebCT. Course 2.

The homepage contains information and material on studying wood technology for this particular group of students. All student groups (1st, 2nd, 3rd, 4th year students) have their own WebCT classrooms featuring relevant information and material. The environment changes periodically when teachers add new material, or new courses begin at the beginning of a new period.

Therefore, the course on Wood as Raw Material does not form an entity of its own. In fact, there does not seem to be a course at all, but some presentation material mentioned in the manuscript and creative material produced by students during the course. This suggests that the course is not fixed in advance but can be flexibly adjusted to meet students' needs. Tasks are not tightly teacher-specified.

Students use the Internet as a resource for laboratory work, and as a forum for presentation of research findings. In the laboratory, they work in self-managed groups, which provides opportunities for task-focused dialogue and peer feedback. This may explain why there are hardly any messages in the discussion forum, and nothing pertaining to this particular course. Both the laboratory work and the individual research task are examples of student control. The goal is more or less determined by the teacher in the instructions, but the conduct of the task is up to students.

Individual research tasks are determined on the basis of the student's own interest and prior knowledge, thus increasing the degree of involvement. Students receive feedback on their research from other students in the seminars, where they present the work (which is also available in the students' presentation area on WebCT). During the research process the teacher provides advice on how to proceed and gives feedback on the progress.

Course 3: Bio- and Recycled Fuels, 1 credit

The course on Bio- and Recycled Fuels has its own WebCT classroom. The homepage has icons for Introduction, Materials, Tasks, Discussions, Printing, Questionnaire, and Course Feedback. Course material consists of presentation material (theory) and performance materials (tasks and links) organized in such a way that the main themes open as separate information pages, thus forming subject-related entities.

Under Materials, students find new icons for Biofuels, Recycled Fuels, etc. (see the picture below). By clicking on the title, more information about, biofuels, for example, is available with hypertext to take students deeper into the subject. The theoretical part also provides links to relevant pages offering more detailed information beyond the WebCT environment. This page also features a Test Yourself icon.
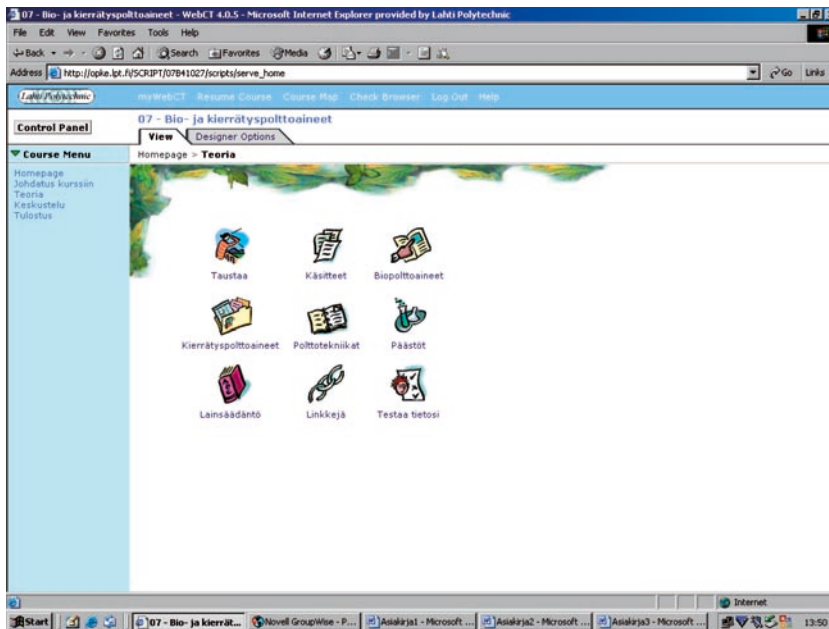
Figure 10. Theory index page with icons for different themes under which more detailed information is available. Course 3.

Tasks are arranged in the same way, each under their own heading, so as to make navigation easy from tasks to related theory and back. The structure is very clear and logical, and students can get an overall idea of the subject by browsing through all the material, first reading the main titles only, if they so wish.

Typical student tasks seem to be simple factual questions of a type, "*What is biogas?*" for which the answer is found directly in the material provided. Another type of tasks comprise so-called "cases," where the question is for larger amount of information: "*What harmful substances can recycled fuels contain?.*" The answer can be found in the links listed on the task page.

Instructions are clear. Students are to study the material and find answers to questions. The discussion forum is available but there is no prompt to discuss anything, nor are there any messages from students. Teacher and students are invisible in the WebCT environment, which is dominated by the material.

The course is text-based and content and tasks are determined in advance. Students cannot influence contents or goals. Dialogue is confined to answering the teacher's pre-set questions. Students receive feedback from only the teacher, and the teacher controls what is learnt and how.

The course feedback form is an electronic version of the form used in the polytechnic. It is a questionnaire with open-ended questions with grading on a scale of 1 to 5, where 5 is the highest grade. Items in the questionnaire probe students' opinions

on the usefulness of the contents, teacher behaviour and ability to teach, student activity, workload, applicability to working life, and teacher feedback and tests.

Course 4: Technical Writing – Thesis Abstract, 1 credit

The homepage for Technical Writing – Thesis Abstract provides icons for Read This First, Course Description, Assignments, Materials, Quick Help, Calendar, Mail, Discussions, and Grammar. Read This First and Course Description introduce objectives and contents of the course. The course includes presentation, performance, interactive and creative materials. Communicative material plays a minor role.

Presentation materials consist of examples, interviews, and theory. Under Materials, students find examples of abstracts written by former students, and three student interviews about their bachelor's thesis. The interviews can be used as a material for writing an abstract, if the student has not got his own thesis to write about.

Quick Help comprises the theory of writing an abstract. It also provides lists of technical verbs as well as sample sentences, and another model abstract. Quick Help is presented in the form of a Mind Map of nine questions. Branches of the Mind Map are hypertexts that lead to the theory. The theory is both in Finnish and English.
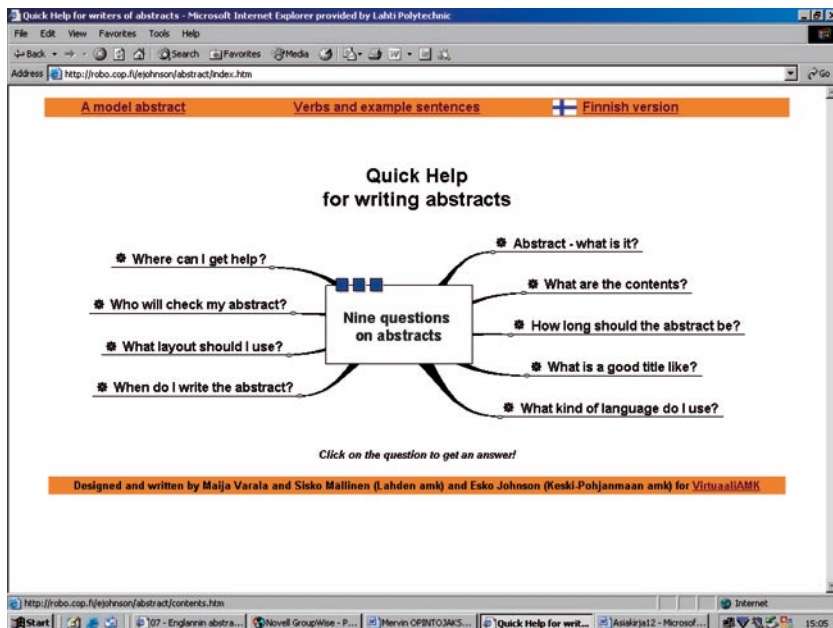
Figure 11.   Theory presented in the form of a Mind Map. Course 4.

The Assignments icon links visitors to Instructions and Tasks. Instructions include a step-by-step timetable of student work with deadlines to keep. Grammar is not an

essential part of the course but is included for handy access to revision of basic structures of the English language for those who need it.

The tasks, performance material, are generally gap-fill exercises or multiple-choice questions that are automatically graded by the programme. The idea is for students to practise theory through tasks rather independently and then try to apply to their own abstracts what they have learnt. They write four different versions. These constitute creative material, although produced alone with little collaboration with a pair.

Mail is used by both students and the teacher to send and receive abstracts and personal feedback. The discussion forum is used for introductions that take place at the beginning of the course. This can be classified as interactive material. On the basis of introductions, students find their e-mail partners, with whom they examine the third version of the abstract and give feedback to each other. The teacher also gives weekly instructions in the discussion forum, and uses it as a communication tool to communicate with all students as necessary.

Students do not seem to send messages to the discussion forum, so there is no real discussion. Dialogue is task-focused (introductions and peer feedback). The main feedback still comes from the teacher. Students have no control over the contents, but they all have their own individual goal, in a sense, since they are all writing their own abstracts. Thus, there is more student involvement than in Course 3. The teacher's role is to instruct and help students via feedback. The teacher controls the learning outcome, contents and deadlines.

Course feedback is collected at the end of the course via the Mail icon. The questionnaire is specially drafted for this online course, and is comprised of questions about workload, level of difficulty, learning transfer to own abstract, clarity of instructions, feedback, deadlines, etc.

Course 5: Basics of Environmental Analysis, 3 credits

The WebCt classroom for the Basics of Environmental Analysis course is constructed according to the same principles as Course 3, Bio- and Recycled Fuels. Online material contains presentation and performance materials, links to Web sites of different equipment manufacturers, and various tasks. Most relevant theory is in an accompanying textbook and CD that students use simultaneously with online tasks. The homepage provides icons for Course rules, Useful links, Tasks, Discussions and Course Feedback.

Tasks consist of multiple-choice questions for individual work, and open-ended questions for group or pair work. Multiple-choice questions test students' knowledge about and use of basic analysis equipment. Questions are in the form of problems that occur while using the equipment. Students must find the single incorrect answer among three to six alternatives:

Task 1: Find the correct cause for the symptom:
The problem is abnormal pressure. Symptom: the pressure is even but too high.

The velocity of flow is too big
a. *The filter is blocked.*
b. *There is too much solvent.*
c. *The injector is blocked.*
d. *Wrong eluent.*
e. *Wrong column.*

Having one wrong answer and five correct answers reinforces learning. The problems are the kind that may occur in fieldwork. This is a new way of using multiple-choice questions, where typically only one answer is correct.

Group or pair tasks are larger and focus on equipment operation principles. A typical example of such tasks is to find out and explain briefly how an atomic absorption spectrometer functions and how it is used. To be able to do that, students need to examine the CD provided by the manufacturer. The answer cannot be copied directly from anywhere, since the CD contains extensive and detailed information about the device. Students, therefore, must first understand the function and then be able to summarise it in their own words. Multiple-choice tasks are self-correcting, but the teacher reads and comments on all open-ended group work questions.

There is no discussion in the discussion forum, but students are likely to discuss problems and symptoms in their groups or pairs while doing the tasks. It must be remembered that this course was held in the computer classroom, where students worked on online material side by side.

Again the teacher controls contents, goals and tasks. Although tasks are tightly specified, learners cannot copy answers directly from material (as was the case in Course 3), but must understand the material. This increases student involvement. Students also support each other in their group or pair work tasks, even though the main feedback comes from the teacher. The teacher's role is mainly that of an instructor. The Course Feedback form is the same as in Course 3.

Conclusions from analysis of online materials

If we look at the online courses in terms of Coomey's and Stephenson's grid (Coomey & Stephenson 2001, 41), Courses 3–5 seem to fall in the NW sector with teacher-controlled, specified tasks, whereas Course 2 is more open and could be placed in the NE sector. The SW and SE quadrants are open to the extent that learners define their own learning goals and explore the subject area in an unstructured way. None of the courses in this study presents elements of the SW or SE sectors.

This is how Coomey and Stephenson describe the NW and NE quadrants of the grid and the part that Dialogue, Involvement, Support, Control, and Teacher play there. Only the relevant parts are quoted below:

The north-west quadrant (teacher determined, task specific):

In this sector, the teacher tightly specifies the activities and outcomes, including deadlines, timings, exchanges and online content (often text based), leaving the learner with little scope for initiative, except for carefully controlled situations.

Dialogue. Student responds to teacher's questions and mini tasks. Dialogue with peers is specified as part of task.

Involvement. Little or no scope for learner to influence the content. Activity is strictly defined and related to a pre-set task. The site is structured to lead the learner directly to specific information. Students can access information from a Web site before, during or after lectures.

Support. The main feedback comes from the instructor.

Control. Learner control is confined to responses to tasks. The teacher controls the reading materials, the content to be learnt and deadlines.

Teacher role. Instructor.

<div align="right">(Coomey & Stephenson 2001, 42)</div>

The north-east quadrant (learner determined, task specific):

In this sector, the learning tasks and perhaps also the learning goals are specified but learners have control of how they work towards and achieve the set of goals and the tasks.

Dialogue. The teacher sets out the general responsibilities… (…) Scope is confined to the task, but the system and protocols support student-managed dialogue with other students, peers and experts.

Involvement. Task-focused self-managed groups. Groups can be self-selected and/or self-moderated. The learner is able to relate or adapt tasks to his or her own circumstances and aspirations.

Support. The tutor provides advice on the nature of the task, learning goals and so forth. Students provide feedback to members of their own groups and others.

Control. Conduct of tasks is up to the learner. Emphasis is on navigable links to a wide variety of sources

Teacher role. Coach.

<div align="right">(Coomey & Stephenson 2001, 43–44)</div>

Thus, it is possible to place the courses in Coomey's and Stephenson's paradigm grid:

```
                            Specified tasks
        Courses 3–5                    Course 2
        Content and tasks preset,      Student-managed research
        little student initiative,     and laboratory work,
        feedback mainly from the       peer feedback, flex-
        teacher, impromptu task-       ibility in tasks and content,
        focused dialogue, teacher      impromptu task-focused
        instructor                     dialogue, teacher coach
Teacher controlled   ——————————————+——————————————   Learner managed



                        Open ended, strategic
```
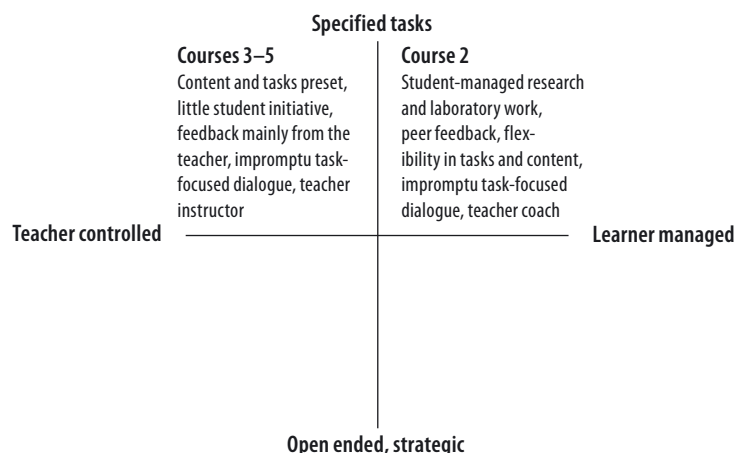
Figure 12.   Online materials placed in the online paradigms grid (Coomey & Stephenson 2001, 41)

In Courses 3–5 the material and tasks are set in advance. The teacher has created the questions for which students find answers, or the students take the same self-correcting quizzes. The teacher provides most feedback. In Course 4 students work on their own abstracts, which requires a little more initiative. They cannot, however, influence course contents or tasks.

In Course 2 students do laboratory work in task-focused groups. They also conduct their own research. Students are given a topic according to their interests and based on their prior knowledge. They plan their work, set their goals, find source material, and present their work to classmates. In seminars, where they present their work, they also receive class feedback. The teacher guides students' research progress.

Summarizing, results of analysis of online materials indicate that, apart from Course 2, these teachers remain in control, leaving students with little opportunity to demonstrate initiative and manage their own learning. The student's role is mainly to follow instructions. There are no discussions in the discussion forum in any courses (the introductions in Course 4 cannot be considered discussions, since there is no interaction, only monologues).

Dialogue can, however, take place, when students meet face-to-face, for instance in laboratory work groups, as in Course 3, or when they work in the computer classroom together, as in Courses 3 and 5 (which are held according to the timetable on school premises). Course 4, on the other hand, has one structured peer feedback task.

Presentation and performance materials are dominant, although in Courses 2 and 4 creative materials represent an essential part of the learning process.

Interviews: addressing the gap between intention and realization

During interviews, teachers discussed their online courses described in manuscripts, and associated practical arrangements. They also referred to their classroom practices or normal face-to-face courses for comparison.

Five questions posed during every interview were:

1. What added value does the Internet contribute to this course?
2. How do you begin the course?
3. How does it proceed?
4. Describe one task in detail.
5. How is assessment carried out?

Textual analysis of interview data was based on the concept of language as a means of describing, creating, and maintaining reality. This view has become widely accepted in sociology as well, since the work of Michael Foucalt (Sulkunen 1997c). Furthermore, language and thought are closely interrelated. To tease out teachers' conceptions of teaching and learning, and their possibly entrenched beliefs – i.e. to access their frames of reference – analysis focused on the linguistic structures chosen, and meanings thus created. Kress points out that, "*…thought exists in the forms and structures of language – conversely, the forms and structures of language represent thought. The process of articulation of language represents the process of thinking.*" (Kress, 1979, 48).

Use of actantial model revealed what these teachers considered important in a learning situation, the goal to be achieved. Modalities play an important role in producing tensions in relationships between different actors. Various linguistic means of producing modalities are discussed in Chapter 3.3.1 the concepts of enunciation and utterance were utilised to bring out teachers' attitudes towards students, teacher-student relationship, and web-based learning. The following table summarises methodology used to analyze interview content:

Table 9.   Methodology for analysing interviews

Data	Analysis of	Focus on	Results	Level
Interviews	What is said	Utterance	Conceptions entrenched beliefs, attitudes	Pedagogical talk
	How it is said	Enunciation		Pedagogical thinking

Interviews were first transcribed at the lexical level. This degree of accuracy was considered sufficient due to the method of analysis that focused on words chosen by the speaker i.e. their utterances, what was said. It must be noted, however, that important information communicated through intonation, emotional force and timing

of speech, irony, humour, etc were missed. As Lemke (1998) points out, some of these features are often redundantly coded in words as well, but not necessarily all of them. Original data was preserved on tapes in case a need would arise to re-analyse it or consult it from a different viewpoint.

Before the actantial model was applied to the transcribed interview, the text was looked at in terms of its grammatical subjects and sentence structures (see Appendix 7 for an example). Finding the grammatical subjects, and verbs through which they became qualified, proved useful in determining actors and the positions they took within the actantial model. To reiterate, the subject actor is not necessarily the same as the grammatical subject.

Passive structures and other impersonal expressions such as generic constructions (*You can't change it.*) and existential sentences (*There are tasks over there.*) were redundant and, therefore, were classified separately in order to investigate, whether or not these sentence types were chosen to describe a specific matter or situation. Thus, transcripts were first reduced to lists of sentences according to subjects: teacher, students, and "we" (referring to teacher and students, or teacher and teacher). Sentences, in which the enunciator was clearly visible, e.g. *Mun mielestä, ne ei ole caseja* (*In my opinion, they are not cases.*) were listed under teacher subjects. In such a sentence, the grammatical subject is "Ne" (they), but expression of opinion reveals the speaker.

Passive and other impersonal structures were listed separately. The sentences thus grouped were calculated to get an overview of the frequency of occurrence of certain structures, for example, how many times the speaker used the passive instead of the first person singular. These numbers, however, cannot be compared from one interview to another, since the length of the interviews varied, and the numbers were obviously bigger in longer interviews. What can be compared, are the proportions of different expressions in the interviews. Some interviewees used the passive voice most of the time when describing their courses, whereas others preferred speaking in first-person singular.

Modalities were produced through principal and auxiliary verbs, quasi-structures, negations and other lexical forms such as adjectives and adverbs. Adverbs were also used as spatial shifters to either include or exclude the teacher and/or students from the online environment. "The course" was often personified and acted as an actorial shifter distancing the agentive subject from the action described.

The following presents the analyses, results and conclusions of the first two interviews in full. The aim is to show how the actantial model was applied and to clarify the concepts of modalisation, enunciation and utterance in revealing teachers' conceptions of teaching and learning, their entrenched beliefs, and attitudes towards their students and the online environment. These interviews are the two extremes among the online courses as regards the teaching approach. The first one is a classic example of behaviourism, the second one is more constructivist. The remain-

ing three interviews produced more uniform actantial models. The results of these analyses are, therefore, presented in one actantial model and discussed together.

In the examples, the quotations are many to validate the conclusions drawn. Direct quotations are provided in Finnish and translated into English, as the linguistic features of the language would otherwise be difficult for the reader to appreciate. Undoubtedly, the translation cannot fully capture all nuances, but will express a rough idea of the thought that the utterance reveals. ("i" stands for the interviewer and "I" for the interviewee in the interview extracts)

Course 1: Online behaviourism

At the time of the interview the course on Project work had not been prepared for online yet, but the teacher felt confident of finishing the course during the summer holidays.

The first question seemed to be difficult to answer. The interviewee took a long time to formulate his thoughts into words. In the end, he seemed to consider the automatic quizzes the best part of an online course. They are easy to check, and it is easy to see whether students have done them. The teacher found self-correcting quizzes more practicable than traditional homework.

The main structure of the course remains the same as in the written course plan. First the teacher presents objectives and contents of the course, and makes sure that every student has access to the WebCt environment. The subject matter being learnt is divided into small logically advancing steps that lead to mastery of the whole. Students work on their own, getting feedback from the programme after taking a quiz to test their learning of each unit. There are, however, two changes. Firstly, the teacher is now abandoning the idea of group work on the grounds that it might not succeed, since it requires a lot of initiative from students:

> I: *Mä aattelin, että jos se ei välttämättä onnistu, kun se vaatii oppilailta sillee… kun niitä ei luokassa patisteta., niin aika paljon tällasta oma-aloitteisuutta.*
>
> I: I thought that it might not necessarily succeed, since it requires from the students in a way…, as they aren't pushed in the classroom, so it requires this kind of initiative a lot.

Secondly, the teacher has decided to include open-ended questions as well as multiple-choice quizzes after each part.

> I: *Mun mielestä täytyy olla kyllä kirjotettujakin vastauksia kysymyksiin, ettei pelkästään voi rasti ruutuun. Se on aika ohkasesti tai niitä täytyy olla paljon tai ne täytyy laatia tosi ovelasti.*
>
> I: In my opinion, there must be some written answers to the questions so that you can't just tick the box. It remains a bit superficial or there must be lots of them (multiple-choice questions) or they must be very clever.

Assessment is based on points that students gather from all quizzes, and the final test. The grade can be seen directly from a table when the points are calculated together. The interviewee emphasized several times how important it was for him to see each student's individual level of knowledge at the end of the course. He was somewhat worried that this might be difficult, if the final test was taken online as well, since students might help each other in the test. This triggered a new question from the interviewer as to why helping each other should not be allowed, project work being, after all, a team effort. In his answer, the teacher was very sceptical of students' ability to co-operate online and suspected that there would be too many "free-riders", while two or three most conscientious ones would do the work.

Group work online seemed to be a serious problem for the teacher, since he had always included it in this course but now felt he had to leave it out. He did not trust it could be done online. The main problem, as he saw it, was the difficulties of making students work together, since he could not see them face to face to "*give them a push.*" Different alternatives were discussed, such as, how there could be a contact lesson to start the group work. In the end, it was agreed that group work online could be this teacher's personal development task in the upcoming new training programme that was being planned to support teachers who were piloting their online courses.

The interviewee assured he was eager to complete the plans and offer the course on WebCT the following academic year.

Actants and actors

The obvious subject based on the course manuscript would be the teacher. It is possible, however, to find three different actors to take the subject position in turn. At the beginning of the interview it seems to be the teacher, later the course becomes the subject, and then students whom the teacher-sender has sent to perform the tasks, until at the end, the teacher again takes the subject position.

There are 62 impersonal expressions, including the ones where the course is the agentive subject, as opposed to 23 where the teacher identifies himself or the teacher as the subject, and 30 cases where students are agentive subject.

The basic relationships of the actants and actors are shown in the diagram below. The sender and receiver actants are not included due to their minor role in the narrative structure:

```
                          Object:
                          control
                          assessment
                              ↑
                                        ←   Antisubject:
                                            students

Helper:        →     Subject:       ←   Opponent:
WebCT                teacher                net
```
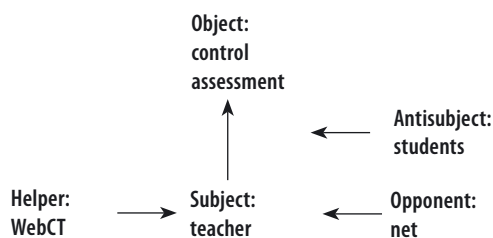
Figure 13.   Actantial model of Course 1 interview

Hiding teacher-subject

At the beginning the teacher-subject has a muffled narrator voice using impersonal expressions and the passive voice to explain how the course is structured. It is the same device that is normally used in scientific writing to achieve objectivity. In the Finnish language, it is a means of hiding the agent or making the agent disappear altogether (Hakulinen & Karlsson 1979, 255; Kuiri 2000, 13; Viertiö 2000, 23).

> *i: Mikä on verkon lisäarvo tällä kurssilla?*
>
> *I: (pitkä tauko) Vaikea kysymys. Sanotaanko että kun tuonne verkkoon tehdään kurssi, niin on hirvittävän paljon helpompi , tai en nyt tiedä hirvittävän paljon, mutta helpompi, tehdä sellasia koko tän kurssin aikana tehtäviä harjoitustöitä. Sinne kun verkkoon mennään, niin sinne on sitten helppo laittaa harjoitustöitä, että miettikääpä tätä ja rasti ruutuun, mikä näistä on oikein ja ne vielä on suhteellisen helppo siellä verkossa tarkastaa.*
>
> *i: Kuvailepa, miten sä aloitat tän kurssin.*
>
> *I: Aloituslähitunti on. Kun tätä on 1 ov ja se pidetään yhdessä periodissa niin se tahtoo sanoa, että sitä on kolomoistunti kerran viikossa. Se ensimmäinen tunti tavallaan käytetään sitten tähän. Luokkaopetuksessa käydään läpi, miten tää kurssi on suoritettavissa verkossa ja kaikki tunnukset annetaan sinne, ja sen jälkeen se tuota sitten siirtyy aika pitkälti sinne verkkoon.*

i: What is the extra value that the net brings to this course?

I: (a long silence) A difficult question. Let's put it this way that when a course is made over there on the net, it is so much easier, or not necessarily so much, but easier, to make such tasks that are to be done during the whole course. When one goes there, to the net, it is easier then to put tasks there like 'think about this and tick the box, which is correct,' and they are also relatively easy to check there on the net.

i: Describe how you begin this course.

I: The first lesson is a contact lesson. Since this is one credit and it is placed in one period, so that means it's three hours once a week. The first lesson is used on this. In the classroom, it is explained how this course can be studied online and all the passwords are given there, and after that it then, well, moves over there to the net to a large extent.

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The teacher's direct intervention here is nonexistent. Many times the teacher subject appears weak on the modal axis through the choice of verbs:

> *i: Mistä se opiskelija keksii sen projektisuunnitelman?*
> *I: No siihen täytyy… Minä voin siihen antaa vaikka esimerkkejä.*

> *i: Mitä opettaja tekee sen kurssin aikana?*
> *I: Joo. Sillon ku kurssi on käynnissä.. materiaali kurssiinhan on tehty jo aikasemmin valmiiksi… mutta sitte kurssin aikana opettajan tehtäväksi lähinnä jää näitten tuota.. oppilaat kun tekee niitä tentin pätkiä, niin niitten tarkastaminen. Niinku mulla on tavallaan on, että joka osion jälkeen on tavallaan se pieni harjoitusjuttu.*

> i: Where does the student get the idea for the project plan?
> I: Well, one must…. I can give like examples of that.

> i: What does the teacher do during the course?
> I: Yes. When the course is running… the material for the course has been made ready before, you know…but then during the course what remains for the teacher to do is basically, when the pupils do those bits of tests, well, checking them. As I have, in a way, so that after each unit, there is, in a way, that little practice test.

First the teacher uses the modal auxiliary verb "must," then "can," which express obligation and ability, respectively. These are both low on the modal axis (Veijola 1997). In the latter sentence, the teacher does what is left for him; he does not seem to have much choice. There are also other linguistic markers that contribute to the powerless language (Franzosi 1998); hedges ("well," "in a way," "like"), hesitation (pauses) further underscored by the adjective "*little*," adverbs "*basically*," "*largely*," and "*over there*," which is used frequently to refer to the online environment acting as a spatial shifter emphasizing the net's remoteness and distance from the speaker.

Impersonality, hedges and other linguistic markers project an image of a weak, distant teacher. The only instances where the teacher subject is strong are when he introduces the course and when he speaks about his desire to monitor each student's level of knowledge and control the order in which tasks are done.

> *i: Miten tavoitteet käydään läpi?*
> *I: Siis ihan opettaja, elikkä minä, esittelen kurssin, mitä se pitää sisällään, miten se suoritetaan, ja sitten käydään läpi tietysti ne käytännön jutut, miten siellä verkossa operoidaan.*

> *I: Joo. Se lopputentti mun mielestä kannattas ehkä pitää sillä tavalla, että siinä eliminoituu tämä kimpassa tekemisen… Vaikka mä äsken sanoin, että niitä on vaikeeta saada kimpassa tekemään työtä, mutta kyllä ne nämä tentit varmasti kyllä tekee kimpassa sitte.*

> *i: Mutta eikö projektin idea yleensä olekin tehdä kimpassa?.*
> *I: On on. Mutta toisaalta kun minä taas haluan selvittää jokaisen yksilön osaamisen tason.*

i: Mitä muita ajatuksia sinulla on herännyt verkko-opetuksen suhteen?
I: Haluaisin nimenomaan pitää tällasen järjestyksen siinä, kun projektin täytyy olla sellanen kurinalainen, tietyllä kaavalla ajallisesti etenevä, niinku projektikin on Poikkeuksena varmaan muilla on sellasia kursseja siellä, että siellä voi tehä ihan minkä osan itse haluaa. Voishan tietysti tänkin kurssin suorittaa ihan missä järjestyksessä tahansa, että esitietoina ei välttämättä tarvita sitä edellistä pätkää seuraavassa, mutta mä haluan nimenomaan ku tää on projektikurssi, tähdentää sitä, että asioiden täytyy mennä just tarkalleen siinä tietyssä järjestyksessä ja tietyn aikataulun mukaisesti. Tää on niinku yks projekti tavallaan tän kurssin suorittaminen.

i: How are the objectives dealt with?
I: Well, the teacher himself, that's me, introduces the course, what it contains, how it is passed, and then, of course, the practical things are covered, how to operate online.

I: Yes. The final test, I think, should perhaps be made so that the possibility to do it together is eliminated. Although I said just a while ago that it's difficult to make them work together, I'm sure they'll do these tests together then.

i: But isn't the whole idea of project work to work as a team?
I: Sure it is. But, on the other hand, since I again want to find out each individual's level of knowledge.

i: Anything else that you have thought about regarding online teaching?
I: I would especially like to keep this kind of order in it, since a project must be disciplined in that way, so that it proceeds according to a certain schedule in time, likea projects do, too. As an exception, I'm sure others have courses there, where it is possible to do any part that one fancies. Of course, one could do this course in any order, too, so that it is not necessary to know the previous bit in the following… But, I really want to emphasize, since this is a project course, the fact that things must be done in a certain order and according to a time schedule. This is like one project in itself taking this course.

When introducing the course the teacher expresses the teacher subject twice in the same sentence with an emphatic intensifier "*ihan*" (translated as "the teacher himself"). Expressions of certainty also reinforce the teacher image. In the sentences, where he speaks about monitoring students' learning outcome and the order of the tasks, he expresses strong desire with the modal auxiliary "*want*" strengthened with the emphatic "*specifically*." The teacher subject's strongly expressed goal is to keep the preset order of the tasks and find out each student's individual level of knowledge.

The contradiction is sudden when, after the introductions, the course becomes the agentive subject and "*moves to the net.*" At this point the course seems a stronger subject than the teacher. It seems to function independently of the teacher.

I: Tää kurssi mun mielestä toimii nimenomaan sillä tavalla että ei pysty tekemään ihan missä järjestyksessä tahansa.

i: Mitä opettaja tekee sen kurssin aikana?
I: Palautetta annetaan totta kai, ja tämmönen kurssimateriaalin päivittäminen. Mä en tiedä, voiko sitä välttämättä tehdä sitten kesken kurssin, koska oppilaat voi sitten kuitenkin siellä verkossa toimia pikkasen niinku eri vaiheessa, että joku voi

olla edellä toista. Se on sitten reilumpaa kaikille, että kun se kurssi kerran alkaa, niin ei puututa siihen materiaaliin sinä aikana kun se kurssi on käynnissä.

I: This course, in my opinion, works specifically so that one cannot proceed in whatever order.

i: What does the teacher do during the course?
I: Feedback is given of course, and the sort of updating the course material. I don't know if one can then do it during the course necessarily, since the pupils can then operate online like in different stages, so that one is ahead of another. It is then more fair to everybody that, when the course begins, the material is not touched while the course is running.

Weak student-subject

Students appear weak subjects in their studies and learning. The modality expressed is either obligation "must," "has to" or ability "can." There are also other means of weakening the subject, for example, expressions of daring, "*uskaltaa mennä*" (dares to go) and doubt in a quasi-structure "*olevinaan sisäistänyt*" (thinks he has internalised it). The weak student-subjects' object is the teaching material that they study, the tasks they do, and the tests they take after each unit.

i: Kuvaile tarkemmin yhden osion eteneminen. Mitä se opiskelija tekee?
I: No jos otetaan tästä nyt ihan esimerkiksi joku osio, vaikka 2, Projektisuunnitelman laatiminen, vaiheistus ja ositus, niin siinä täytyy sitten oppilaan laatia jostakin projektista projektisuunnitelma. Ja vaiheistaa se ajallisesti ja työvaiheitten mukaan ja tällasia. Siihen oppilas joutuu käyttämään, meillä on täällä koululla käytössä tää MS-Prjoect 2000. Se joutuu sillä tekemään tuon vaiheistuksen ja osituksen ja projektisuunnitelman sitten kirjoittamaan ihan tekstinä.

Ja sitten jos ajatellaan joku muu juttu, missä nyt ei tarvi niin paljon tehdä. Täällä voi olla sellasta, mitkä on ennen menny pelkästään luennoimalla, esim. jotain "projektien riskit ja niiden hallinta" tuossa noin, niin siellä on lähdemateriaalia verkossa minun kirjottamaa ja sitten voi olla kyllä linkattunakin. Ja nyt idea on se, että kun oppilas on lukenut tämän ja olevinaan sisäistänyt sen, niin että uskaltaa mennä tekemään sitä tenttiä, niin se voi jokaisessa tällasessa osiossa mennä tekemään sen tentin.

i: Describe in more detail how one part goes. What does the student do?
I: Well, if we take one part as an example, let's say Part 2 Making a project plan, different parts and phases, so the pupil must then make a plan for some project. And time the different phases and work tasks, and that sort of thing. There the pupil must use, we have this MS Project 2000 here at school, he/she must make the phases on that, and the project plan he/she must write as text.

And if we take another case, where there's not so much to do. There could be something here that has been merely lectured before, for example, something like, "the risks in the project and the risk management". There…, so there's source material on the net, written by me, and there could be a link, too. And now the idea is that when the pupil has read this and thinks s/he has internalized it so that s/he dares to go and take the test.

Students appear reluctant to work and isolated.

i: Eli opiskelijoilla ei ole toistensa kanssa oikeastaan mitään tekemistä siinä? Se on ihan yksilösuoritus koko kurssi.
I: Joo. Kyll se sellaseksi… Semmonen on ehkä helpompi järjestää tuossa verkossa. Että se siinä tavallaan menetetään, että tää kurssi jos siirtyy tuonne verkkoon, niin siinä sitte opiskelijatkin eriytyy ja jää keskenään eristykseen..

i: Voishan ne silti tehdä yhteisprojektin luokassa vaikka aineisto on verkossa.
I: Yks vaihtoehtohan on se, että on tottakai lähituntteja vaikka viikottain yks tunti, jossa niitä voi patistella, että "koittakaa nyt jotain saada aikaan". Ja että näkee niitä naamatusten ihan, ettei ne oo pelkästään jotain nimiä siellä verkossa.

i: So the students have nothing to do with each other really? The whole course is basically an individual performance?
I: Yes. That's what it is.. It is perhaps easier to organize that on the net. So that it is in a way a loss that if this course moves over there to the net, so students, too, become separated and remain isolated.

i: They could still do a common project in the classroom, although the material is on the net.
I: There is this one alternative that, of course, for example, one contact lesson a week, where they can be pushed a bit, like "try to get something done". And, that one sees them face to face really so that they aren't just some names on the net.

The only time students take a strong subject position is when they do what they should not do: work together in a test. Towards the end the students seem to become the anti-subject, either reluctantly doing the tasks that the teacher has sent them to do, or defying the teacher by not working together when they are supposed to, and then working together when they should not.

The net as helper/opponent

At the beginning, the weak teacher-subject's helper seems to be the net that makes it possible for the teacher to make quizzes after each unit. On the other hand, the net becomes an opponent that separates students from each other so they cannot work together on the project plan, as wished by the teacher. For the strong teacher-subject the net is an obvious opponent since it makes it difficult for him to monitor individual input. At the same time, the student anti-subject takes advantage of the net, his helper, by trying to cheat on the final test by doing it with other students.

I: Mut se on taas paha sitten, että tekeekö ne keskenään sitten, että se voi olla että siellä pari aktiivista vain tekee ja loput ei tee mitään.

I: Koska se on minusta vaikea tässä verkossa, tai ainakin minä koen sen verkon puutteeksi, että tämmönen kurssi, mikä on ennen mennyt tosi hyvin, että oppilaat on tehny ryhmätyötä paljon, niin nyt se ryhmätyö tulee tavallaan niinku vaikeeksi. Ku se on verkossa.

I: But it's bad then that, do they do it together then, it could be that there are just a couple of active ones who do and the rest don't do anything.

I: Because what I find difficult about the net, or at least see it as a shortcoming of the net, is that a course like this that has gone really well that the pupils have done a lot of group work, that the group work now becomes difficult sort of, when it's on the net.

Sender, receiver

The sender, receiver actants do not seem to play a central role in the interview. The teacher acts as sender as well as subject. He sends students to do tasks and take tests required to pass the course. He does not, however, send the course to the net, because it seems to go there by itself (*…it, well, then largely moves over there, to the net.*) Students are the receivers; they receive feedback from the impersonal teacher (*…feedback is given, of course*) as well as points for quizzes and the final test.

To summarize, the main narrative structure of the interview reveals a teacher - subject, whose goal is to make sure students advance in a preset order, and monitor individual students' level of knowledge at the end of the course. At first the net seems to be a helper; it enables the teacher to make quizzes to test students' progress. After the teacher has introduced the course, it moves to the net and seems to start a life of its own; nothing can be changed while the course is running. At the same time, the net turns against the teacher; it makes students mere faceless names making monitoring their work and "pushing them" difficult for the teacher. It prevents group work, but facilitates cheating in the final test. Students, on the other hand, seem weak in learning, but strong in opposing the teacher's wishes. They are not working together on the project plan, but will certainly work together in the final test, where they should not. It is like the classroom door being locked with the teacher outside in the corridor not knowing what the students are doing inside.

Goal: teacher control

The subject–object relationship reveals what is considered valuable to achieve. In this case, the teacher seems to value his own control of the course and students; he insists on maintaining a certain order of tasks and testing each student's knowledge level at the end of the course. The importance of control is further accentuated by the helpers and opponents. The net as a helper makes monitoring the students' progress possible through automatic quizzes. The net as an opponent makes students faceless names, which can easily disappear from the teacher's control. The student-antisubjects defy the teacher's attempts to control who does what. The teacher also loses control of the final test due to students' insubordination.

Teacher- and student roles

The enunciative dimension reveals the teacher's attitude towards the content of the utterance. The teacher/enunciator's attitudes become visible in his use of modali-

ties. The linguistic structures that come to play are modal verbs, principal verbs, the Finnish quasi-structure and adverbs and pronouns. In the following section, the aim is to look at the teacher's attitude towards students and web-based learning that materializes in the form of the net in the teacher's speech.

Passive students

Most of the time the teacher refers to students as "oppilas" (pupil) or with a pronoun "ne" (they), which in standard Finnish is only used to refer to things and animals, but in everyday language commonly refers to people as well. The plural collective noun "pupils" depersonifies students and presents them as syntactic objects, an inactive mass.

Students' activities on the course are usually characterized as "*joutuu, täytyy*" (having to do) or "*voi*" (can). This choice of a modal verb, which expresses obligation or ability rather than competence, indicates the enunciator's doubt. He does not seem to believe that students would be willing and active participants in the learning process. They only do what they have to do. In discussing group work in the online environment, he is very verbal about his disbelief that it would go well, because "*se vaatii oma-aloitteisuutta*" (it requires initiative), and it is difficult to "push them" online as he does in the classroom. The implication here is that he does not think students have initiative.

This attitude surfaces again later when the teacher compares classroom teaching to web-based teaching. In the classroom he finds it easier to see if there are any students present and "*onko kukaan tehnyt jotakin*" (if anybody has done something). Here the choice of pronoun "anybody" over "somebody" seems to suggest an initial assumption that nobody has done anything. In connection with the idea of web-based group work, the teacher openly expresses the same concern three times in slightly different words: "*pari tekee ja loput vaan on/… muut ei tee mitään /… ja loput on vain joo-joo miehinä siinä*" (one or two are working, and the the rest just hang around/… the others do nothing/…the rest are just yes-yes guys there).

The speaker never uses a principal verb that describes activity in connection with students. The closest he comes to an activity verb is with expressions such as "*sitten ne on ruennu tekemään*" (then they have started to do), and "*oppilaat on tehny ryhmätyötä paljon*" (the pupils have done a lot of group work) where the principal verb is "do" – a colourless activity verb – and "*kun oppilas on lukenut tämän*" (when the pupil has read this). "Read" describes active doing, but here it is used instead of "study" or "learn," which would seem more obvious choices for describing a student's activity when preparing for a test.

The enunciator also seems to doubt whether students, in fact, learn anything, and is quite sure they will cheat if given the opportunity. The quasi-structure in describing a student's state of mind after they have studied one unit of the course reveals

strong doubt (Salminen 2000): "*ja olevinaan sisäistänyt sen*" (and he thinks he has got it), and the utterance continues: "*niin että uskaltaa mennä tekemään sitä tenttiä*" (so that he dares to go take the test). Here the teacher-enunciator seems to think students' knowledge of the material is so poor that they should be afraid to take a test on it. Later the teacher worries: "kyllä ne nämä tentit varmasti kyllä tekee kimpassa sitte." (I'm sure they will certainly work together in the test, I'm sure). The Finnish adverb "kyllä" strongly expresses certainty. The speaker repeats it twice together with an adverb "*varmasti*" (certainly).

To recap, the teacher's attitudes toward students seem to be: students lack initiative, work only under obligation and if pushed, do not study or learn, get lost if not controlled by a teacher, and cheat if given the opportunity. Students are depersonified through use of a collective noun "oppilaat" (pupils). They are characterized as an inactive, faceless, uniform mass.

Omniscient teacher

How the teacher speaks about students and describes the course, reveals not only his attitudes toward students but also his assumptions of the role of a teacher. The speaker's use of the passive voice to hide the agent may suggest an omniscient enunciator as in case of a degree-zero, transparent enunciator (Sulkunen & Törrönen 1997a; 1997c). Thus, the speaker would see the teacher as being in control and omnicient. The teacher-enunciator becomes visible during the interview only once. This is when he describes how he introduces the course: "*siis ihan opettaja, elikkä mina*" (the teacher himself, that's me). The teacher's responsibility seems to be to "push students" to work, check test results, and to try to prevent cheating. At the end of the course, he measures their individual level of knowledge.

Distant net

When talking about the net the speaker repeatedly uses spatial shifters, adverbs such as "*sinne*," "*siellä*," "*tuonne*" (over there, there) to place himself outside. The students are "there" and the course is "there", but the teacher is not. The teacher's first idea of web-based teaching was to change his lecture notes into an electronic form.

> I: *Alussa mä ehkä lähin tätä tekemään sillä mielellä, että okei, on valmis kurssi olemassa, valmiit materiaalit suunnilleen kalvoina, mikä on tuolla luokassa opetettu. Että mätetään ne samat jutut sinne verkkoon, niin kyllä se siitä…*

> I: First I perhaps started to do this thinking that okay, I've got a course ready, materials ready on transparencies, on what's been taught in the classroom. I'll just cram the same stories over there onto the net, and it'll be alright…

The speaker's choice of verb "*mätetään*" (cram) does not suggest much planning. However, the course is thoroughly planned and prepared, and all the material uploaded before it starts. While the course is running on the net, nothing can be changed, because the students might be advancing at a different pace. Here the teacher seems to recognize one of the strengths of web-based learning: how it enables students to pace themselves. Yet he does not acknowledge it as strength, but merely sees it as a reason for not updating course material during the course.

The teacher seems to see the net both in positive and in negative light. The positive side of the net is emphasized in its easiness to provide quizzes and check them automatically. It makes the teacher's work easier in that respect. Providing quizzes to test students' progress is something new inspired by the net. Classroom teaching does not have that feature. In fact, no teacher is needed after he has uploaded the material, if the quizzes are automatically checked by the programme.

The negative side of the net is the difficulty in organising group work, which is an integral part of classroom teaching. The net separates the students. The net favours individual performance instead of collaborative work, and requires initiative from students. At the same time, the teacher fears the net will encourage students to collaborate on a test, which is not allowed. Thus he seems to contradict himself; group work is possible online after all.

The teacher's attitude towards the net could perhaps best be described as suspicious; he does not trust it, and to some extent, does not want to be involved.

Conclusions from analysis of Course 1 interview

Course 1 introduces a somewhat confused teacher, who in the face of new technology tries to resort to traditional ways of teaching, only to find them inadequate in the new environment. The teacher desperately tries to maintain control and measure the outcome, but is, simultaneously, frustrated by the impossibility of it all. In his teaching methods, he seems to regress from collaborative learning to programmed teaching. The teacher-student relationship is traditional; students are relatively passive objects of direct teaching. Interestingly, the teacher uses the verb "learn" only once, which would suggest activity from students, he mainly talks about the "outcome" and the "level of knowledge."

Interesting questions arise if we examine the teacher's emerging role throughout course manuscript and interview. In the course plan, the teacher openly writes about teaching that is now carried out online. In the interview, however, the teacher has almost totally disappeared and teaching and learning are not discussed.

In the enunciative dimension, the teacher is omniscient and in control of the world that he describes. However, in the utterance dimension, he wants to hide the omnipotent teacher agent. This contradiction seems to imply that direct teaching is violating a norm. Has direct teaching become unacceptable? The occurrence of a

norm suggests that the teacher has become aware of some of his assumptions or mental models through reflection and does not take them for granted anymore.

The new challenge, the net, seems to have thrown the omnipotent teacher off balance. He seems to fear losing control and not being able to measure the outcome. He does not feel confident enough in direct teaching and transmitting knowledge, because he decides to hide the teacher agent. At the same time he does not seem to master any other way of teaching, either. This perturbation in the meaning schemes is necessary for accommodation (von Glasersfeld 1995/2002) and transformative learning (Mezirow 1990b; 2000). The interview does not reveal whether this teacher has yet started to question his own role as a teacher, which would be the first step towards equilibrium and a conceptual change.

The group work that the teacher worries about may be an example of assimilation, adding new information to an existing knowledge structure without any changes in the schemas. In the manuscript, the teacher has taken this constructivist catchword and applied it in his traditional teaching plan much in the same way as the children in Vosniadou's experiments (Vosniadou 1992). The teacher's role has remained traditional in the group work assignment; a teacher that tells students what to do rather than tries to facilitate their learning and guide them in practical matters. The fact that he decided not to introduce group work at all suggests that group work became a dilemma (Mezirow 1990b; 2000) that he could not deal with.

Course 2: Online constructivism

At the time of the interview the course on Wood as raw material was running on WebCT. First the interviewee explained what the three credits include. The course has three modules that all last the duration of one period (8 weeks). The first two modules are contact teaching but the third module is studied online. In the third module the main emphasis is on a research project that the students carry out. This also includes laboratory work.

The added value that the Internet brought to the course was, according to the interviewee, the initial test that enabled the teacher to find out about students' prior knowledge of the subject. The test is easily modified at the end of the course to check what students have learnt.

The course structure is the same as in the manuscript. Students are first given an overview of the wood processing industry in Finland. The emphasis is then placed on activating students to learn through practical laboratory work and learning tasks, such as the research project designed by the teacher based on students' interest and prior knowledge of the subject. Students present and discuss their results in face-to-face seminars. Their work is published on WebCT for review by classmates and future students to study and learn from. The teacher seemed very proud of his students and, at the end of the interview, he was eager to show the students' work on WebCT.

In contrast to Course 1, this teacher did not believe his students could cheat. To the interviewer's direct question about the possibility that students might copy text for their research reports straight from the Internet, the teacher answered with a surprised negation, as if the thought had never crossed his mind.

The only change in the course plan now that the course was actually running was that there had not been any discussion in the discussion forum or in the Chat Room.

> I: *Täällä on joku ongelma tässä ihmisillä, että sitä keskustelua ei taida helposti syntyä ja jotenki tuntuu vaikealta.*
>
> I: There seems to be some kind of problem here with these people so that there aren't discussions, not easily, and they some how feel difficult.

The technical aspect of the course surfaced more in the interview than in the manuscript. The teacher seemed enthusiastic about all the things that technology makes possible. Students take digital photos, make web pages of their results using html, make use of presentation graphics, etc.

Assessment inspired long discussion. The interviewee seemed to have reflected on different assessment methods. As the course was still running he had not decided yet, how he was going to assess the students. He wanted the learning gain, i.e. the difference between the initial test and the final test on WebCt, to show in the assessment. He was not quite sure whether the test measured understanding or remembering facts. He had, however, tried to make the questions so that they would require understanding as well. The assessment consists of many parts; laboratory work plays a role in it, and so do the research projects. The teacher found assessing research work difficult, since the projects were different and partly at different levels, some were more demanding than others. In conclusion, the teacher decided that the traditional final test, during which students write answers to open-ended questions, was going to be the basis for his assessment with consideration to all the other student work.

Actants and actors

The grammatical structure of the interview has 41 expressions with the teacher as the agentive subject, 39 student-subjects, 12 we-subjects referring to both teacher and students, and 21 passive expressions. The narrative structure, however, seems to reveal a teacher-sender, on one hand, on the other hand, the teacher is a helper while students occupy the most prominent subject position with a goal to learn about the properties of wood.

Thus, it is possible to draw the following actantial diagram:
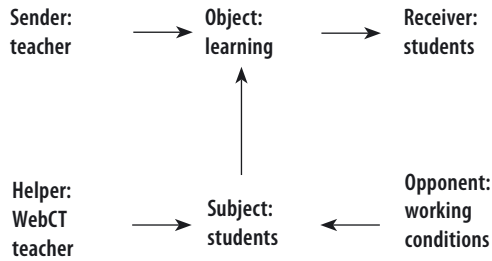
Figure 14.   Actantial model of Course 2 interview

Teacher-sender/helper

At the beginning the teacher collects his students together and puts them symbolically on the map, in the infrastructure of wood processing in Finland. He then explains to students what their objective is and how it is attained; to learn to know wood as raw material. He also gives students the necessary means to attain the goal: WebCT tools, digital cameras, a laboratory with all its equipment, plus the theory and learning tasks. He is available throughout the course to lecture on key issues and to give feedback, personal assistance and advice in the students' research projects. The teacher-sender's objective seems to be to know his students well enough to be able to equip them with the necessary tools on their journey towards the goal, and to determine how well they succeed, and how well he has succeeded as a teacher.

The teacher sets the scene:

> I: *Minä kerron, mikä on ajatus. Ja kerron, miten tää kurssi toimii ja sitte siihen liittyy semmonen koko Suomen paperintekoon perehdytysjakso tavallaan. Asetetaan opiskelija ikään kuin tähän infrastruktuuriin, mitä on puun jalostus Suomessa.*

> I: I tell what the idea is. And I tell how this course works, and that includes a kind of introduction to paper making in Finland. The students are in a way placed in the infrastructure of what wood processing is in Finland.

He wants to find out students' prior knowledge to determine what they need and to evaluate the students, but also himself as a teacher, at the end:

> I: *Verkon lisäarvo oli se, että mullon täällä alkukoe, jossa on 43 kysymystä kansantajuisesti puumateriaalista, puun lujuuksiin kaiken näkösiin liittyen, jolla alkuosaamistason sais selville. Ja se hyöty on niinku mulle itselle, että mä tietäsin, mitä ne opiskeljat tietää ja sitten tähän liittyy lopussa melkein sama koe osin vähän muutettuna, jolloin voi katsoa, että oppiko he asioita ja oppiko he tärkeitä asioita, että miten tässon niinku onnistuttu.*

> I: The extra value that the net brings is that I have this initial test here, which has 43 layman questions about wood as raw material, dealing with the strength of wood and that sort of things, in order to find out the initial level of knowledge. And the benefit is mainly for me,

so that I would know what the students know. And then there is almost the same test at the end, a bit modified, for me to see whether they learnt things and whether they learnt important things, how we have succeeded in this, kind of.

Then he gives them their tasks and tools, and sends them away:

> I: … näiden tutkielmien aiheet, niin minä ryhmittelin ne niin, että ne, jotka oli pärjänneet siinä alkukokeessakin hyvin, niin mä annoin niille, oikeastaan vähän hankalampia, syvempiä aiheita ja sitte jos oli vähän huonompia, niin sitten mä annoin helpompia aiheita.
>
> Mulla on nettimateriaali tuolla puun mikroskooppirakenteessa olemassa.
>
> Meillä on hienot laboratoriot tuolla. Siellä otetaan digikuvat..

> I: … the topics for the research projects, I grouped the students so that those who did well in the initial test, I gave them a bit more complicated, more in-depth topics, and if there were a bit weaker students, I gave them easier topics.
>
> I've got material on the microscopic structure of wood on the net there.
>
> We have fine laboratories there. There we take digital pictures.

The teacher acts as a helper:

> i: Mikä on opettajan rooli tässä sun kurssilla?
>
> I: Kyllä kai tässä aikamoinen maestro joutuu olemaan. Sitte toisaalta näissä tutkielma jutuissa monella on kysymistä, että mikä näkökulma olis hyvä ja mistä löytys materiaalia. Että ehkä se alkuosa sellasta perinteisempää enempi, muta tää loppuosa on sellasta neuvomista.
>
> i: Kumpi sinusta itsestä on mukavempaa?
>
> I: Ne on niin ihan kivoja auttaa näissä tutkielmissa. Ne on todella hienosti tehtyjä, että nää on nyt opetettu tekemään ne jutut. Niitten neuvomisessa ja näkökulman valitsemisessa ja kun ne laittaa ne verkkoon, niin minä voin kattoa, että mitä ne on tehny ja sitte ne voi tulla kysymään, että mitä siinä tarvis vielä tehä ja se niinku etenee sillai hyvästi.

> i: What is the teacher's role here in your course?
>
> I: I guess one needs to be quite a maestro here. Then, on the other hand, in these research jobs many have questions as to what aspect would be good to take and where to find material. So that perhaps the first part is more traditional, but this last part is giving advice, in a way.
>
> i: Which do you prefer?
>
> I: It is really nice to help in these research projects. They really show fine work, these have been taught to do these things. When giving advice and choosing the aspect, and when they upload them on the net, I can look at what they've done and then they can come and ask what they should do more, and that's how it proceeds well.

The many expressions with "we" as a grammatical subject seem to endorse the teacher's role as a helper; he appears to walk by the side of the students participating in the activities, sometimes as one of them.

I: Sitten me aloitetaan tää opiskelu,
Meillähän on sellainen puun tunnistustestikin.
Itse asiassahan meillä on aikamäärät olemasssa.

I: Then we will start this studying,
We also have a test on identifying wood species.
In fact, we do have deadlines.

The first person plural is often invisible, the predicate taking the passive form, which is typical in the Finnish language. The implication of "we" together is, however, clear:

I:Sitten vielä kertaalleen käydään ne tärkeimmät.
Siten voidaan tehdä jotakin jo monimutkasempaa.

The passive voice cannot be used in English in such a case.

I: Then we once again go through the most important things
then we can do something more complicated already.

Student-subjects and their learning object

Students are very much "acting subjects" (Schleifer 1987). The predicates are functional describing the kind of activities students are engaged in. Students already know something at the beginning, later they take pictures, teach each other, write reports and give feedback. At the end, they see what they have learnt. On the modal axis, the student-subjects seem strong through the active functional verbs. The modalities are endotactic, stemming from the subjects themselves and having inner motivation (Sulkunen & Törrönen 1997a). The receiver actant is only implied in the sense that students acquire new knowledge; "*learn things*" and "*see their learning gain.*"

In the following examples we meet the knowing subject. Knowing is positive in itself, but the more unexpected it appears, the more positive it becomes. Here the teacher narrator uses the adverb "already" to place knowing in a deictic time frame to describe it as unexpected (see also Sulkunen & Törrönen 1997a):

I: jos ihmisille on perusasiat selvät,
jos ne esim. tuntee jo puun hyvin

I: if people master the basic things
if they, for example, already know wood well.

The acting and learning subject is then introduced:

I: He ottaa mikroskooppikuvan, ja kuvan käsittelyohjelmalla merkitsee, että tuossa
tuon tyyppinen solu.
* Ja sitten tähän liittyy myöskin näitä erilaista materiaalin tuottamista niin, että*
opiskelijat tekis entistä enempi näitä tutkielmia, mitä mulla onkin jo tässä tehtynä,

oikein hienoja nettisivuja tuolla.Ja toisaalta opiskelijat toimii osaltaan opettajina näitten tutkielmien muodossa.

> *Ne oppii tekemään html:ää*

I: They take microscope photos and mark them with an image processing program to show that there is that kind of cell there.

> And this includes the production of material as well, so that the students would do this research more and more, of which I, by the way, have a few here already, really fine web pages there, and, on the other hand, the students act as teachers in the form of these research reports.
>
> They learn html.

The motivated subject follows:

> *i: Eikö sisältö kärsi sen teknisen kikkailun vuoksi?*
> *I: Ei, päinvastoin. Kun siellä on upeat kuvat ja upeat graafiset esitykset niistä asioista niin se sisältö tulee ihan hyvä, että nää on ihan toisenlaisia kuin jos mä olisin pyytänyt paperilla nämä. Ehkä ne nuoret haluaa tehdä…ja tässön ehkä jonkunlainen sellanen kilpailukin jopa, että ketkä tekee hienoa,*

I: Won't the contents suffer from all that technical jiggery?
I: No, quite the opposite. When there are great pictures and great graphic presentations about these things, the contents become quite good, these are totally different from the paper versions that I might have asked for. Perhaps the young want to do…and here might be some kind of a competition even over which of them do fine work.

The evaluating and receiving subject comes next:

> *I: Ne näkee siitä ihan prosentteina sen learning gainin.*
> *…ne tykkäs että oli jännä juttu.*

I: They can see their learning gain in percentages even.
… they thought it was quite interesting

Helpers

Students are assisted in their learning objective by the WebCT learning environment that provides, not only technical tools such as the presentation graphics, but also a forum for students to present their work and learn from each other. On WebCT, there is also the material that the teacher has prepared for students: the initial test that is important in determining students' needs, theory, and mid-course and final tests. There are also other technical devices to help students, such as the laboratory and digital cameras. The purpose of all these is to enable students to pursue their research project and perform other learning tasks and to help them see how they are progressing and what they are learning.

The WebCT with its quizzes helps the teacher, as well, in determining what the students know about wood at the beginning of the course, and how much they have improved during the course.

Opponent

It is difficult to find opponents in the text. Everything seems to go smoothly for the teacher-sender and the student-subjects. The text is full of positive adjectives such as "*fine*," "*great*," "*interesting*." There is one big problem, however. Students tend to hand in their laboratory reports at the last minute, so giving them feedback becomes impossible. Students have left the school already. Discussions do not seem to take place in the electronic discussions forum on WebCT, either, as was planned. Neither of these seem to hinder students from reaching their main object, learning. If anything, they affect the teacher's helping role.

What, quite surprisingly, surfaces as the main opponent, is working conditions in the present situation now that the person responsible for the laboratory has retired. There are several references to this inconvenience in the interview. The lack of the former master laboratorian directly affects teaching and learning:

> I: *Mä olisin muuttanut harjoitustöitä…. Mutta se ei tänä vuonna vielä toteutunut, koska meillä vaihtu tässä laboratoriomestari ym. Kun entinen laboratoriomenstari häipy niin, meillä on ollu vähän…Enkä voinut edes paljon huomioda sitä osaamista, kun tuolla ei oikein voi tehdä mitään,*

> I: I would have changed the assignments… But it couldn't be realized this year, because our Master Laboratorian changed and such.. When the previous Master Laboratorian took off, we've had a bit of .. And I couldn't even take into account what they knew, since it's rather difficult to do anything there.

In sum, the teacher sends students on a quest for knowledge of the properties of wood as raw material. Students function actively and independently, also learning from each other. They get help from all kinds of technical devices and the electronic learning environment, WebCT. At times, the teacher himself seems to be "a guide on the side" participating in the learning situation as an equal. The WebCT helps the teacher in helping students. Everything is fine, and results are great. Students learn. The only villain in the story is the fact that the master laboratorian has changed, which complicates things, and sometimes hinders teaching and learning.

Goal: learning

The subject–object relationship in the actantial model reveals learning as the main value that all the actors determine. The helpers, technical devices and WebCT, as well as the teacher-sender, all seem to function for the purpose of learning. The only opponent in the narrative seems to be working conditions that hinder learning. "Learning" and "teaching" as principal verbs appear several times in the teacher's talk and in references to students:

> *että oppiko he asioita*
> *ja oppiko he tärkeitä asioita,*
> *Ja toisaalta opiskelijat toimii osaltaan opettajina*
>
> if they learnt things
> and if they learnt important things,
> And on the other hand, students act as teachers..

Discovering students' prior knowledge is also considered valuable. There are several utterances that emphasize the importance of knowing what students' know, and using that information to plan learning tasks.

Teacher- and student roles

As in Course 1, the speaker's attitudes and conceptions are investigated in the enunciative and utterance dimensions. Active principal verbs and the choice of positive attributes are the main linguistic features that make the enunciator's positive attitudes visible.

Active students

The enunciator, the speaking teacher, sees his students as active learners who have prior knowledge of the subject and inner motivation. He refers to students with pronouns "he" and "ne." The former is the third person plural used in standard Finnish, the use of the latter is discussed in connection with Course 1. In addition to these two pronouns, the teacher uses the following nouns to talk about students: "*opiskelijat,*" "*ihmiset,*" "*nuoret,*" "*porukat*" (students, people, the young, folks). With the choice of such nouns at the level of utterance, the enunciator shows that he considers students his equal, "people" like himself, while on the other hand, he recognizes the age gap in "the young," which he then tries to cross with the friendly "folks," stepping again as equal into the students' world. This image of a participating teacher rather than an authorative one is further strengthened through frequent use of the first person plural (me = we) in describing learning tasks.

> *Sitten me aloitetaan tää opiskelu*
> *siten voidaan tehdä jotakin jo monimutkasempaa*
>
> Then we'll start this studying
> then we can do something more complicated already.

The choice of principal verbs to describe students' activities indicates a belief in students' capability to take responsibility for their learning. Students "*know,*" "*learn,*" "*take photos,*" "*act as teachers,*" "*see,*" "*answer,*" "*write reports,*" etc. The appreciation of their work is apparent in the many attributes used to describe student work: "*fine,*" "*interesting,*" "*great.*"

In sum, the teacher seems to believe in his students and sees them as active learners and equal partners in a learning situation.

Visible teacher

The teacher/enunciator is visible at the utterance level. He uses the first person singular (minä = I) when describing objectives and organisation of the course, the material that he has prepared, the feedback he gives, and the assessment that he does:

> *mutta mulla on tällanen tavoite*
> *näiden tutkielmien aiheet, niin minä ryhmittelin ne niin*
> *mulla on nettimateriaali tuolla puun mikroskooppirakenteessa olemassa*
> *Ja minä kerron heti, että mikä oli hyvää ja olisko tarvinnut jotakin lisää.*
> *Pidän sitten ihan perinteisen loppukokeen.*

> but I have this goal
> the topics for the research, I grouped them so..
> I have web-based material there about the microscopic structure of wood
> And I tell them right away what was good and if something more was needed
> I then administer quite a traditional final test.

As noted above, the enunciator becomes "me" (we), almost one of the students when he talks about learning tasks. This indicates a new kind of teacher role as guide and facilitator. Thus, the teacher takes full responsibility for the planning and organisation of the course, but then assumes a participant's role in the actual studies. He himself is learning from students' work.

Fabulous technology

The speaker's attitude towards the net and all new technology seems only positive. The adjectives he chooses to describe the equipment and programs, and results achieved by using them are "interesting," "fine," "great," "fabulous." Technology empowers students and promotes learning. Modalities such as "osaavat," "haluavat" (know how, want to) refer to students' work with the help of digital cameras and web pages. Technology and the Internet especially make it possible to save students' work, thus accumulating knowledge to benefit future learners.

Conclusions from analysis of Course 2 interview

This teacher seems to believe in his students' capability to learn, celebrates their work, and embraces the new possibilities that new technologies bring to teaching and learning. He is familiar with the constructivist theory of learning and attempts to apply it to teaching. Constructivist principles are visible in his emphasis on students' prior knowledge and interests, in teacher-student relationships and roles, and learn-

ing tasks that require, on one hand independent research, and on the other hand co-operation and collaborative sharing of ideas. The course is not fixed from the beginning, but is built together with students and teacher. The teacher is engaged in critical self-reflection as regards the best ways of learning and testing students. He has not got all the answers yet but is aware of things that need to be improved.

Courses 3–5: Transition

The remaining three interviews are summarised in the following and results of analyses presented, not in their entirety as above, but together. Finally, conclusions drawn from all interviews are discussed.

Course 3: Bio and Recycled Fuels, 1-2 credits

At the time of the interview the course had been piloted online; based on that experience the teacher could already suggest some improvements. In her opinion, having the course in the online environment had made it possible to have updated material at all times. Also, the Internet was a good source of material, since there were not books on the topic. One more reason to offer the course online had been the students' wish. They had already attended one online course and wanted to study the theory on their own online instead of listening to lectures.

The course had mainly been realized as planned, except for social interaction that was emphasized in the manuscript. The structure of the course was built around questions and answers which could be found in the material. The initial test that aimed at finding out students' prior knowledge did not affect the course plan. The test was taken but results were not utilized in any way. The online course was studied during contact lessons on the school premises. Students were given a choice to come to school or do tasks in their own time. Most of them attended the classes. The teacher supervised students' work and offered help and advice if required. After classes she gave individual feedback on students' answers.

There were no discussions online, since students were able to talk to each other in class. This was, however, spontaneous and did not correspond to the systematic participation in discussions as described in the manuscript.

During the interview the teacher appeared to have reflected quite a lot on the realization of the course and had critical views and improvement ideas regarding the tasks and the contents. Clearly, assistants had not only written the theory and found links for the subject areas, but had also formed the questions. The teacher now found the questions too simple. The teacher described the questions as asking for particular details, factual information, that could easily be found in the links and material provided. For the new online realization she now wanted to include some more demanding tasks.

When asked about the nature of the more demanding tasks, the teacher referred to her previous course on contaminated soil. There students had had five open assignments that were not directly related to the material on WebCT. It had also included pair and group work. One example that the teacher gave was a practical case study, where students had to make a reconditioning plan for a real site of their own choice based on theory available on WebCT. Students then presented their work in a face-to-face seminar.

Assessment on the online course was mainly based on the final test, but all tasks had to be completed in order to pass the course. At the end of the interview, the interviewee called for more cooperation between teachers in order to avoid overlapping and gaps in the curriculum, due to the fact that teachers in general do not know about each other's courses. Now that many of the courses were on WebCT, easily accessible for all the teachers, browsing through them would not be too time-consuming. Her own web-based material was free for other teachers to use.

Course 4: Technical Writing – Thesis Abstract, 1 credit

At the time of the interview the course had been piloted once with two teachers co-tutoring. It was offered a second time one year later with just one teacher, the interviewee. The interview took place immediately after the second time.

This course was offered in the online environment to meet a demand for instruction in writing the English abstract for the Bachelor's Thesis. There was no corresponding face-to-face course. In addition, many students at this point of their studies were already working outside school, and could not attend contact lessons even if they wanted to.

The basic idea of the course had not changed. The theory on writing an abstract was provided in the form of nine questions and answers. Students were required to study the theory, do the exercises related to the theory, and apply what they learnt to their own thesis abstracts. Students wrote their abstracts in the form of process writing, producing altogether three improved versions of the first draft.

Students worked independently. They knew the teacher would be online at a certain time every week in case they had any problems. The teacher provided feedback on exercises as well as on three versions of the abstract. Students gave feedback on each other's work once. There were no discussions in the discussion forum; neither was there visual or audio material. The discussion had not succeeded as planned the first time the course was run; as a result, the idea was rejected. According to the interviewee, there was no real need for discussions in the discussion forum.

Throughout the interview, the teacher was engaged in critical reflection. She reflected on different decisions made, and merits and shortcomings of different pedagogical solutions. It became apparent that she had not only carefully considered the pedagogy before and during the course, but also critically evaluated it after course

completion. Assessment, especially, generated critical self-reflection on the grounds of grading. It seemed that the interview served as a forum for the teacher to voice new ideas and to use the interviewer as a sounding board for those ideas. This was natural since the course was originally planned together, and both teachers were going to teach the course again the following academic year. In fact, during the interview new ideas for making the assessment more transparent for students were produced together.

Assessment was based on the process and the final result. In assessing the process, the teacher looked at how well the students had done the exercises, how they kept the deadlines, how they were able to transfer what they had learnt from the exercises to their own writing, how they gave feedback to their pair, and so forth. The new ideas in assessment mainly concerned explaining the grades to students, and giving examples of work which resulted in particular grades. (At the end of this course students received a grade, such as 2 out of 5 without any explanation as to what was lacking in their work.)

The interviewee enjoyed teaching online. She felt contact with the students was more personal than in the classroom. She also liked the fact that the course had been well planned in advance and that students had to assume more responsibility. The teacher did not have to be as alert all the time as in contact lesson.

> *Luokassa se on niinku se hetki, että sun pitää pitää niinku kurissa ikäänkuin se hetki. Sä niinku sitä tuntia ohjaat. Niin tuo on eri tavalla.*
>
> In class it's like every moment in time that you need to, sort of control. It's you who run the lesson. And this is different.

What the teacher found slightly problematic was the art of giving feedback positively, yet show the shortcomings of a student's work. Another thing she seemed to have considered was how much the teacher should actually help, if students asked direct questions. She had been evasive so as not to provide ready answers.

> *Ja sanoin esim. että osa näistä sun kieliopillisista kommenteista oli nappiin, ja osa ei. … En tiedä, että oliko sitten pitänyt antaa ihan suoraan.*
>
> And I said, for example, that some of these grammatical comments you've made are to the point, some are not… I don't know, whether I should have told him more directly.

Course 5: Basics of Environmental Analysis, 3 credits

At the time of the interview the course had been piloted once. This teacher had made two other online courses, and in the interview she kept describing all three of them. The two other courses were not included in the present study, since one of them was planned by a teacher who had then left the school, and the other course had been realized without a course manuscript. Talking about all three courses was allowed,

since the focus of the interview was on teacher's attitudes and conceptions, which are not course-specific.

These three online courses had all been offered to the same students, who already had had two online courses that academic year. As in the case of Course 3, all these online courses were administered on school premises during the contact hours, i.e. students had these courses in their timetable, and they went to the computer classroom to study online, all at the same time. The teacher attended the lessons as well.

The course on the Basics of Environmental Analysis was conducted only partly online; the other two courses were completely online. The teacher did not find studying online during school hours to be problematic. On the contrary, she deemed it necessary at this piloting stage, in order to see how much time the online work took. Again, as in Course 3, online work took teacher's time more than students', since she had first prepared the course, then supervised studies in the computer classroom helping if necessary. Finally, she read all answers and gave individual feedback. Sometimes, in her own words, "*the comments were longer than the answer itself.*"

The main aim of the online course was to make students work more independently. The course generally followed the manuscript. Students studied theory and answered questions based on it. However, there were no online discussions or interaction between students via the Internet. Although the manuscript emphasized the role of student interaction, the teacher now stated that it was never planned.

> *Kurssille ei ollut varsinaisesti suunniteltu keskustelutehtävää verkkoon eikä muuallekaan.*
>
> No discussion task was planned for the course, online or anywhere else for that matter.

Nevertheless, spontaneous interaction took place in the computer classroom while students were working on the same tasks. The teacher tried to tease out students' prior knowledge on the subject by asking questions about the first contact lesson. The students' prior knowledge did not, however, affect the course plan.

For her three online courses, the teacher used different kinds of assessment methods, peer evaluation and continuous assessment on one course, final test on another, and on this particular course, the students had a so-called crib sheet test. In a crib sheet test students are allowed to prepare a crib sheet ("lunttilappu" in Finnish) for their test and use it in the test. Making a crib sheet shows how well students can grasp fundamentals and organize the whole. The crib sheet is handed in with the test paper, and both are assessed.

Actants and actors

The three interviews described above produced such similar actantial models that it is possible to deal with them together, though there are obvious differences in teachers' conceptions and attitudes towards students and the online environment. The

differences are discussed as necessary to present the teachers' views as truthfully as possible. Quotations, however, are taken from all three courses in turn and represent all three courses, if not specifically pointed out as a typical feature of one course.

Generic sentences, existential structures and passives are redundant in all these teachers' speech. However, these impersonal expressions do not dominate the interviews, since there are as many cases or more of student- and teacher subjects. In Course 3, impersonal expressions account for 37 cases, students are a grammatical subject in 31 expressions, and the teacher in 25. The respective numbers for Course 4 are: 54 impersonal, 64 student-, and 59 teacher-subjects, and for Course 5 are: 22 impersonal, 26 student-, and 13 teacher-subjects. The last was the shortest interview.

There are also several examples of inanimate agentive subjects, which suggests that things happen by themselves without people having any control over them (Karvonen 1996). This example is from Course 5:

> *Tälle luokalle sattuivat kaikki viisi verkkokurssia.*
> *Keskustelua syntyi spontaanisti.*
>
> All the five online courses happened to this class.
> Discussions developed spontaneously.

The teacher seems to suggest a lack of planning in the curriculum, and a lack of teacher control. The course often takes the position of an inanimate subject, and the teacher does not seem to have any control over it :

> *Ensin esitellään siis ihan luokkatilassa, miten se kurssi rakentuu, mikä sen tavoite on, jne.*
> First it is introduced, in the classroom situation, what the course includes, what is its objective, etc.
>
> Course 4

> *Mutta siinä vaiheessahan ei sitten oikeastaan pääse vaikuttaan siihen kurssin sisältöön,*
> But at that point you can't really contribute to the course contents
>
> Course 3

As in the examples above, impersonal expressions are mainly used to describe the course; how it was designed, how it begins, what the objectives are, what materials and tasks it includes, and so forth. With the many impersonal expressions teachers seem to distance themselves from the course and the net. Especially the existential type of structures, together with the adverbs "*there*," "*over there*," function as spatial shifters disengaging the teacher from the course contents as in Course 3:

> *Näitä oli kymmeniä näitä kysymyksiä,*
> *Sit sen löysi sieltä jostakin.*
>
> There were tens of these questions.
> The answer was found there somewhere.

The teacher becomes a visible enunciator when she describes her own role as a helper, a guide who gives feedback on students' progress and makes herself available in case students have questions.

The actantial diagram summarises the actants and actors in the following:
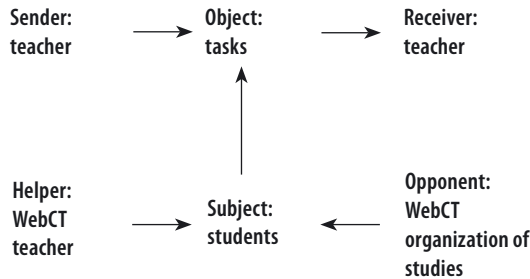
Figure 15.   Actantial model of Courses 3–5 interviews

Teacher as sender, helper and receiver

The teacher takes the positions of a sender, helper and receiver. On the first contact lesson, she prepares students for the course by explaining objectives and structure, and then sends them to do tasks, find answers, or write their own abstracts. During the course she is available for help and advice, receives answers, and gives individual feedback to students. The first example below is from Course 3, the second from Course 4:

> *Ja sitten esittelin verkossa sen (kurssin) kanssa ja aikataulut,*
> *minä siellä tarvittaessa ohjasin ja avustin.*
>
> Then I introduced it (the course) on the net, too, and the timetables.
> I was guiding and assisting if necessary.
>
> *Sanoin, että käyn siellä vähintään joka toinen päivä.*
> *kyllä mä siinäkin jokaiselle annoin palautteen.*
>
> I told them that I'd visit there every second day at least.
> I gave feedback to everybody on that one, too.

The teacher's role as receiver and outside observer in Course 3 is further reinforced through her critical evaluation of the course. It is as if she had sent students away to take the course and now sits back and looks at the strengths and weaknesses of the whole endeavour, when it is over.

> *Mun mielestä nämä ei kyllä mitään varsinaisia caseja oo,*
> *Jotenkin musta itsestä tuntuu, että kun tätä kehittää, niin tekee pikkasen niinku*
> *monimutkasempia…*

In my opinion these are not really any real cases.
Somehow I feel that when one develops this, one should make it a bit more complicated…

Student-subject with task-object

All three teachers clearly wanted to make students the subjects of their courses. Students' object is either tasks and quizzes, or the answers they need to find, or as in Course 4, writing their own abstracts. The principal verbs that describe student activities are dynamic in Courses 4 and 5. Students "*introduce themselves,*" they "*write,*" "*give feedback,*" "*ask questions,*" "*suggest changes,*" "*and take responsibility,*" "*search for answers*" and "*wonder.*"

In Course 3 students do not appear as dynamic. The verb most frequently used to describe student behaviour when trying to achieve the object is "to do." However, verbs that express wishes, opinions, likes and dislikes are frequent with student subjects:

> *Opiskelijat tekivät aika itsenäisesti.*
> *Ne teki niitä tehtäviä siinä lähitunneilla.*
> *Ne toivoi niin, että ne sais tehdä.*
> *Ne, jotka halus tulla….*

> The students did (the tasks) quite independently.
> They did the tasks during the contact lesson.
> They hoped that they could do…
> Those who wanted to come…

Verbs used in the interviews qualify the student-subject as dynamic or along the axis of desire making it very strong (Veijola 1997), while on the other hand, the subject appears rather weak in study skills. In Course 3 and 5 the modalities produced by auxiliary verbs suggest obligation or permission and thus external motivation to reach the object. Students "*have to find answers themselves,*" "*they had to work through the course material,*" "*they are allowed to make a crib sheet,*" and "*they dared not access each others' work.*" This disinterest is reinforced in another utterance in Course 3, where the teacher describes students' participation in class as "*those who had bothered to attend.*"

Course 4 differs in this respect from the other two courses. However, at the utterance level the teacher frequently classifies students as weak or strong:

> *Hyvä opiskelija saa sen tietysti kerralla hyvin.*
> *Se on heikoille hyvä, voi tehä niin monta kertaa ku tykkää, niin hitaasti ku tykkää.*
> *Se ois musta aika mielenkiintoinen juttu, että ketkä tästä hyötyy eniten, heikot opiskelijat vai hyvät.*

> A strong student gets it right the first time obviously.
> It is good for weak students, they can do it as many times as they like, and as slowly as they like.

It would be quite interesting to see which benefit from this most, weak students or strong students.

In the example above, the speaker expresses her own judgment about a strong student's ability by producing a modality of certainty with the adverb "*of course.*" The choice of adverbs "*weak*" and "*strong*" as attributes to students is obviously also an expression of judgement. It must be noted, however, that although the speaker seems to categorize students as weak or strong, both types can make progress and benefit from teaching. For weak students it may only take longer.

Opponent

Apart from poor organization of studies (many online courses offered to the same students), there does not seem to be a clear opponent that would make it difficult for students' to attain their goal. The only reference to some kind of problem is about WebCT in Course 4:

> *WebCT:llehän on hirveen vaikea laittaa ohjaavia tekstejä. Siinä kohdassa minusta WebCT ei ole hyvä. – Siinäkään.*
>
> It's very difficult to include instructions to tasks on WebCT. In that respect WebCT is not good. – In that respect, either.

WebCT is making the helper's work more difficult here. Students are also affected since the problem is insufficient instructions for the students.

In Course 3 and 5 the only opposition seems to stem from practical arrangements or general organization of studies. Students do not have access to the Internet from home, so they are forced to come to school to study. This undermines the idea of freedom from time and place. Teachers face the same problem. They are required by their timetables to be present in the classroom. In addition, the same students were offered five consecutive online courses, which was likely to affect their motivation.

Goal: Students work independently

The subject-object relationship in the actantial model accentuates students' independent work in completing the learning tasks. The teachers seem to value an autonomous student who thinks and understands, has opinions and takes responsibility. This is a recurrent theme in all three interviews at the enunciative as well as utterance level. Student autonomy shows at the utterance level through the choice of principal verbs like "*take responsibility,*" "*work independently.*" In Course 3 students' wishes and opinions – "*they wanted*" and "*hoped*" – similarly contribute to the image of autonomous students who know what they want.

In Course 4 there are frequent references to students' understanding and abilities. Here modalities reveal what the enunciator's values, i.e. finds important in a learning situtation. Through the modality of negation the teacher expresses her expectation of an able student who understands. (Hakulinen & Karlsson 1979, 266.) Below, the use of a conditional "*so that they would understand*" is another example of modalisation. The use of the hypothetical conditional indicates that the speaker refuses to take responsibility (Hakulinen & Sorjonen 1989, 85). The responsibility, therefore, is left with the students.

> *ne tajuais, millai se liittyy.*
> *ne ei ollu ymmärtäneet,*
> *sitten heidän kielitaitonsa ei riittäny,*
>
> so that they would realize how it is linked to..
> they hadn't understood
> then their language skills were not sufficient.

The teacher remains invisible and disengaged to some extent. This is done through actorial and spatial shifters, i.e. the many different impersonal expressions as well as adverbs that place the teacher outside the course and the net. The teacher is most visible in her role as a helper. At the utterance level, the verbs used are "*assist*" and "*guide.*" "*Help*" surfaces as a keyword especially in Course 4. Student subjects "*want help*" in writing their thesis abstracts. Desire is highest in the hierarchy of modalisation that expresses values. Students want help and the teacher is willing to give it to them. It becomes clear from the beginning that the main purpose of the course is to help students in their goal. Theory and tasks provided are all there for this purpose only. Even the opponent surfaces in the difficulty of giving students clear enough instructions on how to do the tasks.

Teacher- and student roles

In these three interviews, modalities mainly expressed in principal verbs convey the teacher/enunciator's attitudes toward students, and their conceptions of teacher- and student roles, as well as teaching and learning. Although all three teachers seem to value student autonomy, their belief in their students' ability and motivation to become autonomous learners is less obvious. The teacher seems to be doing most of the work, as can be seen in her many roles in the actantial model. The teacher decides what the object is, sends students to do the tasks, assists and helps them, and receives the results.

Omniscient teacher and helpless students

In describing reasons for offering an online course and its benefits, these teachers use active principal verbs at the utterance level to explain the changing student role. At the enunciative level, however, the doubt and disbelief in students' motivation and autonomous learning become visible:

> *ne ei verkossa juuri kyselleet mitään neuvoja, vaan nää, jotka vaivautuivat paikalle, kyselivät siellä luokassa.*
>
> *Että ei mun tarvinnut oikeastaan aktivoida. Kun ne (tehtävät) oli pakko tehdä, niin ne teki.*
>
> they didn't much ask for advice on the net, but those who bothered to show up kept asking questions in the classroom.
>
> I didn't really need to motivate them. Since they (the tasks) had to be done, they did them.
>
> (Course 3)

Similarly in Course 5, students "*have to find the answers themselves*," "*they had to work through the course material*." Students do not take responsibility for their learning but do what they have to do. The modalisation is that of obligation, which produces a weak subject and exotactic motivation as regards learning. This implies that the teachers do not believe that students would, in fact, do much if the teacher did not force them. The teacher seems to take responsibility for students' work input. Yet, desire implies a strong subject and inner motivation. Students' desire, however, does not seem to focus on learning but on their workload and practical arrangements. They do not want to listen to lectures.

Course 4 is somewhat different in this respect. Instances where students are qualified through obligation are rare. Instead, they are frequently qualified through ability as weak or strong students. The teacher does not consider student interaction important in this particular course and, therefore, students become dependent on the teacher's help, the individual feedback she gives. This teacher seems to regard herself to be the primary source of information. The missing interaction between students further accentuates the teacher's role as sole support.

Similarly, Courses 3 and 4 present a teacher who helps students by giving them correct answers, if they have not found them themselves. There is a risk that the help that the teacher gives objectifies the students. The teacher is helping the helpless, not helping them to help themselves in Rogers' terms (Rogers 1951/94). Assistance does not focus on the learning process, "helping the hungry to fish," but is closer to "giving a fish." On the other hand, in the Course 4 interview, the teacher brings up social interaction:

> *ainoa opiskelijoiden välinen kontakti oli se, kun heidän piti muodostaa ne parit…*
> *…että se oli sitte ainoa… sellanen heidän välinen.*

The only contact that the students had with each other was in the task where they had to form pairs.
..so that was the only one… sort of between them.

The repetition of "ainoa" (only) modalises the statement as a kind of regret. The enunciator seems to recognize the fact that there could have been more contact between students. This implies that she is aware of a need for more social interaction. Nevertheless, she remains unwilling to include more interaction in the course:

> *Mä oon sitä mieltä, että sitä (keskustelua) ei kannata yrittää ympätä tähän pakolla.*
>
> In my opinion, it's not worth trying to force it (discussion) here.

It is apparent that teachers want to fit the new teacher model as a facilitator. They have tried to facilitate student learning by offering them theory and learning tasks. Several principal verbs with teacher-subject express assistance, guiding, advising. Direct teaching, on the other hand, is not favoured. There are frequent examples of striving away from teaching:

> *Niinku meillä kaikki muutkin verkkokurssit, niin tämä oli tavallaan pakko opettaa, kun se oli resurssoitu se lähituntimäärä.*
>
> As with all our online courses, this, too, had to be taught, since the contact lessons were in our timetable.
>
> (Course 3)

> *Ei suinkaan niin, että opettaja korjaa*
> *Kyllä mä audiotoriossa heitin sen kysymyksen ja sain joiltakin vastauksia,*
> *jotka mä jätin sitte ilmaan*
>
> By no means so that the teacher corrects
> I did pose that question in the auditorium, and got some answers, which I then let hang in the air
>
> (Course 4)

> *Verkkokurssilla jokaisen on pakko etsiä itse vastaukset, opettaja ei anna.*
>
> In an online course everyone has to find the answers themselves, the teacher does not give them.
>
> (Course 5)

"*This had to be taught*" places the teacher-subject in the lowest category of obligation in the modal axis suggesting that teaching is not the role to be embraced. Similarly, quotations from Course 4 and 5 interviews show that teachers seem to assume teaching is not part of the new teacher role as a facilitator of learning. Yet, they do not quite seem to understand what facilitating entails.

> *(antaessaan palautetta opiskelijatoverille) he luuli jotain vääräksi, joka oli oikein.*

Ja sanoin, että osa näistä sun kieliopillisista kommenteista oli nappiin, osa ei. En tiedä, että olisko sitte pitänyt sanoa suoraan (mitkä olivat väärin, mitkä oikein).

(when giving feedback to a fellow student) they thought something was wrong although it was right.

And I said that some of your comments on grammar are correct, some are not. I don't know, if it had been better to give a direct answer (which were correct, which were not).

(Course 4)

The teacher refuses to correct the student's misunderstanding, possibly seeing it as unpopular direct teaching. Her mixed interpretation of a teacher's role seems to be a source of knowledge (traditional), who does not transmit knowledge (constructivist). The above situation might have given an opportunity to bring the student's misconceptions into the open and help them to start building a new understanding on that basis.

Thus, although the interviewees seem to hold new views on a teacher's role, the earth remains flat (Vosniadou 1992; 1994). They are still in control of the knowledge that they now impart to students via electronic networks. The teacher knows the right answers, which the students work to find in the material provided for them. If they fail, the teacher gives them the right answers. The frequent occurrence of existential structures and passive forms produce a degree-zero enunciator (Sulkunen & Törrönen 1997a; 1997c), which suggests an omniscient speaker image. In the enunciative dimension, the teachers remain omniscient transmitters of knowledge instead of the guides that they proclaim to be at the utterance level.

Internet for updated information

The three teachers seem to see the Internet mainly as a source of information, and a delivery vehicle, an electronic means of transmitting knowledge; the Internet makes it possible to have updated and many-sided information on the topics to be studied. As a material bank it is a good resource for other teachers, as well. The net enables freedom of time and space (which is not true for Courses 3 and 5), quick feedback, advance planning, closer contact between individual students, and the teacher's changed role. The Course 4 teacher feels that she does not have to be so much in control of everything all the time as in the classroom.

The net, however, does not connect people across a dynamic network. All natural interaction between students takes place face to face. Students work through web-based material on their own, or in pairs, and submit their answers so that other students cannot see them. In normal contact lessons, between online sessions, students in Course 3 "*present their findings,*" "*ask each other questions,*" "*spontaneous discussions develop,*" and "*students learn from each other.*"

The course becomes something separate when it is on the net. The teacher detaches herself from the net and the course with a spatial shifter "*there,*" by using the

passive, and other means of aspectualization signifying the teacher's lack of involvement. A case in point is the existential sentences in Course 4 that the speaker uses to describe the online material:

> *Siellä meidän verkkoluokassahan on se materiaali.*
> *Tietokoneella ei ollut tarpeeksi vaihtoehtoja*
> *kun siellä on nää harjoitukset.*
>
> There was this material in our virtual classroom.
> There weren't enough alternatives on the computer.
> Since there are these exercises.

It seems that the teacher could not interfere with the course even if she wanted to. In Course 3 students' prior knowledge is first mapped out, but results do not affect the course plan:

> *Mutta siinä vaiheessahan ei sitten oikeastaan pääse vaikuttamaan siihen kurssin sisältöön, koska se kurssi on verkkoon jo tehty.*
>
> But at that point you can't really contribute to the course contents, because the course has been made on the net already.

The course exists on the net and someone has written the rules there. The teacher and the students go to see what is there as in Course 5:

> *Mennään kurssiin sisälle ja katsotaan sinne kirjoitetut pelin säännöt.*
>
> The course is entered and the rules that have been written there are looked at

Conclusions from analysis of Courses 3 – 5 interviews

In all three courses, as in Course 1, there seems to be a tendency to shift focus away from the teacher. Interviewees distance themselves from their online courses by using various impersonal expressions and actorial and spatial shifters. The teacher-agent disappears and the course is put in a focal position. At the utterance level the course is described in a factual objective manner, as if it existed and functioned in its own right rather than being the creation of a teacher's mind. The teacher cannot intervene after the course has started running. In fact, teachers are as invisible in their talk about their online courses as are people in texts about environmental destruction (see also Karvonen 1996, 155). However, the enunciative dimension reveals that teachers are very much in control of both knowledge and students' activities.

At the utterance level, teaching itself seems unpopular with the interviewees. Along with the new teacher-facilitator concept, "teaching" seems to take on a negative connotation. Similarly, these teachers seem to need to hide the omniscient teacher agent, who is transmitting knowledge through web-based material and through tasks, to receive the right, expected answers.

These teachers' attitudes towards the online environment indicate that they see their online courses as something separate from themselves, something that they are not involved in. Transferred to a normal classroom, this would mean that the teacher prepares all the material that s/he thinks students are going to need for the lesson, perhaps covering the blackboard with instructions on how to proceed. She then welcomes the class, tells them what to do, and leaves the classroom. She comes back at regular intervals to check that the students are on task, gives feedback on their progress, and answers their questions.

Students, however, do not ask much; neither do they talk to each other while the teacher is gone. Between the teacher's visits students know where to find her, if they need her, but they do not make the effort. At the end of the lesson, students leave their work for grading, the teacher collects the student work and goes home to mark the papers. The only difference from traditional classroom teaching seems to be the absence of a teacher; otherwise teacher- and student roles remain the same.

3.3.3   Validity and reliability

The following considerations mainly pertain to the second and third phases of the research process as validity and reliability of the first phase of this research is discussed in connection with its results in Chapter 3.1. This chapter first looks at the objectivity of the research and continues then to examine the validity and reliability separately and intertwined to a certain extent. The chapter ends with a discussion on ethical concerns.

Objectivity

Qualitative research is often accused of subjectivism; the respondents' and the researcher's opinions, values and attitudes may bias the results. Similarly, in this research the human factor must be acknowledged. However, even the purist quantitative research is not totally free from researcher bias, as it is researchers who make value decision throughout the research process, starting from what problems they find worthy of research, choosing what to measure and with what instruments, and so forth. In addition, researchers make interpretations, draw conclusions and decide what elements of data to emphasize and publish. As Johnson and Onwuegbuzie (2006, 15) point out "*the conduct of a fully objective and value-free research is a myth.*"

Patton (2002, 50) draws attention to the investigator's emphatic neutrality. The investigator does not set out to prove her perspective or predisposed truths, but tries to understand the complexities and multiple perspectives as they emerge. This is achieved by rigorous and systematic data collection procedures, multiple data sourc-

es, triangulation, and external reviews. The result is "*high-quality data, which are credible, trustworthy, authentic, balanced about the phenomenon under study, and fair to the people studied.*" (ibid., 51).

Patton (2002, 47) also emphasizes the investigator's personal experience and engagement: "*Qualitative inquiry means actively participating in actual program activities … going where the action is.*" Closeness and direct personal contact with people under study in their own environment make key insights possible. This "*does not make bias and loss perspective inevitable; distance is no guarantee of objectivity.*" (ibid., 49).

Closeness as a colleague to the teachers who volunteered to be part of the research, personal experience of producing and teaching online courses, as well as participation in the same in-house training programme enabled the investigator to understand the reality of these teachers and formed a solid basis for the interpretation and authenticity of the findings.

To make the investigator's position transparent to the public, a brief professional autobiography is provided in Chapter 1.3. The investigator's constructivist orientation to teaching and learning is also disclosed, which proves that the author is aware of her selective perceptions, personal biases, and theoretical dispositions (Patton 2002, 51). This transparency contributes to the trustworthiness of the research.

As the aim was to increase credibility and minimize invalidity, efforts were also taken to give as honest and truthful representation of data as possible, to avoid selective use of, or manipulation of, data so as not to misrepresent the message, to provide an adequate rationale for the interpretations made, respondent validation of the data and interpretations, and to be open about the researcher's own background, perspectives and values. An attempt was also made to secure that the claims made were sustained by the data. (Patton 2002, 50; Cohen, Manion & Morrison 2000, 120.)

The choice of analytic methods, the actantial analysis and the linguistic approach, helped to avoid researcher bias by focusing on the structural and lexical features in the data, instead of mere interpretations based on reading and re-reading of the texts. Actantial models are abstract narrative structures that allow the relations between characters to be distinguished in accordance with a neutral actantial structure, instead of relations and reality conditions assumed by the analyst (Wang & Roberts 2005).

The following section discusses the internal and external validity of the research with reference to catalytic and criterion-related validity (Cohen, Manion & Morrison 2000, 105–125). Methodological and data analytic triangulation, and, to some extent, a mixed research approach also contributed to the validity and reliability of the study.

Internal validity

With regard to data, internal validity was sought through recording the interviews for accuracy, through the use of naturally occurring data (manuscripts and online materials) for authenticity, and through the amounts of evidence and the corroboration of findings (Cohen, Manion & Morrison 2000, 108).

Interviews were transcribed verbatim. This level of accuracy was considered adequate, since the analysis examined lexical items and sentence structures, not meanings conveyed through pauses, intonation, and so forth. This linguistic analysis seemed more objective leaving less room for subjective interpretations than, for instance, determining ironic undertones and emotions in a speaker's intonation.

The baseline assumption that teachers held traditional conceptions of teacher- and student roles was sustained in the first phase questionnaire survey, and corroborated in the manuscripts, online materials, and the interviews. This could also be seen as concurrent validity. These data also provided stronger evidence for the findings, because they all remained tangible and visible throughout the research contributing to the confirmability of data. Teaching in a classroom would have to be videotaped to accomplish the same level of visibility, and to provide data that the researcher could go back to.

In order to convince the public of the credibility of the data and the analytic methods, two complete analyses of the interview data were included in the report. The aim was to show that the method used could indeed bring out the differences in respondents' accounts of their teaching. At the same time, the two examples served to show that the data could sustain the claims made based on them and to build confidence on the findings from the later analyses that were not as fully reported. (Cohen, Manion & Morrison 2000, 107.)

Internal validity was also increased by respondent validation (Cohen, Manion & Morrison 2000, 108) and, to a certain degree, by seeking expert support for the examination of the data. Respondent validation took place in different phases of the research. After the interviews the respondents were asked to read the transcripts and correct their statements and/or to add further information to them. In addition, the interviewees were later asked to check and comment on the interpretations made in the follow-up discussions.

The researcher's own confidence on the analytic methods was increased by asking an expert in actantial analysis, Jukka Törrönen with the University of Helsinki, to comment on two example interview analyses. Following Törrönen's advice more attention was paid to presenting adequate amounts of data for the public to make their own judgments on the credibility of the findings.

External validity

External validity refers to the generalizability of the results. Qualitative research can meet the requirements of generalizability by trying to "*provide a clear, detailed and in-depth description so that others can decide the extent to which findings are generalizable.*" (Cohen, Manion & Morrison 2000, 109) Johnson and Onwuegbuzie (2006, 20) see generalizability as one of the weaknesses of qualitative research in that "*the findings may be unique to the relatively few people included in the research study.*" Silverman (2001, 249) points out that in qualitative research generalizability can be obtained through the combination of qualitative research with quantitative measures of populations.

In qualitative research, however, generalizability is not necessarily the main concern, but the credibility of the research process and the findings. There are no rules for sample size in qualitative research as long as the cases are information rich (Patton 2002, 244). Information-rich cases are obtained by purposeful sampling and they reveal a great deal of the issues that are central in the research (ibid., 46).

It seems that all these arguments about generalizability and credibility can be related to this study. Only five teachers were included in the in-depth description. Moreover, they were all from the Faculty of Technology with a science and technical background, with an exception of one language teacher. This made a small but information-rich sample, as all participating teachers had first-hand experience of online instruction. Bearing in mind the aim of the research: to increase understanding of the conceptual change with teachers, in-depth information from a small number of people can be very valuable (Patton 2002, 244).

However, the questionnaire survey conducted in the first phase of the research drew from the whole teaching staff of the polytechnic with similar indication of teachers' traditional conceptions of teaching and learning as well as possible transitions in progress. Cohen, Manion and Morrison (2000, 111) call this predictive validity; the data acquired at the first round of research correlate with data acquired later. This is another form of criterion-related validity, the other being concurrent validity discussed earlier.

There is no indication in the evidence from this study that these five teachers would be a peculiar group due to their background in how they understand teaching and learning, and how they use ICT in instruction. There is evidence to the contrary; the teacher with the most constructivist mindset of the five interviewees was an engineer, and so was the most behaviourist one. In addition, a language teacher was among the three teachers whose conceptions and approach to online teaching were found to be in transition.

Leinonen (2007, 190), however, found that teachers in the field of engineering held the most traditional conceptions of teaching and learning compared with teachers in social and health care, and business. Other studies show that the initial difficul-

ties with online instruction are common across disciplines (Aarnio & Enqvist 2004; Coomey & Stephenson 2001; Paavola, Ilomäki & Lakkala 2004; Sinko & Lehtinen 1999). That said, it is important to acknowledge that there are cultural differences between schools, polytechnics and even between faculties in the same polytechnic, which are likely to affect teaching practices as well.

That the requirement to learn to use ICT in instruction is enough to trigger transformative learning with teachers is hard to prove. Neither does this study offer proof one way or the other. Even with a concurrent in-house training programme there was only a promise of transformations. We can, however, make an observation about certain changes occurring on the conceptual level of those teachers who had the online experience as opposed to the one teacher who did not.

Finally, an attempt was made to give adequate theoretical background to the phenomenon of conceptual change so that the results could be considered in light of the theory, even if they were not drawn from a larger population. A detailed description of the theoretical considerations sought to clarify the construct of conceptual change and to explain the results so that others could make their own judgements about whether the construction was acceptable and the results representative.

Catalytic validity

Cohen, Manion and Morrison (2000, 111) discuss catalytic validity in a social and political context; research should have an agenda and it should "*help participants to understand their worlds in order to transform them*," and "*to promote emancipation, autonomy and freedom.*" In this respect, the present research aimed high in catalytic validity, even though not in a political sense. The agenda, if you like, was to help teachers to understand their inner worlds better, and "*improve the empowerment of the participants*" (ibid., 111) by showing what the obstacles for transformation might be, and by suggesting corrective measures. The research tried to encourage participants to transform, not their "*oppressed situation*," but their restricted frames of reference. In this way, the research sought to promote freedom from rigid and biased routines and enable professional growth.

Triangulation and mixed research

Research aimed at being better informed by the use of both quantitative and qualitative methods. According to Cohen, Manion and Morrison (2000, 115) triangulation is relevant where a complex phenomenon, in this case conceptual change, requires elucidation. The types of triangulation in the present study that are common in mixed research were the sequential research phases, the fact that the data was collected from multiple sources making use of different instruments, and the interdisciplinary approach in the data analytic methods (content analysis, linguistics and semiotics).

The quantitative first phase was used to inform the qualitative phase in the overall research design. The questionnaire in the first phase of the study included quantitative data collection as well as open-ended questions and interviews. Findings from the content analysis of manuscripts and online materials were used to help inform interviews, which, in turn, were carried out both individually and in groups. Findings corroborated across different approaches. These are all characteristics of a mixed research approach (Johnson & Onwuegbuzie 2006, 20).

The only reason for mixing methods and triangulation, however, was not to seek corroboration but to increase understanding of the processes and outcomes of conceptual change. As Johnson and Onwuegbuzie (2006) point out, mixed research can add insight that might be missed if only one method was used.

Reliability

Reliability is usually understood as replicability; another researcher should be able to repeat the research and have similar findings. In qualitative research, however, reliability could be seen as dependability, which involves, among other things, respondent validation and triangulation (Cohen, Manion & Morrison 2000, 119). As these have already been dealt with above, the following discussion mainly focuses on the reliability in interviews, and interviewer and interviewee effects that might bias the results.

The conduct of interviews aimed to be true to the choice of the theoretical paradigm, constructivism, adhered to throughout the research (Silverman 2001, 95–97). Therefore, the interviewer did not try to detach herself from the interviewees, but came to the interview situation as herself with her own attitudes, opinions, and expectations. This alone creates a possibility for bias.

However, the interviews were not strictly structured but remained as open-ended as possible, with many open questions, to enable also the respondents to demonstrate their unique way of looking at the world in their own words, and to digress from the main themes so that important but unanticipated questions could be raised (Cohen, Manion & Morrison 2000, 121). This avoided the tendency for the interviewer to seek answers to support her own preconceived ideas. To the contrary, findings were fully based on analyses, and quite unexpected.

Similarly, recording the interviews and respondent validation of the transcripts helped to avoid misperceptions on the part of the interviewer of what had been said. As the interview was built around a few basic themes that were discussed together at length, there was no danger of a misunderstanding on the part of the respondents, either, of what was being asked, nor did the questions probe information that the respondents did not know (Foddy 1993, 13). The two, full interview analyses in the present report also serve as examples of the interviewer's questioning techniques so

that others, too, can determine, how open the questions were, whether they were "leading," and to what extent the questions could have influenced the answers.

There was one leading question that was asked all interviewees: question 1: *What added value does the Internet contribute to this course?* This is a leading question in a sense that it presupposes that the Internet is automatically something positive. The purpose of the question was to find out why the teacher had decided to change this particular course into an online course. Obviously, it would have been better to ask directly that. Nevertheless, these teachers were likely to understand the question in a way it was meant, since this had been one of the lessons to be learnt in the training; it was emphasized how important it was for teachers to be aware of the reasons why a web-based solution was a better approach in each particular case, the idea being not technology for technology's sake only.

The two example analyses also serve as examples of the interviewer qualifications that contribute to reliable interview data. The following self-evaluation follows Cohen, Manion and Morrison's list of interviewer qualifications (2000, 121):

- The interviewer knew the subject matter. The interviewer had the same personal experience of the training and online instruction as the interviewees. In addition, the interviews were based on analyses of manuscripts and online materials (knowledgeable).

- She made the purpose clear, which was to describe the online course (structuring).

- The subjects were allowed to say what they wanted to say (gentle).

- The interviewer employed active listening skills trying to really understand the message (sensitive).

- Interviewees were allowed to talk about what seemed to be important for them (open).

- Interviews all dealt with the same themes, although there were digressions (steering).

- The interviewer asked probing questions to check again what was actually being said (critical). Sometimes these questions for additional information may have seemed "leading", although the idea was to elicit a fuller answer, and to tease out the reasoning behind the response; e.g. "*But isn't the whole idea of project work to work as a team?*" (Course 1 interview) as a response to the interviewee's complaint about students' unwanted collaboration in a test situation.

- All through the interviews, the interviewer related what had been said to earlier statements in the interview (remembering).

- The interviewer sought to clarify any unclear statements with interviewees during interviews and afterwards through respondent validation (interpreting).

Moreover, there were no power relationships that would have influenced the interviewees' responses; the interviewer was a colleague and a peer in the training programme, which helped to create an informal and safe interview situation.

Finally, the choice of data analytic methods contributed to the reliability of the findings. Silverman (2001, 190–191) warns against relying on single-element explanations and urges to look for interrelationships. It is suggested here that multilayered analysis of data; the levels of thinking, speaking and practice in manuscripts, interviews and online materials respectively, and, additionally, the two dimensional analysis of interviews; the dimensions of utterance and enunciation, helped to avoid too simple explanations. The linguistic analysis supported the meanings which were identified in or interpreted from the language data (see also Freeman 1994, 78–79).

This comprehensive data treatment aimed to show how the theoretically defined elements, e.g. conceptions of teacher- and student roles, were identified and assembled. The interrelationships on the conceptual level between these teachers' existing conceptions of teaching and learning and their entrenched beliefs, and the new concepts, sought to reveal the processes from which the explanations were derived.

Ethical concerns

Professional competence and obsolescence are sensitive issues. Neither of them was the focus of this research. However, as online learning experiments are continuously increasing and being discussed, those teachers who, for some reason or another, do not wish to participate may feel it as a pressure. Further, a study that focuses on the mastery of IT and ICT skills and the teaching approach, may in the worst case be experienced as an attempt to reveal old-fashioned thinking and teaching methods, an attack against teachers' professional competence. In the following section, the measures taken to minimize such impressions are discussed, obtaining an informed consent from respondents being one of them. The main concerns lie in privacy and confidentiality.

Informed consent means that respondents can decide for themselves whether they want to participate in the investigation. Their decision must be informed, i.e. all benefits and risks involved in participation are explained. They also know they can refuse and withdraw from the investigation at any point (Cohen, Manion & Morrison 2000, 50–51).

In the first phase of the study, the questionnaire was given to all those respondents personally who could be reached, and the research focus was openly discussed to obtain an informed consent. Similarly, volunteer participation was a prerequisite in the later phases of research. Nobody refused to participate. Respondents were kept informed about the analyses, interpretations and conclusions drawn throughout the research process, and their consent was sought for publication of the results. Con-

fidentiality was assured both in writing and orally when introducing the questionnaire. Respondents answered the questionnaire anonymously.

However, answering all questions in the questionnaire meant giving so much detailed information about oneself (age, sex, faculty, subject taught) that it would have been easy to guess the identity of many of the respondents even without the name. Therefore, respondents were encouraged not to answer any questions they felt uncomfortable with. The statistical analysis of the questionnaire responses, however, decreased the possibility that the respondents' identity, even if revealed, would have influenced or shown in the results. The fact that the response rate was so high (78%), and that almost all respondents had answered all questions, speaks to the fact that participants did not feel threatened.

In the second phase of the study issues of privacy and confidentiality were more problematic, and therefore, obtaining informed consent was essential. The five teachers in the Faculty of Technology, whose course manuscripts and online materials are presented and analysed, can be easily identified by other members of the faculty, although not by outsiders. Making these teachers' teaching transparent in this way, probing their attitudes, entrenched beliefs and conceptions in the interviews, and revealing them in the analyses violates their privacy and makes them vulnerable. This is particularly true, as teaching is traditionally regarded as very private work only involving students, not even colleagues.

In this research the privacy has to be considered from two perspectives: the sensitivity of the information and the dissemination of information. As discussed above, the information may be regarded as sensitive. It is suggested here that these five teachers voluntarily gave up their right to privacy regarding their online instruction when they consented to participate in the investigation after they had been thoroughly informed of everything it involved (Cohen, Manion & Morrison 2000, 61). In fact, they had already given up their privacy regarding their teaching, since they decided to produce online courses that anyone within the faculty could access. Even so, it was important not to betray in any way the trust and confidence that these teachers gave the researcher.

To avoid betrayal of trust Cohen, Manion and Morrison (2000, 63) suggest submitting reports and evaluations to the teachers involved for comment. These teachers were given an opportunity to check everything that the researcher had written about them, whether it was transcripts of the interviews (in Finnish), or interpretations and conclusions made. Since the latter were written in English, the contents were truthfully explained to participants in a one-to-one follow-up discussion in their own language. In addition, the theoretical underpinnings were explained and teachers were taken through the analysis process to help them understand how the findings had been obtained. Finally, the researcher invited all five teachers to a private publication of results, where they still had an opportunity to refuse the use of their information, or to withdraw from the investigation altogether.

Even though the report is critical of teachers' teaching approach, and reveals some of their entrenched beliefs, none of the teachers denied the use of the information or the publication of results. It is also important to remember that the researcher herself was part of the investigation, and what is reported applies to the researcher as much as to the other participants.

There are concerns about the ethical implications in attempts to study other people in their process of transformation, and challenge and transform other people's meaning perspectives, as was the case in the in-house training programme (Merriam, Caffarella & Baumgartner 2007; Mezirow 1990a, 361). The risk of indoctrination is apparent in introducing constructivism as an alternative to traditional, behaviourist teaching approach. But, as Mezirow (1990a, 362) points out:

> *Emancipatory education, which helps learners become aware and critical of the presuppositions that shape their beliefs, is not the same thing as prescribing a preferred action to be taken.*

> *Education becomes indoctrination only when educators try to influence specific actions as extensions of their will… To show learners a new set of rules, tactics, and criteria that allows them to judge situations in which they must act is significantly different from trying to engineer learner consent to take the action favored by the educator.*

The rationale behind Mezirow's argumentation, as it is understood here, is that when learners become critically reflective and learn to question their own and others' presuppositions they will also become less susceptible to others' influence, but will only change their views, if necessary, through critical-self reflection, the resulting new insight and a will of their own.

Finally, interpretations made about respondents' conceptions of teaching and learning, and their attitudes towards students and the online environment are understood to be only interpretations, not facts. A relatively large amount of data is provided in the report, and the analysis process is described in detail for respondents themselves or other researchers to draw their own conclusions.

Due to the research interest in understanding the process of conceptual change, not in the generality of it, nothing conclusive can be said about polytechnic teachers' teaching approach in general. Results will especially serve as guidelines for future teacher training and support. They will be published bearing in mind the context and will not be used to label these or other polytechnic teachers in any way.

3.4   Phase IV: Follow-up discussions with teachers

All interviewed teachers were asked to comment on interpretations made in order to validate the results. Another, more implicit, purpose of the follow-up discussions was to reinforce critical self-reflection with these teachers on hearing what the researcher saw as their conceptions of teaching and learning, teacher and student roles, as well as attitudes towards the online environment.

The follow-up took place two years after the interviews, in a face-to-face discussion with each interviewee. The time lapse was necessary to allow enough time for reflection triggered by the online experience to show as changes in pedagogical thinking, and practices in the classroom, or in the online course itself.

During the follow-up discussion, methodology was explained so teachers could appreciate the conclusions drawn. Also, theoretical frame of reference was briefly discussed in order to provide a theoretical basis for discussion and invite self-reflection.

All teachers confirmed the main interpretations made. Most online courses had changed since the pilot run, or there were plans to change them. The changes were in general towards a more constructivist teaching approach. In some instances, experience gained from the online course had inspired changes in classroom teaching, as well.

Course 1: Project Work, 1 credit

The course on Project Work was never realized, because after the manuscript was made and it was time for the teacher to start producing course material for the following academic year, he learned that it was not part of the curriculum that year. A decision had been made to offer this particular course every second year only. The motivation to make a course now and try it out a year later was not high enough for the teacher to proceed with his plans. At the time of the follow-up discussion he was not sure whether or not he would find the time or the energy to start working on his plans again.

Since the interviewee did not have online teaching experience, the follow-up discussion focused on interpretation of his interview. The teacher fully agreed on all the interpretations made. Although the wording in the analysis when describing his attitudes toward the students was rather provocative (*They are presented as an inactive, faceless, uniform mass*), he confirmed the interpretation by repeating his opinion:

> *Kokemus on opettanut, että luokassa joutuu potkimaan perseelle. Kyllä ne helposti näkee passiivisena laumana.*

> Experience has taught me that one has to kick their arses in the classroom. It's true that you easily see them as a passive flock.

Regarding the researcher's interpretation about the distance between the teacher and his online course, the interviewee commented by referring to the net as a fence between the teacher and students. He continued by drawing attention to the mediated nature of interaction:

> *Siinä on se kaksi kilometriä kaapelia välissä.*
>
> There's the two kilometres of cable in between.

Course 2: Wood as Raw Material, 3 credits

The first thing that the interviewee wished to point out about the course on Wood as Raw Material, was the change in curriculum that had resulted in not offering the 1-credit course that had prepared students for producing their own online material. Consequently, student reports had deteriorated in quality, and they were no longer available online for other students to see. Seminars, however, were still held and reports were discussed there.

The interviewee agreed on results of the analysis in general, but appeared to be somewhat embarrassed about the constructivist praise he felt he was receiving. He wished to emphasize that the results only showed how he was thinking, and how he would like to arrange teaching and learning, but "*things don't always go the way we'd like them to go.*" Nevertheless, he admitted that teaching for him was mainly working together with students.

The interviewee also strongly agreed with the interpretation that his attitudes towards using educational technology are very positive. He explained how he was probably the first, apart from IT teachers, who learned html and graphics on his own out of sheer interest.

Course 3: Bio- and Recycled Fuels, 1 credit

The course Bio- and Recycled Fuels had been assigned to another teacher after the interviewee piloted it once. The interviewee did not know whether this other teacher had used the online material somehow or taught online at all.

The teacher agreed on the interpretations made and supported them by her explanations. She explained her own lack of involvement by the fact that her assistants had written the course material and formed the questions. In her view, students lacked motivation to study this course because it was additional to, not one of their key courses. This course was not integrated with other courses in any way, either.

> *Se on tavallaan "orpo" kurssi, ei liity muihin kursseihin. Ehkä opiskelijat siksi ei pidä niin tärkeänä, haluavat vain sen opintoviikon.*

> It is in a way an "orphan" course, not related to other courses. Maybe that's why the students don't see it as important; they only want the credit it gives.

The missing interaction seemed to have troubled the interviewee. She fully took responsibility for not being able to create any social interaction online. Again, she tried to look for an explanation: Was it because the teachers belonged to a generation that was not used to online chatting like today's young? Or was it perhaps because the tool was called Discussion, instead of Group Work, for example?

Teachers may associate discussions with all other social activities in a learning situation, not learning per se. Students do not really discuss subject matter during contact lessons, either. If they talk with each other, it's usually about something else.

Course 4: Technical Writing – Thesis Abstract, 1 credit

Before the follow-up discussion the teacher had already run Technical Writing – Thesis Abstract for the third time. She agreed with most interpretations made about her conceptions of teaching and learning and attitudes towards the online environment, although she wanted to challenge some. Regarding the critical reflection that took place during the interview she wished to point out that had the interviewer been someone other than the co-teacher, there might have been less open reflection and more factual review of the course. Nevertheless, she agreed that some reflection would still have occurred, she merely might not have voiced as much of it.

The teacher also referred to her classification of students as weak and strong, confirmed the interpretation made that this was an indication of seeing students as different kinds of learners, and pointed out that she did not talk about good and bad students.

Social interaction and comments made about it by the teacher during the interview produced a strong reaction. The teacher seemed to be surprised at her own choice of contemptuous words and emphasized that she otherwise considered interaction important. It was only in that particular task that it did not seem like a good idea, and not necessarily in this course. Later she came back to the same topic, pointing out that she was not against social interaction as such, but found it difficult to realize.

The interpretation made that the teacher did not seem to understand interaction as a form of peer support and learning from peers produced another strong reaction. This interpretation was based on her comment on a task where students gave feedback on their pairs' writing. In the interview the teacher had seen this as a useful task to learn to pay attention to the right things in the abstract – and had not described it as an opportunity *to learn from each other*. The teacher now felt it was self-evident that students learned from each other, when they were exposed to their pairs' work

and gave feedback on it. She argued that the fact that she did not mention learning from peers did not mean she had not thought about it.

The interviewee agreed on the interpretation that as a teacher she was in control and wanted to help her students learn and understand. Whether she agreed on the conclusion that she was in a way hovering between a "sage" and a "guide," was not altogether clear. One among several comments from which the conclusion had been drawn was: "*They thought something was wrong although it was correct. I said that some of your grammatical comments were correct, some weren't. I don't know if it had been better to give direct answers (which were correct, which were not).*"

 The interpretation that she had perhaps become aware of the new teacher role and did not want to resort to direct teaching anymore, and that she did not quite understand what this new role entailed and was, therefore, confused, seemed to irritate the teacher. To the interviewer it appeared that the cause of irritation was the teacher's own vague answer to the student rather than the interpretation made. To a direct question about how she understood her own role as a teacher, she answered:

> I guess I have changed as a teacher over the years, and I suppose I have a view of a teacher's role deep inside, but I haven't really thought about it.

Course 5: Basics of Environmental Analysis, 3 credits

The teacher of Basics of Environmental Analysis was not completely happy with the structure of her online course. She felt the contents remained too theoretical with no practical application and that the multiple-choice questions were too difficult for students. After the interview the teacher ran the course again, this time with new collaborative tasks for students to better link theory to practice. In this new version students were required to work in pairs and choose one piece of equipment to study more closely contacting, for example, the supplier for more information. They then prepared a PowerPoint presentation on the device to the rest of the class. The assessment consisted of both the crib sheet test (50%) and the presentation (50%). In future, students would be able to go to the university laboratory to actually make analyses with this equipment.

As regards the difficulty of the multiple-choice questions, the teacher had plans to replace them with open-ended questions that would present a real problem for students to solve. The task would be so designed that it would increase student interaction. Groups of students would pick a problem from the list, use the group discussion forum to solve it and write their answer in the common discussion forum. In an ideal case students would then read each other's answers and comment on them. How this would succeed remained to be seen.

Running the course for the second time, the teacher started to treat student answers to theoretical questions as indicators of what students did not understand in the subject matter, and started to focus her face-to-face lectures on these particular

difficulties. The online material was still only a third of the whole course, so the other remaining two thirds were contact teaching. Thus, it was possible for the teacher to use the online course to make students' understanding of the topic, or the lack of it, visible, and act on that information in her face-to-face lessons. She felt this was something she had not been able to do before, when the course was based on lectures mainly, because students usually looked the same whether they understood or not and seldom asked any questions.

The teacher confirmed the interpretations made on the basis of the analysis of her interview. She repeated that she valued students' independent work and also agreed on the interpretation made on her conceptions of student and teacher roles; students do not take responsibility unless forced to, and the teacher does most of the work. She saw the net as a tool in teaching and learning. The teacher said she felt a certain amount of online teaching fatigue, the online instruction having become part of her job description without her own consent:

> *Ei pääse irti verkkokursseista. Täytyy vaan vääntää näitä.*
>
> You can't get rid of online courses. You just have to keep churning these out.

Different practical arrangements

There were great differences in the practical arrangements of running the courses.

In two cases, the teacher met students face-to-face at the beginning of the course. After that, all interaction between teacher and students was via the Internet. In a third case the online module was part of a larger course, in which different learning methods were interwoven; the students worked online, in a laboratory and attended lectures and seminars. Laboratory work, excursions and visiting lecturers were included in two other courses as well.

Usually teachers received the same pay whether they taught online or face-to-face. There were two cases in which online material was studied in a computer classroom during the lessons. One teacher explained that these were the department head's orders: if the teachers were paid for 20 contact lessons, they had to have face-to-face contact with the students for 20 lessons. Another teacher felt she needed to be present all the time, in order to see how much time the online work required from students.

Thus, in practice, teacher and students attended lessons according to the timetable, but instead of lecturing, the teacher supervised students' work with the online material. This generated a greater workload for teachers compared with traditional lecturing. First, they had planned the course contents, as they would have done for any normal course. They had then compiled the teaching material, written everything down in a form suitable for the learning platform, and prepared questions to the material. Teachers were present while students worked online answering questions. After classes, teachers spent hours checking students' answers and giving feed-

back through the Internet. "*Sometimes my feedback was longer than the students' answers*," one teacher commented.

- In sum, school-level decisions affecting these teachers' work included:
- The course, for which a manuscript was written, was no longer in the curriculum anymore;
- The course was given to another teacher after the first teacher had planned it, made all the online material, and piloted the course;
- A preparatory course was removed from the curriculum, making it more difficult for students to produce their own online material;
- An "orphan" course, unrelated to the studies as a whole, was included in the curriculum;
- The teacher was expected to continue producing online courses.

These decisions did not support these teachers' professional growth or attempts to develop their teaching.

4   SUMMARY OF RESULTS AGAINST THEORETICAL BACKGROUND

This chapter summarizes research results and sets them in the theoretical frame of reference. The reader is first reminded of the different phases of the research that gradually increased understanding of the research topic and target population. The conceptual change that took place and the first indicators of transformative learning with the five teachers who consented to interviews and follow-up discussions are then described in detail.

4.1   Conceptual changes

The aim was to increase understanding of conceptual learning as a process of change in polytechnic teachers' conceptions of teaching and learning as they were faced with the introduction of ICT in instruction and new pedagogies. Based on a literature review of previous research, it was assumed that polytechnic teachers might hold rather traditional views of teaching and learning. This assumption was later confirmed in a questionnaire survey conducted among the polytechnic permanent teaching staff. The survey also showed that teachers at Lahti University of Applied Sciences were very interested in experimenting with new technologies in instruction and wanted to learn the pedagogies involved.

Twenty teachers in the Faculty of Technology were offered an in-house training programme on how to produce online courses. The objective of the training programme was to support participants in their planning of web-based material and, on the other hand, to provide a constructivist framework for teaching and learning, as well as examples of a constructivist teaching approach. The programme was designed so as to create opportunities for and to foster transformative learning of participating teachers.

Participants' high expectations were not quite met. Most teachers were happy for the opportunity to work together, although on different projects. Peer support and mutual collaboration towards a common goal was considered the best part of the training. Some participants were disappointed at a lack of concrete support in their

own hands-on work in designing and realizing the online material, and a lack of good practice examples and online interaction. Critical discourse about new concepts and their implementation in online courses was also missing.

Altogether eight manuscripts for online courses were completed by the end of the training programme. Manuscripts showed evidence of constructivist features, such as determining students' prior knowledge of the subject and involving students in independent learning and social interaction. Otherwise, teacher- and student roles seemed to have remained traditional. Five courses were selected for further examination, the criterion for selection being their probability of resulting in web-based material. In the end, four of the five courses were offered in the WebCT learning environment.

Despite the training, three of the four online courses seemed to conform with results of the previous research; they were heavy in material with a lot of teacher control. Constructivist features present in manuscripts were not realized in the online material. Thus, it would seem that the training produced no change in participating teachers' pedagogical thinking. Online courses appeared to confirm the assumption that teachers' initial teaching approach was rather traditional – and remained so.

The figure below compares and contrasts the two paradigm grids that summarize results of the initial survey and the online materials produced after in-house training.

Survey 2001

```
                  Specified tasks                            Specified tasks
                        |                                          |
       43  25  18       |                          Courses   |   Courses
       15  15  22     31|                          3   4   5 |     2
         26  13         |                                     |
Teacher ---------------- Learner           Teacher ---------------- Learner
controlled              managed            controlled              managed
                   0   10  1  |                                    |
            29  22 2   8   18 |                                    |
                   22   3     |                                    |
                        |                                          |
                  Open ended,                              Open ended,
                  strategic                                strategic
                  Survey 2001                              Online material 2003
```

Figure 16. Results of the 2001 survey and the online materials in 2003 placed in paradigm grids for comparison.

In both cases, the Northwest quadrant of the grid representing the traditional teaching approach is most occupied. The grid on the left illustrates the polytechnic teachers' conceptions of teaching and learning mainly based on how they believed they taught. The number values represent the frequencies of answers that were interpreted to reflect either behaviourist or constructivist views. The grid on the right shows the

features of actual, realized online materials in the later study. Thus, it seems that traditional pedagogical thinking results in a traditional teacher-controlled approach in online courses. This is as expected; teachers using online methods recreate their normal classroom practices.

The two grids, however, differ in their SE sectors. According to the questionnaire survey, quite a few teachers agreed with the new learner-managed approach featuring a lot of interaction between students, the teacher remaining in the background allowing students to influence goals and outcomes. This is not how the online courses turned out in the end. Even the most constructivist of the realized online courses fell in the NE sector, and there were none in the SE sector. Obviously, the number of online courses under study leaves room for doubt; had there been more courses, perhaps some of them would have been learner-managed with open-ended, strategic tasks.

It is suggested here that the empty SE sector hardly reveals sudden disagreement with the learner-managed approach. Rather, it appears to illuminate the difficulty of putting one's changed ideas into practice. Ilomäki and Lakkala (2006, 185) also report findings that support the conclusion that teachers' conceptions of learning and ICT in instruction are more developed than their teaching practices.

When asked, many teachers subscribed to the constructivist approach to teaching and learning. Manuscripts for online courses reflected some constructivist concepts. Teachers' comments during interviews indicated they knew of the new teacher-as-facilitator role, and they apparently valued autonomous, actively-involved students. What happened when they were invited to put into practice some of these constructivist concepts? Below the results are examined within the theoretical framework of conceptual change and transformative learning.

Process of change in teachers' pedagogical thinking

In the centre of teachers' pedagogical thinking seems to be their conceptions of teacher- and student roles. These are the entrenched beliefs that determine the choice of teaching methods and learning tasks. The key question in teacher's conceptions of teacher- and student roles seems to be: Who is in control?
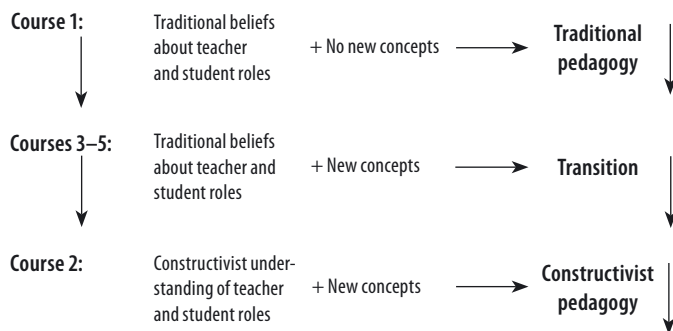
The person in control has the power to decide what and how; the objectives and strategies of learning. Basically, the person in control decides, whose questions are answered. In this study, in four out of five cases, the person in control was the teacher.

When new pedagogical ideas were introduced to teachers holding traditional beliefs about the teacher's role, it seems that the new concepts were first adopted into speech as if to comply with the public discussion. Teachers began to sound "politically correct." Talking the talk did not, however, assure that the concepts were fully understood and implemented in the resulting online courses. On the contrary, there

were frequent examples of misconceptions and consequent unsuccessful pedagogical solutions:

- Teachers were afraid to teach. Instead, they became helpers, who gave feedback on students' work, but otherwise waited rather passively for students to ask for help;

- Instruction was made student-centred by allowing students to find the right answers themselves in material provided. Students, however, had no scope to influence the contents and goals of their own learning. The teacher remained in control;

- Apart from one or two specified tasks for students to do in pairs, there was no interaction or collaboration via the Internet. Students mainly worked alone on set tasks.

Analysis of courses shows a continuum of conceptual change in teachers' pedagogical thinking. Course 1 represents the starting point with very traditional conceptions of teacher- and student roles, where not much change can be detected. Course 2 is an example of a transformation that has already taken place; the teacher and student roles are understood in a new way. Courses 3–5 provide evidence of the process of change, and are, therefore, perhaps the most interesting of them all regarding the research focus. The arrows on the right raise a question, whether the confusion phase with misconceptions is an inevitable part of the process of change, an unexpected result leading to accommodation and ultimately to a new dispositional orientation, constructivism.

Course 1: Traditional beliefs about teacher and student roles + No new concepts → **Traditional pedagogy**

Courses 3–5: Traditional beliefs about teacher and student roles + New concepts → **Transition**

Course 2: Constructivist understanding of teacher and student roles + New concepts → **Constructivist pedagogy**

Figure 17. Courses in a continuum of pedagogical change

Leinonen (2007) similarly found three distinctively different kinds of teaching approaches in her study on vocational education teachers' (N 52) pedagogical development in online instruction. Her three categories compare well to the three stages in the continuum of change described in this study. In the first category teachers transmitted knowledge with the help of new technology, and there was no interaction. In

the second category teachers were clearly aware of new concepts, but were not able to implement them in practice yet. The new concepts were part of their language but not their practice. This category would seem to correspond to the transition stage in my study. Leinonen (2007, 157), in fact, uses the term transition to describe these teachers and notes that they were clearly confused in the midst of new theories and and new technologies. The third category consisted of teachers whose conceptions of teaching and learning had changed.

In my study, the Course 1 teacher adhered to the traditional role of a teacher in control. He did not use the new constructivist concepts in his manuscript or in the interview, and remained strong in his position as the one who determines what and how is learned.

Courses 3–5 present teachers who were clearly aware of the new concepts of teacher as facilitator, student-centred learning and the need for social interaction. Yet, they could not let go of their dominating role and allow students to take responsibility of their own learning. This discrepancy on the conceptual level resulted in the above mentioned unsuccessful pedagogical decisions.

The Course 2 teacher used the new concepts in their true sense, and his new understanding of teacher- and student roles was apparent in the realization of the online course; students worked in task-focused self-managed groups and provided feedback to each other; the teacher acted as a coach facilitating learning by helping students relate the tasks to their own aspirations. Systems and protocols supported dialogue, although online interaction was still missing.

Learning through assimilation

The following figure takes a closer look at Courses 3–5 in an attempt to visualize the process of change; how the misconceptions came about. It is argued here that they are examples of learning through assimilation. As noted above, the new concepts that teachers seem to have started using slightly modified in their pedagogical talk are "teacher as facilitator," "student-centredness," and "social interaction." As shown in the figure below, the concepts have changed to better correspond to teachers' current understanding and experience; "facilitator" has become "helper," "student-centredness" now connotes "independent study," and "social interaction" is simply "discussion."
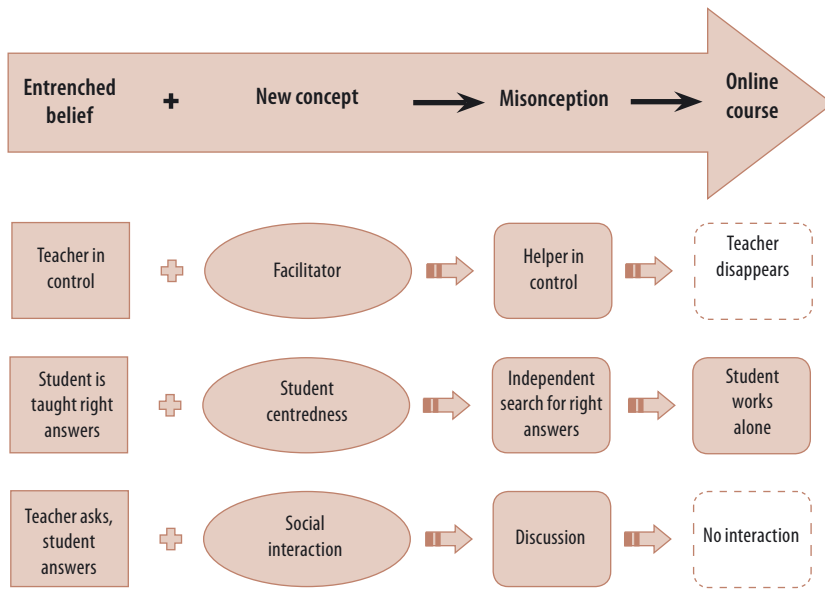
Figure 18. New concepts assimilated with old beliefs causing misconceptions and unsuccessful online solutions.

In the illustration, entrenched beliefs are presented as rectangles, new concepts as ellipses, and the resulting misconceptions, the mixture of the two, a combination of a rectangle and an ellipse, round-cornered rectangles.

Following the theory of assimilation and accommodation (Von Glasersfeld 1995/2002; Vosniadou 1992; 1994; 1996), teachers first seemed to recognize what was familiar in the new concept and disregarded the rest. "Facilitator" implies a familiar concept of helping. Therefore, that part was recognized while everything else that is involved in facilitating did not seem to have registered at all. As a result, learning through assimilation led to partial accommodation of the meaning structures, and thus "helper" replaced "teacher" but sustained the dominating "control" part of the old teacher concept. Leinonen (2007, 157) had the same finding with teachers whom she described as being in transition in her study; these teachers were transmitters of knowledge but also helpers and supporters more than before. The new concept is not unlike the picture that the children drew of a spherical earth with a platform for people to stand on in one of Vosniadou's studies (Vosniadou 1996, 16).

Similarly, the second new concept, "student-centredness," was assimilated with the traditional concept of students being taught the right answers. The result of this

conceptual marriage was students who were not taught the right answers but had to find them themselves in the material provided.

The third conceptual confusion seemed to follow from teachers' inability to recognize anything even remotely related to teaching and learning in "social interaction". In a traditional classroom, the only form of interaction is students' responses to the teacher's questions. Otherwise the class is expected to be quiet unless they have subject related questions (see also Freire 1985).

"Social interaction" has no counterpart in a traditional teacher's pedagogical frame of reference. Therefore, in Chi and Roscoe's (2002, 18) terms teachers may have lacked a category in which to assign it. It is suggested here, that these teachers associated the new concept with socializing, social talk, and discussions outside school. Unfortunately, discussion in teaching and learning remained an oddity in teachers' minds and was easy to forget. What would the students have talked about? They did not have discussions during contact lectures, either. Or if they did, they talked about other than the subject under study, as one interviewee pointed out in the follow-up interview.

Thus, the above are examples of how entrenched beliefs about teacher- and student roles constrain teachers' mental models to the extent that misconceptions are formed. The horizontal axis of the figure shows the process of learning through assimilation, whereas the vertical axis on the right, read from top down, reveals the effect of these misconceptions on the resulting online solutions: the teacher disappears, the student works alone, and there is no interaction.

The conceptual change process illustrated in Figure 18 above is supported by the theoretical and systematic model presented by Merenluoto (2006, 25). In Merenluoto's model the misconceived "facilitator" and "student-centredness" would fall under the heading of "the illusion of understanding." This is an apt description of the situation. Social interaction, turned into "discussion," on the other hand, corresponds to Merenluoto's "no idea" -reaction, which leads to evading the whole problem, much like what happened with social interaction in online courses. The third "path" that the learner can take in Merenluoto's model is "cognitive dissonance," which can result in conceptual change, or motivated learning.

Reflection that teachers were engaged in during and after interviews seems to indicate that they were in the process of reviewing the situation and trying to eliminate the perturbations caused by the inconsistency between their intentions and the outcome. This striving for a conceptual equilibrium ultimately leads to accommodation and reconstruction of one's frame of reference, i.e. transformative learning (von Glasersfeld 1995/2002; Mezirow 1990b; 2000). Thus, the results provide evidence of the beginnings of transformative learning of participating teachers. The two most obvious signs of beginning transformations were increased collaboration and its appreciation, and teachers' critical self-reflection. The following chapter looks at the signs of transformative learning manifested in the results of the interviews and follow-up discussions.

4.2   Evidence of transformative learning

All interviewees appeared to be disappointed at some aspect of their online course. Course 1 teacher regretted the lost opportunity for group work, Course 2 teacher was not altogether sure he was assessing understanding, Course 3 teacher found the tasks too simple, Course 4 teacher wanted to make grading more transparent, Course 5 teacher found the material too theoretical. All of them to some extent expressed their disappointment with not being able to create online collaboration and interaction.

Reflection

The unexpected outcome of the online activity seemed to have triggered teachers' critical self-reflection and questioning of their pedagogical solutions. The following Mind Map summarises what the teachers reflected upon and what questions they raised.
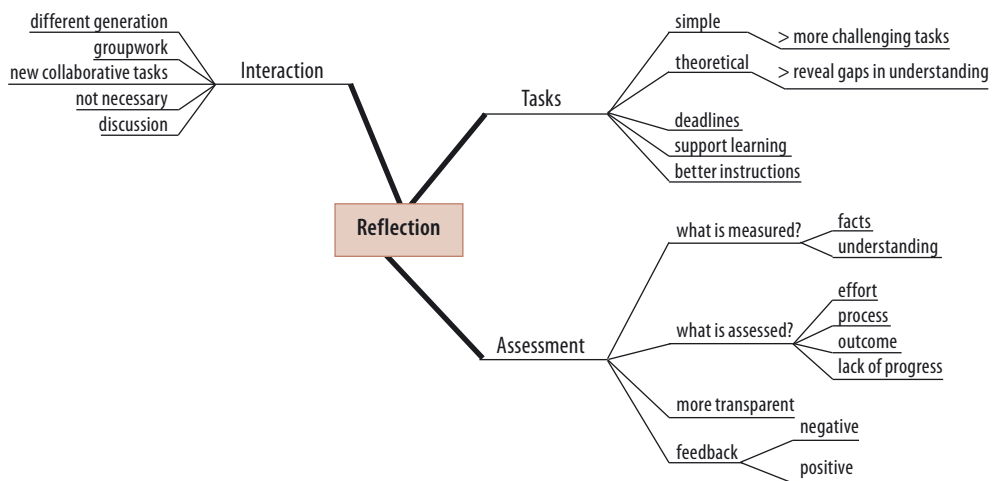
Figure 19.   Teachers' critical reflection and questioning

Interaction, or rather the lack of it, tasks and how well they served their purpose, and assessment were in the centre of these teachers' reflection. What was interaction supposed to be, group work or discussion? Was it possible online or even necessary? What were students supposed to discuss? These were questions teachers asked themselves. Lack of interaction in their courses seemed to have troubled all teachers. Some had already acted upon it (Course 5 teacher had created new collaborative tasks), some had decided interaction was not necessary and abandoned it, some sought an

explanation in the teacher's lack of experience of realtime chats and other forms of mediated communications.

Teachers also held rather critical views of the tasks they had given their students. They questioned their usefulness and found them either too simple, or too theoretical. They wanted the tasks to better support learning through timing and scheduling. Here, keeping deadlines seemed problematic. One of the questions raised was how to write instructions so the learning objective would become clear.

Questions concerning assessment seemed to stimulate most reflection. Three of the five teachers had introduced new forms of assessment instead of, or in addition to, the traditional test that measures end behaviour (reports and seminars, process writing and progress made, crib sheets and presentations). There was also evidence of critical reflection on, whether what was assessed was the increased understanding or factual details, or whether the assessment was transparent enough for students to know what was measured and how it was measured. Some attempts towards peer and self-evaluation could also be detected (especially in courses 2, 3 and 4).

The Course 4 teacher took the interview as an opportunity for critical self-reflection on her pedagogical decisions. The interview became what Kohonen (1999, 58) describes as "*discussing one's beliefs in collegial interaction*" – another sign of transformative learning. It was evident, however, that this teacher had been engaged in "Reflection-in-Action" as well as "Reflection-on-Action" after the course (Ruohotie 1999, 31).

By the time of the follow-up discussion, reflection had in some cases led to improvements in course plans. This was the case in Course 5, where the teacher found questions too theoretical and decided to include some case studies in the course that would also include collaborative tasks to encourage interaction. She had also found a way to utilize theoretical questions to reveal what was difficult for her students to understand, and addressed those problems in her contact lessons.

Course 3 teacher had decided to include more challenging tasks for students, in addition to what she considered too-simple questions.

During interviews and follow-up discussions teachers did not openly reflect on teacher- and student roles, although analyses of interviews indicated that they experienced certain confusion over the changing roles. At the enunciative level, however, teachers seemed to have become aware of the changing roles.

The subsequent misconceptions described above as conceptual change can perhaps be expected to lead to reorganization of existing structures; i.e. the entrenched beliefs about teacher- and student roles. Although this awareness had not yet reached teachers' consciousness in the form of critical reflection, it may perhaps be seen as unconscious questioning of teacher- and student roles – a sign of perturbation in the higher conceptual structures, which will ultimately lead to accommodation and transformative learning. In the following section, this perturbation is looked at more closely.

Teacher- and student roles

Confusion of the teacher's role was manifested in three of the four courses. In Course 2, the teacher seemed comfortable in his role as a coach and facilitator. In the enunciative dimension teachers were omniscient and in control of the world that they described. In the utterance dimension, however, they wanted to hide the omnipotent teacher agent. This contradiction seems to imply that direct teaching was violating a norm.

Alasuutari (1994, 194) states that norms are related to public discussion. Lack of teaching and learning talk, and the hidden teacher agent in the interviews, may suggest that not teaching has become a norm. A norm may be revealed through extensive explanations of one's actions, or choices made, or in a need to defend one's decisions or opinions. Sometimes what is not said reveals an underpinning norm (Alasuutari 1994, 194). Teachers' interviews show examples of defending one's actions, for instance, "*it had to be taught*" in Course 3. Furthermore, in Course 1 the teacher seems to feel a need to defend his decision to control the order of studies. At the same time, he avoids using words related to teaching. He recognises himself as a teacher only once during the interview, and in so doing seems to overly emphasize it as if to challenge the norm. Similarly, in Courses 3-5 interviews, the teacher is hidden, and there are examples of confusion over what a teacher can or cannot do, for instance, whether she can give direct answers to direct questions or not.

The occurrence of a norm suggests that a person has become aware of some of their assumptions or models through reflection, and does not take them for granted anymore. S/he recognises new possibilities, which s/he reveals through a normative expression. Alasuutari says this in Finnish as follows:

> *Normatiivisen ilmauksen esiintyminen on merkki siitä, että jokin toiminta- tai ajattelumalli on tullut reflektiivisen tietoisuuden kohteeksi: ei ole enää itsestään selvää yksinkertaisesti toimia tai ajatella tietyllä tavalla, vaan muut mahdollisuudet tunnistetaan, ja niille annetaan osittaista tunnustusta jollain normatiivisella ilmauksella.*
>
> (Alasuutari 1994, 239)

Apart from questioning the teacher's role, results also show evidence of questioning the student's role in a learning situation. In all courses, an effort was made to give more responsibility to students. Often this resulted in more freedom in studies rather than learning (see Manninen 2003, 31–34). The follow-up discussion with the Course 5 teacher, however, shows how she was able to make her course more student-centred after the piloting phase and how she learnt to use online tasks as indicators of students' understanding. This could only have been possible through careful review of the unsatisfactory experience and critical reflection.

Collaboration

Teachers seemed to have found, and learnt to value, collaboration and co-operation between colleagues. Several manuscripts were produced in a team of two or three teachers, or individual manuscripts were developed as a team effort. Out of the five courses that were investigated more closely, Course 4 was a product of three teachers working together; Course 3 was planned and realized in a team of a teacher and her two former students as assistants, and supported by a team of three other teachers in environmental technology. This team also assisted Course 5 teacher in her planning work, although she produced the online material by herself. Courses 1 and 2 were mostly made by a single teacher, although it must be remembered that during the training programme they, too, had their group's support.

All interviewees emphasized the importance of peer support and collaboration in the training programme and saw it as the best part of the whole experience. Organizing the programme was a collaborative effort in itself with a lot of involvement from participants in the form of providing books, sandwiches, assistance in the gathering of data, and so forth. In the group and individual interviews, teachers reminisced about the fun they had had, the efficiency of collaborative work, and the sharing of ideas that resulted in new realizations:

> *I remember sitting on that sofa, all three of us, sharing ideas and having these sudden realizations!*
>
> (Course 4 teacher)

Collaboration seems to be a skill to be learned. Although all the teachers valued collegial support, there was no evidence of critical discourse and constructive critique on the planned courses, which would have enhanced learning. On the contrary, teachers seemed to feel they could not, or should not give negative feedback on, or even question, each other's pedagogical solutions. Only in the author's journal notes was there any evidence of taking a critical look at each other's work:

> *I also feel that we can give and take feedback on each other's writing without scruple. Collaboration gets easier with time.*

In addition to increased collaboration, interviewees also saw the material they had produced as a resource for other teachers. Some regretted the lack of collaboration between different subject teachers. Kohonen (Kaikkonen & Kohonen 1999, 58) regards all of the above as indicators of transformative learning with teachers.

4.3 Research questions answered

This chapter sums up answers to research questions from different phases of the research. For clarity, each question is dealt with separately. The answers are concise as results are discussed in more detail in the previous chapters. Still, some repetition cannot be avoided. This chapter begins with answers to the two subquestions, which provided baseline information about teachers' use of ICT in instruction and their perceptions of their own learning needs.

Subquestion 1: How do polytechnic teachers make use of ICT in instruction?

In 2001, when the survey was conducted, teachers mainly used the Internet for sending and receiving student assignments via e-mail, and asking students to search for information on the Internet. Few teachers had any experience of online courses either as participants or instructors. Two years later, in Phase III study, teachers produced online courses. ICT was mainly used in making own material available for students, for information search, to produce self-correcting quizzes and to enable instant and/ or individual feedback on tasks. It was not used to promote student interaction.

Subquestion 2: What learning needs do polytechnic teachers attach to online instruction?

Teachers seemed to expect technical support, pedagogical advice, and concrete examples of successful online teaching solutions.

Research question 1: What conceptions do polytechnic teachers hold about teaching and learning?

Results indicate that teachers' conceptions of teaching and learning, to a great extent, still conformed to the behaviourist orientation, although there were also signs of transition. Course 2 teacher was an exception with his constructivist conceptions.

In general, teachers' conception of knowledge seemed to be bulklike. It was something they possessed and of which they wanted to deliver the parts they considered important to students. They were very much in control of knowledge and how it was acquired. This showed in preset goals and logically advancing tasks to which students had to find the right answers. Materials and tasks were the same for all students. ICT helped to reinforce learning by providing immediate feedback. Learning showed in outcomes. At the end, students were tested for their learning gain. (See Chapter 2.1 for typical features of behaviourism.)

At the same time, however, teachers appeared to appreciate autonomous, active students who learn by doing. They did not see students as "tabula rasa" but under-

stood that they all had preconceptions of the subject matter on which they could build new knowledge in social interaction. Teachers also made efforts to find out students' prior knowledge and encourage interaction although not quite succeeding in it. These are examples of a constructivist approach to teaching and learning (Chapter 2.2).

Course 2 teacher's conceptions were mainly constructivist. He saw learning as a process and teaching as facilitating this process. Knowledge was something he constructed together with students.

Research question 2: How do polytechnic teachers' preconceptions affect their views of teacher and student roles?

Constructivisit preconceptions of teaching and learning lead to new kind of teacher- and student roles, where students manage their learning and the teacher acts as a facilitator of learning. Course 2 teacher is an example of a constructivist teacher. He saw his role, on one hand as an organizer of learning opportunities, on the other hand as a teacher whose goal was to find out what students needed to learn and help them achieve their own goals. He also saw himself as one of the learners; he was learning with students and from students.

Course 2 teacher's view of his students was that they were motivated, active learners who each had different kind of prior knowledge of the subject matter and, therefore, needed individual tasks and guidance. He also saw students as capable of taking responsibility for their learning.

Behaviourist preconceptions result in the teacher's role as a transmitter and controller of knowledge leaving little scope for students to manage their learning. Course 1 is a good example of a behaviourist view of teacher- and student roles. The teacher possessed the knowledge and transmitted bits of it to students. He was in control of what was learnt, how it was learnt and how learning was assessed. The teacher was responsible for students' learning and had to "push" them every now and then to ensure they were on task.

Students' role was to follow the preprogrammed learning path, study the same material, produce correct answers to tasks, and pass the final test. The teacher saw students as passive mass, not as individuals.

Most teachers, however, cannot be classified as behaviourist or constructivist but hold views that can best be described as being in transition. Their preconceptions are a mixture of traditional and new orientations to teaching and learning and, consequently, their views of teacher- and student roles are in a process of changing. Courses 3–5 teachers provided examples of changing views of traditional roles.

The behaviourist preconception of teacher in control held ground and resulted in the teacher making most decisions about learning goals, methods, and assessment. At the same time, however, new constructivist conceptions that emphasize student

involvement made teachers view their role as a helper in learning. Despite decisions that had already been made regarding learning tasks, teachers saw students as independent, active learners. In sum, mixed preconceptions seemed to produce mixed views of teacher- and student roles. The teacher's role was to be a source of knowledge (behaviourist), who did not transmit knowledge (constructivist). Students' role was to do what they were told (behaviourist) and to take responsibility for their learning (constructivist).

Research question 3: How do polytechnic teachers' conceptions of teacher- and student roles show in their online instruction?

When teachers conceive their role as being in control, the result can be an online course that is fixed from the beginning; objectives, activities and outcomes are tightly specified in advance. Students respond to teacher's questions and have little or no scope to influence the content. Material is partly prepared by teacher, partly linked to teacher-specified web pages. The main feedback comes from teacher. When teachers at the same time conceive students as independent learners who are responsible for their learning, they step back as instructors and find themselves as helpers in the background. In practice, this means students finding the right answers on their own in the material provided. Teachers are not teaching on an online course. (See Figure 18, p. 186.)

Constructivist views of teacher- and student roles seem to result in an online course which is not fixed at the outset but is built up together with students, partly with material produced by students. General learning goals are specified but learning tasks can be modified to meet students' individual learning needs. Students work in groups receiving feedback from peers and teacher alike. The teacher takes active part in the course monitoring student progress and coaching and guiding when necessary.

Research question 4: What kind of conceptual changes occur among polytechnic teachers engaged in ICT training and online instruction?

Results indicate that when teachers with rather behaviourist conceptions of teaching and learning, but positively inclined towards constructivism, are faced with new constructivist concepts, they adopt the familiar part of the new concepts and disregard the unfamiliar (Figure 18, p. 186). This seems to be a case of learning through assimilation (von Glasersfeld 2002; Vosniadou 1992; 1996). Conceptual changes that follow may lead to misconceptions, as the old concept retains some of its attributes leaving room for only partial assimilation of the new concept. Courses 3–5 provide examples of misconceptions created this way (see Chapter 4.1 for more detailed discussion).

These changes seem to be typical of teachers in transition from traditional classroom teaching to more constructivist web-based instruction. Misconceptions thus created account for the gap between the plan (course manuscript) and the realization (online course). Obviously, once teachers internalize constructivist conceptions (Course 2) they are less likely to develop misconceptions. Results also indicate that teachers with strong behaviourist conceptions (Course 1) resist change and retain their old beliefs rather intact instead of modifying their mental models to assimilate new concepts to the same extent as teachers in transition. However, the example case, Course 1 teacher, never produced online material of his manuscript, so his experience remained partial.

Research question 5: How do polytechnic teachers' entrenched beliefs affect their conceptual change?

Teachers' conceptions of teacher- and student roles seem to be deep-rooted beliefs that constrain their conceptual change and learning of new constructivist concepts. The conception of a teacher in control does not allow a full appreciation of a new concept of a facilitator. Instead, the new concept is modified to fit the prior assumption at least partially (see also Chi & Roscoe 2002; von Glasersfeld 1995/2002; Vosniadou 1996). The old belief constrains the understanding of the new concept thus reducing it to a helper, which is familiar, and retains the controlling part. The result is a misconception of "helper in control."

The entrenched belief of teacher in control also affects understanding another new concept, student-centredness. Attributes, such as students' own goal setting, individual learning needs, etc. which the new concept carries and which contradict the old belief are disregarded. Students still have to learn the answers to the teacher's questions that the teacher considers correct. But, as teaching has given way to helping, in the resulting fragmented mental model of teacher- and student roles, student-centredness comes to denote independent work to find the right answers.

Lastly, teachers' entrenched belief about social interaction with class dominated by teacher's questions and student answers contradicts the new concept of student-student interaction. The only familiarity they find in the new concept is discussions that students carry out outside lessons and, therefore, classify the concept of social interaction as socializing that has no part in learning (see also Chi & Roscoe 2002 for miscategorization of new concepts).

5 DISCUSSION

The paradigm shift in teaching and learning theories is fundamentally a conceptual change. It requires a new understanding of teacher and student roles. If teachers cannot let go of their traditional controlling role, students will not have an opportunity to take responsibility for their own learning.

New methods and technologies are insufficient means to bring about the desired change in teachers' pedagogical thinking and practices unless attention is paid to teachers' existing beliefs and conceptions of teaching and learning as well as theoretical understanding of new concepts. Too hasty implementation of new technologies without proper understanding of their pedagogical use may result in worse learning than before.

History of education provides examples of unsuccessful introduction of new technologies that has been imposed from above by policy-makers and school authorities. Each new innovation in turn, radio, television, film, even the overhead projector, before the computer and the World Wide Web has been embraced as something revolutionary in education – only to turn out to be a disappointment in many cases (Cuban 1986). The reason for the failure of new technologies in bringing about better learning outcomes may have been lack of teacher training in how to use the technologies in new and innovative ways. Hard-pressed teachers in their everyday work may have merely adopted the new equipment into their conventional teaching practices.

A similar tendency can be detected in the requirement to offer more online instruction in polytechnics with introduction of new virtual learning platforms. At the same time, teachers are given more and more responsibilities that take their time away from teaching. This makes pedagogical professional development difficult and begs a question: Is teaching valued in polytechnics?

In the following sections, results of the study are first discussed in relation to what is known about online pedagogy and teachers' changing role. The in-house training programme and the learning platform, WebCT, are evaluated next. Conclusions are then drawn that impinge upon theoretical understanding of teachers as learners; a model of intentional conceptual change is drawn, followed by a discussion on resulting conceptual processes and outcomes. Finally, practical solutions are suggested to promote teachers' professional growth in order to meet the challenges of new professional qualifications.

Progressio ad contrarium

The following discussion pertains only to course manuscripts, five teachers' interviews, and online material produced during and after the in-house training programme, and teacher- and student roles in that context. Therefore, my aim here is not to suggest that teacher behaviour in online instruction can be taken as indication of these teachers' behaviour during contact lessons in the classroom. Results indicate that teachers' pedagogical thinking is in transition, but results do not show how far the transformation has proceeded in classroom teaching. In fact, interviews and follow-up discussions implied that teachers might have been much more constructivist in their contact teaching, and that the technology limited their repertoire.

Analysis of course manuscripts and online material shows that the change from teaching to learning remained at the level of "progressio ad contrarium." Grimmett (2000, 72) gives an example of this strategy in use, when the names Unemployment Office and Welfare were changed to Employment Office and Social Services, respectively, in an attempt to make the ills of the old system disappear along with the name – which did not happen, as Grimmett points out.

The gap between the new constructivist terminology in teachers' course manuscripts and the actual realization of online instruction is somewhat similar to the change of names in the abovementioned services. Teachers described their own role as a facilitator, students as independent learners, and emphasized the importance of social interaction in their courses. Despite this new terminology, the teaching approach remained traditional. Possibilities that ICT in instruction offers for meaningful learning were not realized. Most courses were fixed, unchangeable, while they were running; teachers decided what was learnt, whose questions were answered, how it was learnt, what was assessed, how, and by whom. There was no dialogue between students or between students and teacher.

As discussed earlier in this paper (Chapter 2.6), the teacher's role in online instruction is manifold: *facilitator, organizer, communicator, expert*, and *motivator*. Calling themselves facilitators did not change the fact that teachers in online instruction were not able to give their students the space they would have needed to become autonomous learners, or guide them in the process of growing more self-directed. All but one teacher failed in this respect. Teacher- and student roles remained traditional in essence, though students worked independently, and teachers helped in different ways. In their role as facilitator, teachers seemed to have skipped the early stages of coaching and scaffolding and moved directly to "*assistance only when requested*" (Ruohotie 2000c, 14).

It seems that teachers in their role of organizer were facilitators of studying rather than learning (Manninen 2003, 31–34). Ground rules were set and explained to students, teaching material was logically arranged, navigation was made easy, and many times students had a choice to cover material in whatever order they wished,

and within certain deadlines, also where and when they wished. This gave students freedom in their studies, but as mentioned before, their hands were tied as regards decisions on their learning; goal setting, learning strategies, and so forth.

Teachers communicated with students via e-mail and feedback tools. Although they did not succeed in creating and maintaining learning networks between students, the feedback they gave to students was personal and detailed. Therefore, even though social interaction between students was mostly missing in the online course, interaction between individual students and the teacher increased, and the teacher was thus able to better monitor student learning. (See also Pulli 2003.)

Teachers acted as experts in their fields pointing out the shortcomings in the students' understanding and performance, and suggesting better solutions. On the other hand, modelling expert behaviour in solving complicated problems was mostly missing. This is in accordance with previous research (Pulli 2003).

Where these teachers were perhaps most unsuccessful was in their role of a motivator. Motivation was mainly through obligation; "*I didn't really need to motivate them. Since they had to do the tasks, they did,*" said one teacher. Most researchers agree that the teacher creates an active learning environment by being very much visible and present in an online course. The teacher's participation motivates students to become actively involved in learning (i.a. Bonk et al. 2001; Jonassen 1999; Manninen 2003; Mannisenmäki 2000; Matikainen 2001; Mäyrä 2002; Nevgi & Tirri 2003; Tammelin 2004; Tella et al. 2001). As results suggest, apart from the personal feedback that teachers provided, they mostly remained invisible in their online courses.

For all these teachers this was the first experience in online instruction, which mainly explains the outcome. Pulli (2003) found out in a very similar study with polytechnic teachers that those teachers who had little online teaching experience tended to make their online courses ready, or fixed, before the course began, whereas those teachers who were more experienced in online instruction were able to "let the course float", i.e. they were able to adjust online material to their students' changing needs. It seems safe to assume, therefore, that here as in many other cases, practice improves outcome, and the knowledge these teachers gained in piloting these courses is going to help them develop their online teaching in the future.

Contribution of technology and training

Perhaps the first question to be raised is, whether the learning platform used, WebCT, could provide for a constructivist online course. The answer must be affirmative. In Chapter 3.2 Web Course Tools is described in detail with a conclusion that software does not dictate the teaching approach. It has tools for dialogue and collaboration (E-mail, Chat, Discussions, Students Presentation area) as well as tools that can be used to promote students' metacognition and self-regulated learning (My notes, My progress).

However, teachers found WebCT difficult to master. All but one teacher needed assistance from technical support personnel in the technical realization of the online course. The teacher who did not need help produced the only truly constructivist course. This may explain the inflexibility of the other courses to some extent. If teachers feared that they might not master the technology, they wanted everything ready by the time the course was to begin. For the same reason, changes were not possible while the course was running. Teachers were dependent upon the help of technical personnel, whose availability could not be guaranteed at a very short notice. Bennett and Lockyer (2004) also found that the dependence upon technology influences all aspects of online teaching.

Having to involve technical personnel is an added complication to course design, even though they can offer valuable insights as regards technical implementation, visual appearance, and usability. Not many teachers are experts in how to present information on web pages, for instance. However, such a situation moves the power from the teacher to somebody else. This limits the choices teachers can make. They can only follow the advice given by technical personnel regarding, for instance, what is possible to do and what is not, what is the best way to realize the plan. If technical support personnel do not have pedagogical training the solutions they suggest, although technically fully functional, may not be pedagogically valid.

This is not to say that, in this case, technical personnel gave bad advice. The intention is, rather, to seek an explanation to why these teachers may have felt outsiders in their own courses, and to draw attention to the importance for teachers' mastery of technology, at least to the extent that they can make necessary alterations themselves.

Evaluation of in-house training programme

The in-house training programme was designed to model a constructivist learning experience and foster transformative learning. Results show, however, that there was hardly any transfer to participants' own courses. A case in point is the teachers' appreciation of teamwork and collaboration, which they felt was the best part of the training. Still, they did not organize collaborative activities in their own courses.

The in-house training programme was structured round participants' own online projects. Online pedagogy was introduced in the form of lectures and literature, and new information was processed in groups immediately after lectures involving each participant's own course plan. In addition, groups met once with the consultant and weekly on their own. The Studium environment contained reflection tasks on subjects covered in the lectures and literature.

In hindsight, it seems there might have been a need for more than one consultation in groups. Groups met weekly to discuss their own course plans and share ideas. The aim was to encourage critical discourse, dialogue, and critical self-reflection.

Dialogue did not take place. Teachers did not critique each others' courses or question the premises of their own or others' pedagogical solutions. Interaction may have remained on the level of conversation.

An expert consultant should perhaps have taken a more active part in creating dialogue and sustaining it, as teachers were obviously unaccustomed to critical discourse. Rogers (2001) also calls for *a skilled facilitator to guide participants through the process of reflection*. Cranton (2000) discusses a variety of group activities to foster self-awareness and transformative learning that might have been employed. The consultant could have steered the discussion to theoretical underpinnings of teaching and learning, scaffolding when necessary in the zone of proximal development, assisting teachers in conceptualizing of their experience, and encouraging critical reflection. This could have been based on literature that participants had been given as well as information from lectures.

Reflection tasks in the Studium environment challenged teachers to consider their own views and plans against new theories of learning, but reading and reflection tasks remained participants' own responsibility quite separate from the structured meetings. Thus, reflection during training was "looking in the mirror" at best, which, according to many researchers (Bengtsson 1996; Kauppi 1998; Ruohotie 1999), is not enough to effect change. A more visible and active facilitator would perhaps have been needed in guiding reading and encouraging reflection, for instance, in online discussion groups, where participants could have practised interdependence and dialogue.

Weekly group meetings would have provided a suitable forum for meaningful dialogue to take place possibly fostering new understanding of commonly recognized concepts. For instance, group members could have talked about their understanding of the teacher's role as facilitator. What did it entail? How did this new role show in the tasks they had planned for their courses? This might have invited critical comments from other group members, if clearly the tasks did not portray facilitator but controller, for example. Suggestions on more open tasks could then have been made. To achieve this level of interdependence and dialogue, groups would have needed much support from the expert consultant.

The training programme lacked an online experience. The Studium environment contained tools for informal as well as study-related discussions and participants were encouraged to make use of them, but online activities were rare. On the other hand, teachers met daily at work and weekly in meetings. This was why there was no real need to communicate via the Internet. This was an oversight in the design of the training programme. Creating a real need for these teachers for online interaction would have been paramount in modelling the kind of networking and collaboration that online instruction can make possible. Perhaps some of the weekly group meetings could have been replaced by an online session with the consultant. The experi-

ence that the participants had may have reinforced their own assumptions that social interaction in an online course does not work.

Some teachers felt the training programme remained too theoretical and did not provide enough concrete examples of good practice in online instruction. Teachers often want examples they can then apply to their own teaching (author's own experience). However, what works for one does not necessarily work for all. Therefore, it is important to understand the theory behind the example; why the example works well, what kind of learning it promotes, etc. Otherwise, one may end up abandoning a good method or learning task without really understanding why it failed.

Thus, it is more important to understand theory before putting examples into use. In that respect the theoretical part of the training was justified. In fact, there might have been too little theoretical discussion. As Kohonen (2000, 139) points out, teacher learning should be "*connected with actual teaching, supported by ongoing theory building.*" (See also Luukkainen 2004b, 97.) Bearing in mind that participants' teaching approach was assumed to be rather traditional at the outset, more attention should have been paid to ensuring that the new concepts were understood correctly. Perhaps naively course manuscripts full of constructivist terminology were taken as evidence of conceptual learning.

Where training succeeded, however, was in promoting collaboration, making time for pedagogical talk, and providing technical and pedagogical support. The importance of mutual time for teachers to deal with pedagogical issues, to generate new ideas in collaborative work groups, and to receive collegial support in experimenting with a new method cannot be underestimated. In fact, this is seen as a prerequisite for school development (Kaikkonen & Kohonen 1999, 57; Kohonen 2000, 140–41).

Despite its shortcomings, the training intervention served as a necessary support for these teachers to plan their first online courses. Many of them might not have even started such a project without support. With regard to changes that did not take place in teachers' teaching approach, one could refer to Aarnio and Enqvist (2004, 56) who have stated that the course – in this case teacher training – has been successful if it has made students even consider examining their own practices and behaviour. In this case, all teachers took time to deliberate on what was good in their online material and what was not satisfactory. As a result, they all wanted to further develop their teaching, and as shown in the follow-up discussions, some had already made radical changes for the better – not just online, but in their classrooms as well.

Finally, transformative learning takes time. The half-year period that the in-house training lasted can only be regarded as a stimulus for critical reflection and learning.

> *Changes of the magnitude of paradigmatic shifts in teacher thinking, pedagogical action, and school culture do not take place overnight; they are inevitably a function of time in any profession.*
>
> (Kohonen 2000, 141)

Results also indicate that conceptual change had begun. The fact that the effect the change process had on outcomes was not yet the desired one may very well trigger a review of the situation that ultimately leads to accommodation, and transformative learning. Signs of this could already be detected in follow-up discussions. Pedagogical and theoretical content of the training intervention, though perhaps inadequate, may still have provided teachers with tools to start conceptualizing their online experience better than before.

Expertise threatened

The fact that teachers practically disappeared from their online courses was unexpected. This may be connected to teachers' deeper concern about their changing role in the educational field as their work descriptions change and new requirements are imposed upon them, leaving less time for the basic teaching task for which they have been trained. Teachers may feel teaching as such is not valued anymore.

In this research, a "facilitator" appeared instead of a teacher, who mainly remained backstage and whose range of action seemed very limited. It seemed as if these teachers had interpreted the two concepts, "teacher" and "facilitator" as paradigmatic oppositions, mutually exclusive (Silverman 2001, 199); one can be either teacher or facilitator, not both simultaneously. A facilitator was associated with learning, which then implied a contrast between teaching and learning. Thus a "facilitator" almost became an antonym of a "teacher."

This kind of binary discourse is common when something is percieved as threatening. The stronger the contrast is, the more stereotyping occurs, i.e. oversimplifying a conception (Törrönen 2004). This seems to have happened with the concepts "teaching" and "facilitating." "Teaching" has come to connote behaviourist transmission of knowledge (Mannisenmäki 2003, 41). It appeared in results as reluctance to give answers to students' direct questions and in the way that the verb "teach" was only used in negative collocations, if at all. "Facilitating," on the other hand, seems to have been understood simply as helping whenever students asked for help.

It seems that the very core of the teaching profession is touched when conceptions of teacher- and student roles are in transition. Experienced teachers are experts in their field. Therefore, when there is confusion of concepts in teaching and learning, the whole expertise may be threatened. Feelings of inadequacy, even incompetence, may surface. Suddenly, expert teachers feel they do not know what to do. They have been trained to teach but teaching seems out of the question.

In online instruction, there may be many factors that together build up the feeling of threat. The web-based environment in itself is unfamiliar. It is distant and revealing. Experts "*tend to avoid unfamiliar situations,*" instead "*they act in ways which will give them control over situations*" (Ruohotie 1999, 43). Maybe the fear of losing control is what threatens teachers most. Distance may contribute to fear of losing

control over students and their learning. Technology involved in online instruction, which teachers do not master, may additionally cause concern about losing control of pedagogical solutions.

The Internet is revealing; teaching becomes transparent, everything is documented. Other teachers can see what you are doing with your class. In fact, anybody who has access to the virtual learning environment can see. For traditional teachers, who are used to working alone in their classrooms, this can be threatening.

Ruohotie (1999, 43) points out that in education "*professionalism is often confused with perfection or even omnipotence*." Similarly, the results of this study strongly indicate an omnipotent teacher image. This may result in expert defensiveness, which prevents learning and change. Experts are usually enthusiastic about promoting learning through new systems, but "*even the possibility of their own role being examined critically*" or, with teachers, "*any confusion about how learning occurs*" (Ruohotie 1999, 43) makes them feel uncomfortable.

Finally, teachers may experience theories as threatening:

> *Teachers feel theory is threatening because it is produced by a group of outsiders who claim to be experts at generating valid knowledge about educational practices.*
>
> *It negates their professional culture which defines teaching competence as a matter of intuitive craft knowledge, tacitly acquired through experience.*
>
> (Elliot 1996, 41–45)

In other words, the emphasis of theoretical knowledge may make teachers feel their knowledge acquired through experience does not count; as if they knew nothing themselves.

Expert defensiveness is clearly an obstacle to learning. It can perhaps be considered what Jonassen et al. (2005) call a rejection factor, affecting the disposition to change conceptions; tendencies to, for instance, exclude, ignore or reinterpret the cognitive conflict. The other two factors that have bearing on conceptual change, according to Jonassen et al. (2005), are generic factors, e.g prior knowledge, and acceptance factors; ability to interpret the experience.

The following chapters first look at teachers as learners, and how experience-based knowledge (generic factor), and teachers' metacognition (acceptance factor) affect conceptual change.

Experience-based knowledge

The design of the in-house training programme relied heavily on experience; participating teachers enjoyed many years' experience in classroom teaching; the training programme provided an experience of constructivist learning, and finally, teachers had a first-hand experience with online instruction.

It is easy to assume that experienced teachers are probably in a better position to manage online instruction than novices. They have more experience-based knowledge of teaching in general and are likely to have developed certain class management skills and a deep understanding of the taught subject. Pulli (2003, 47) also points out, how teachers in her study generally made their pedagogical decisions based on intuition, and teaching and working experience.

Teachers under study here had most likely been taught in a traditional way. They may then have repeated that model in their own teaching for many years. Interpretations that they had made of outcomes had been based on the conception of traditional teacher- and student roles. These are the filters that may have distorted their interpretations of the training and online experiences. A case in point is teacher control. Previous experiences may have led teachers to believe that students need to be tightly monitored and controlled by the teacher in order to stay on task and learn.

In this light, it is logical that teachers mainly valued students' independent work on tasks. Control was inbuilt in the course, since tasks had to be completed to pass the course. No special motivating was needed, as one teacher pointed out. Here the learning platform proved very helpful; it was easy to monitor whether or not students were doing tasks.

Experience-based knowledge affected both teachers' expectations of online instruction and interpretation of outcome. If teachers were not entirely satisfied with students' performance, their interpretation was that the tasks were too simple or too theoretical. They never questioned the basic premises, i.e. whether the tasks were too teacher-specified or too closed, for instance. The premise was the traditional "teacher asks, students answer" -model.

The same applies to creating social interaction online. Interaction in a traditional classroom is mostly an exchange of questions and answers. Freire (1985, 72) calls traditional teaching "banking education," which resists dialogue. Students live in a "culture of silence." They are allowed to ask topic-related questions, but discussions in class, if they occur, are usually about something not related to the subject. In accordance with their experience, teachers had created possibilities for students to ask questions or talk about something else via provision of a discussion forum. When nothing happened, the conclusion drawn was that discussion was not necessary in this course, since students could ask their questions when they met each other and the teacher face-to-face, or that discussion just was not necessary in this particular course at all.

All teachers were concerned about the lack of interaction in their courses, and agreed on the difficulty of creating it online. They had, after all, gained personal experience during the in-house training programme of failed online discussions. However, teachers did not question why interaction might be needed, what purpose it could serve in learning, or how to facilitate interaction. Transformation of this ex-

perience would have required looking at it through new lenses. Now, instead, it may have strengthened existing assumptions.

## Metacognition and need to change

An intrinsic element in constructivism is learners' active involvement in the process of learning, not merely in studying, i.e. doing required tasks. Active involvement implies intentionality. What intentions did teachers have in terms of learning? They wanted to learn to make online courses that would perhaps improve learning outcomes. They wanted pedagogical support mainly in the form of good practice examples, and feedback on their own plans. In a way, teachers wanted to know the right answers to questions about online pedagogy.

This research suggests that these teachers did not possess the metacognitive knowledge of what they did not know in order to engage in "intentional conceptual change," a term that Ruohotie uses when discussing self-regulation abilities (Ruohotie 2003, 267; 2005, 6). Thus, teachers were not aware of discrepancy between their existing conceptions of teacher- and student roles, and new constructivist concepts. Consequently, they did not recognize the need for change. Instead, they focused on surface-level practical competencies; how to produce an online course, how to operate in a virtual environment, how to give feedback, and so forth. According to Ruohotie (2003, 269) intentional conceptual change is possible if:

> Learners regulating their own change processes are aware of their own knowledge and beliefs, and are willing to change in a way that helps in attaining their goals. They can also a) see the gap between their own knowledge and the alternative views, b) understand the need for change, c) perceive what needs to be changed, ….

Teachers were planning online material but may not have been planning their own learning. Their goal was obviously to create an online course, not to change their conceptions of teaching and learning.

Mezirow (2000, 8) describes such task-oriented problem-solving as "instrumental learning," the purpose of which is to improve performance. The actantial model can be used to illustrate teachers' beliefs about what they needed as follows:
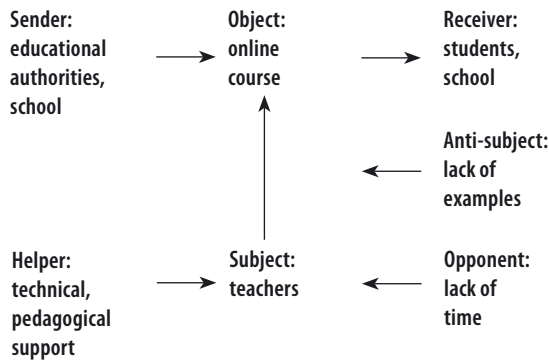
Figure 20. Actantial model of teachers' instrumental learning

Results of the 2001 survey, as well as interviews before, during and after the in-house training programme, all indicated that teachers wished to have pedagogical and technical support while attaining their goal of producing online courses. They usually complained about lack of time to work on the project and felt they did not have enough examples to go by. Interviews also revealed that teachers saw online learning as a new trend in education and, therefore, felt the need to update their skills. On-line courses were also considered more interesting and perhaps more motivating for students.

The actantial model, therefore, shows that teachers valued a concrete outcome, an online course. The pressure comes from educational authorities and their own school, which wants to survive in the tough competition. Teachers seemed to believe that the only obstacles preventing them from creating good online courses were lack of time and good practice examples.

Reflection

Self-reflection plays an important role in transformative learning. It helps to make meaning of the experience. There was evidence of reflection-on-action, retrospectively after the online experience, in teachers' interviews and follow-up discussions.

Reflection mainly focused on practical matters such as usability and task function, assessment and lack of interaction. However, there was also evidence of some critical reflection upon the very premises of one's own action. This was clearest in teachers' reflections on what they were measuring and assessing.

Teachers did not seem to have consciously questioned their own conceptions of teacher- and student roles at any time during their online experience. There was evidence of efforts to give students more freedom of choice concerning their studies, for instance, in which order they completed the tasks. This change, however, was rather

superficial since students still maintained their role of being told what to do and how to do it. Still, it may be a beginning of change.

In this connection it must be remembered that the present study could not capture real-time reflection. This might have been due to unsuccessful organization of the research (there were no interviews while the online courses were running), or poorly managed research instruments (workshop diaries), or the fact that real-time reflection did not take place. Nevertheless, if teachers had critically reflected on teacher- and student roles during their online instruction, it is likely that it would have come up in the interviews and follow-up discussions. One teacher seemed to confirm this apparent lack of critical questioning of teacher- and student roles by stating during the follow-up discussion that

> *I guess I have changed as a teacher over the years, and I suppose I have a view of a teacher's role deep inside, but I haven't really thought about it.*

Ruohotie (2003, 257) argues that retrospective reflection on action is not enough in today's rapidly changing world; reflection must take place during an action so that it can have an impact on it. In this case, as teachers pointed out several times, nothing could be changed in the online course after it had started. This might have discouraged reflection-in-action. However, recognizing successes and failures afterwards can still help improve the course for new students.

Teachers' reflection primarily focused on outcome, the online course and how to improve it, not on their own learning process or existing conceptions. This is congruent with their beliefs about what they knew and did not know. Instrumental learning focuses on a better performance, a concrete, improved outcome of activity such as teaching, for instance. According to Mezirow (2000, 9), frames of reference can be transformed in both domains of learning, instrumental as well as communicative learning. The transformation, however, presupposes critical self-reflection and perturbation in meaning schemes; learners must become aware of their need to change.

The following chapter challenges the teachers' beliefs and suggests that, for teachers to produce meaningful online courses their learning goal should be a new understanding of teaching and learning involving new conceptions of teacher and student roles.

Teachers' intentional conceptual change

For conceptual change to occur learners must be willing to change. An initial dilemma, or cognitive conflict, may serve as trigger but be insufficient to bring about conceptual change. Researchers agree that learners must be aware of their need to change (Chi 2005; Chi & Roscoe 2002; von Glasersfeld 1995/2002; Jonassen et al.

2005; Mezirow 1990b; 1997; 1998; 2000; Slotta et al. 1995; Ruohotie 2003; Vosniadou 1996).

Prerequisites for transformative learning are 1) identifying prior assumptions, 2) making the assumptions explicit and 3) questioning the assumptions in critical discourse and critical self-reflection. Research findings indicate none of these pre-requisites occurred. Tentatively, it can be suggested that teachers became aware of new concepts such as "teacher facilitator," "student-centred instruction," and "social interaction." However, they were unable to see the discrepancy between these new concepts and their existing beliefs, and recognized only what was familiar in them.

In Chi's (1992) terms these teachers were trying to reorganize concepts within the same ontological category, assigning new features to existing concepts which produced a new misconception; e.g. a controlling teacher changed into a controlling helper. The teacher's role did not fundamentally change, since no radical conceptual change took place. Another example of a conceptual change within the same category, according to Chi (1992, 142), is changing perspective. During interviews some teachers said they were now looking at course material more from students' perspective.

New concepts do not evolve from existing ones. Radical conceptual change requires understanding the new category and realizing that the concept does not belong to the category, in which the learner has assigned it (Chi 1992, 133–138). It seems that teachers assigned the new concepts in their existing categories without fully understanding that they did not belong there.

Learning as an intentional conceptual change presupposes metacognition of what must be learnt, volition, i.e. a desire to change, and self-regulation of the learning process (Limon & Mason 2002, xv; Ruohotie 2003, 268–269). Mezirow (1990b, 354–355) also points out that reflective discourse and the resulting insight do not make transformative learning, but learners must have a will to act upon their new convictions. In terms of teaching and learning, teachers should recognize the need to change their traditional conceptions as their goal of learning, be willing to pursue that goal, and continuously monitor and evaluate their change process, for instance, reflecting on their own pedagogical solutions in light of the desired change.

A new actantial model can thus be drawn to illustrate intentional conceptual change:

```
Sender:                Object:                Receiver:
paradigm shift    →    transformed       →   school, students
ICT                    conceptions            online course
professional
qualifications                                Anti-subject:
                                         ←    entrenched
                                              beliefs

Helper:                Subject:               Opponent:
theory            →    teachers          ←   lack of mutual
dialogue               students               time
critical self-reflection
```
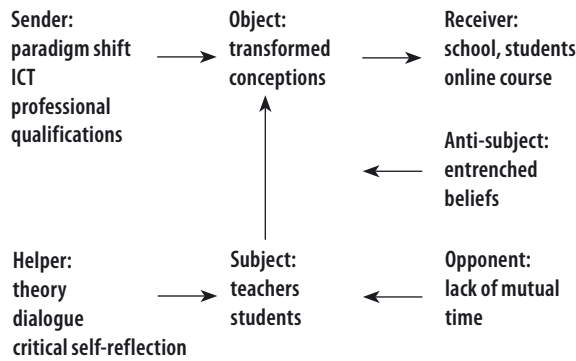
Figure 21.   Actantial model of teachers' intentional conceptual change

The requirement to change comes, on one hand, from the paradigm shift in theories of learning and, on the other hand, from a paradigm shift in working life, where new professional qualifications call for skills that cannot be acquired in traditional education and training. Furthermore, information and communication technologies enable the kind of teaching and learning that prepares students for the Information Society. It is up to teachers to learn to utilize new technologies in a meaningful way. All this necessitates a conceptual change among teachers. Central conceptions that need to be reviewed are teacher- and student roles.

Intentionality is illustrated in the model by placing teachers as subjects. Their aim is not merely to learn to do, i.e. to produce an online course, but to engage in communicative learning (Mezirow 1990b, 7–9); to understand the meaning of the new theories of learning. Their object is to transform their conceptions of teaching and learning. They realize that their entrenched beliefs, for instance, about teacher and student roles, filter their learning experience and may prevent them from thoroughly grasping the meaning of the new concepts.

Teachers seek help in their transformation process from interdependent collegial dialogue based on study of learning theories, which helps them to see various characteristics of new concepts, not merely the familiar part that may conform to old beliefs. The new understanding is a result of mutual deliberations and critical self-reflection.

Theoretical understanding alleviates insecurity at the beginning of the transformation process and enables teachers to see their own successes and failures in a new light. Theory provides concepts to describe and understand the experience, i.e. to conceptualize the experience. This means that one can put a name to tacit, formless, experience-based knowledge once it enters one's awareness. Experience-based knowledge as well as beliefs and assumptions are easier to make explicit and review during a collegial dialogue when all participants draw on common concepts. Moreover, if teachers possess theoretical understanding of their own learning process,

they might better understand students' reactions, deal with them in a constructive way, and promote students' conceptual change.

Chi (1992, 142) has outlined the process of radical conceptual change, which has three steps. The steps are presented below with reference to learning constructivist theory and its embedded concepts.

1. Learn the new ontological category's properties via acquisition process.

This means studying the constructivist theory including inherent etymological principles using whatever learning strategies learners find most effective.

2. Learn the meaning of individual concepts within this ontological category via acquisition processes.

This means ensuring that new concepts, such as "facilitator," "student-centredness," "social interaction," "scaffolding," "peer evaluation," etc., are understood in their true meaning.

3. Reassign a concept to this new ontological category in one of three ways:
a. Actively abandon the concept's original meaning and replace it with the new meaning;
b. Allow both meanings to exist separately;
c. Replace the original meaning automatically.

This last step means, for instance, reassessing the roles of teacher and student in a learning situation and assigning the concepts to a new constructivist category in which they inherit the new attributes belonging to that category; teacher facilitates, students set goals, and so forth. Intentionally rejecting the existing old conception (alternative a.) and replacing it with the new one seems the most likely process of change.

In the actantial model students are placed as subjects alongside teachers. This is to suggest that not only teachers' but also students' conceptions and expectations about teaching and learning must change. Essential in the new understanding is seeing teachers and students as participants in the same learning process. Students may also hold traditional beliefs about teaching and learning, which seriously impedes them from taking responsibility for their own learning (Mällinen 2005). Teachers and students are set side-by-side as subjects in the actantial model to illustrate not only the fact that both need to change, but also teachers' facilitating role in gradually coaching students towards self-directed learning.

 In addition, students' goal is also to really understand the new concepts pertaining to the phenomena they study. For students the object is twofold; learning to learn (transformed conceptions of teaching and learning) and learning to conceptualize the professional subjects they study. These two objects need not be separate things,

but could be intertwined in a meaningful learning experience. Kolari and Savander-Ranne (2000; 2002) give some practical solutions for this purpose.

The online course in this model is placed at the receiving end together with the school and students. The most desirable goal, revealed in the subject-object relationship, is transformed conceptions, which may lead to the transformation of a teacher's whole frame of reference, i.e. transformative learning – not the production of a concrete online course as such. If teachers' conceptions of teaching and learning are transformed, the results will show, not only in their online instruction, but in all interaction with students in physical as well as virtual classrooms, and outside them. Ultimately, this is likely to effect change at the school level.

Conceptual change takes time. Entrenched beliefs die hard. This is because frames of reference consist of conative, cognitive and affective constructs. Teachers may become aware of the need to change through metacognition, they may have a willingness to change, but their feelings must also be accounted for. Perturbation on the level of meaning schemes can be frustrating, even frightening (Kohonen 1999; Mezirow 1990b; 2000; Ruohotie 2000b; 2003), and where teaching is concerned, teachers may be questioning their own expertise in light of the new knowledge.

Teacher collaboration in vocational education is currently seen as a prerequisite for pedagogical development and in planning the curricula to better meet the changing working life (Stenström & Nikkanen 2005, 6). Cochran-Smith and Lytle (1992, 306) emphasize the importance of mutual time in all staff development:

> When the pace of a community's work is unhurried and when members of the group make a commitment to work through complicated issues over time, then ideas have a chance to inculcate and develop, trust builds in the group, and participants feel comfortable raising sensitive issues and risking self-revelation.

According to Kohonen (2000, 141) increasing pressures in teachers' work without proper time resources to deal with them may result in the feelings of powerlessness, frustration and even professional crises.

Therefore, lack of mutual time is seen as the main opponent in intentional conceptual change. The present organisation of work in the polytechnic does not encourage interaction between teachers (see also Ruohotie 1999, 34). In fact, it is almost impossible to find common time to deal with even the most urgent matters, to socialise in a more informal manner and share experiences during the working day, let alone to reflect on and analyse experiences in supportive groups

Conceptual change processes and outcomes

Through transformative learning teachers' frames of reference can become more flexible and more inclusive allowing new conceptualization of teaching and learning. Thus the new, more inclusive teacher -concept encompasses teaching content

and learning skills; the word "teacher" comes to signify "teacher-facilitator." This presupposes, however, that the controlling aspect of the existing teacher concept is recognized and found incongruous with the new understanding.

Similarly, the other key concepts discussed earlier can become transformed, if the constraining beliefs are recognized and rejected allowing the existing concepts to be enriched. The flawed mental model is repaired. Thus the existing conception of "student" as somebody who is taught the right answers drops the "right answers" element. Also, the traditional conception of interaction in class, which takes the form of "teacher asks, students answer" is restructured so that the one-way interaction gives way to something else. The following figure illustrates the resulting conceptual outcomes and how they might show in an online course:
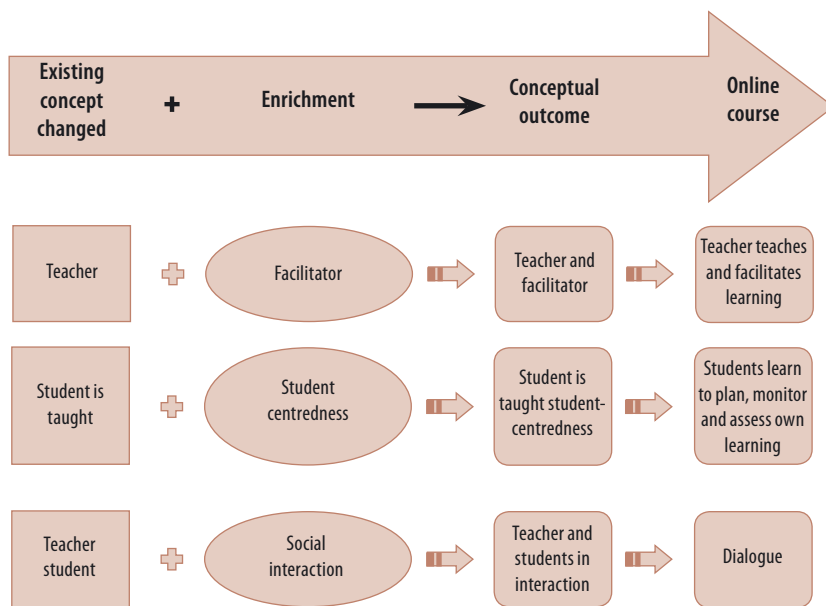
Figure 22.   Conceptual change processes and outcomes

Figure 22 is a modification of Figure 18 (p. 186), which presents learning through assimilation. The terminology has been kept the same to illustrate how the removal of constraints on the conceptual level can radically change the outcome.

In the transformative conceptualization illustrated in Figure 22, the existing concepts have changed so that they do not constrain the understanding of the new constructivist concepts anymore. The new concepts in this model are seen as enrichment to the repaired mental model that is open to new information. Consequently, the outcomes are more inclusive, not altogether different. This process of enrichment is

slightly different from the one that Vosniadou (1992, 150) and Chi and Roscoe (2002, 10) discuss in connection with assimilation, where "enrichment" refers to adding to and extending the existing conceptual structures.

In this model, the new concept is a teacher-facilitator, who teaches and facilitates learning. A student is still taught, which may sound behaviourist, but does not have to be so. Given the fact that the teacher is still allowed to teach, students are inevitably taught. <u>What</u> they are taught makes the difference. Students are taught student-centredness, i.e. metacognitive and self-regulation skills so that they can take responsibility for their own learning. For instance, instead of seeking right answers to clearly defined problems, they are now taught to ask questions to find what the problem is. As Ruohotie (2000b, 215) points out, the skill to ask the right questions may be more valuable in this changing world than the skill to answer given questions.

The change from traditional classroom interaction looks perhaps somewhat arbitrary in the model, the "ask-and-answer" parts having been removed, leaving the teacher and students without any indication of their roles. However, they exist side-by-side as in the actantial model for intentional conceptual change. The purpose is to describe openness to various interactive solutions. The "teacher asks, students answer" -conception is constraining in a sense that it does not allow any other kind of interaction. Without this kind of constraints social interaction between students and students, and students and teacher, can take many forms, and at its best result in a dialogue where they all function as equals.

The conceptual outcomes are transformed conceptions which are more inclusive than old ones. This is an example of constructivist and transformative learning, where teachers not only acquire new skills and new information but change as teachers. As a result, they see themselves both as teachers and facilitators, teaching content and teaching students how to become aware of what they know and what they need to learn, how to monitor and assess their own learning, and so forth. At the same time, teachers facilitate learning by modelling and scaffolding, organizing learning networks, creating meaningful learning environments, motivating. These changes are reflected in an online course, where all participants – teachers as well as students – are more actively involved.

6 FINAL REMARKS

Teachers' role in promoting learning in physical as well as virtual classrooms is undisputed. Students still need teachers and teaching (Järvelä, Häkkinen & Lehtinen 2006). The role of the teacher is emphasized in Vygotskian zone of proximal development, and even more so in technology-rich learning environments (Tella & Mononen-Aaltonen 1998). The question is: What is it that teachers should teach?

This question answered has a bearing on what teachers see as important to learn. Kreber et al. (2005) found in their study of university teachers' self-regulated learning about teaching that many instructors did not see themselves as learners about teaching but as learners about the subject that they taught. Leinonen (2007) also found that especially teachers in the field of engineering tended to focus on the contents of teaching, the subject matter, rather than pedagogies, and did not feel the need for updating their pedagogical thinking. This seems to be the case with polytechnic teachers as well; they do not see the need to change as teachers.

Nevertheless, changing the way we teach may be exactly what is needed in transforming polytechnic education. In addition, in order to change the way teachers approach their teaching, there seems to be a need to change how they conceive teaching and learning (Ho et al. 2001). This, in turn, may gradually impact on students' learning approaches and lead to better learning outcomes. Trigwell et al. (1999) report on relationships between teachers' approaches to teaching and students' approaches to learning. A teacher-focused approach seemed to coincide with students' surface learning strategies, while a more student-focused approach coincided with students' deep learning approach. Results were based on teachers' and students' own reporting, which is why researchers are cautious with causality conclusions. The relationship was evident, however. Ho et al. (2001) had similar results in their study on conceptual change approach to teacher development.

If we accept that language not only describes reality but also creates and maintains it, it is important to pay attention to how we talk about online instruction and teaching in general and what we mean by the words we use. If "teaching" disappears from educational and public discussion (online "instruction" being a perfect example of the language used), or if its connotation is obsolescence, it is no wonder that teachers feel threatened, not really knowing what is expected from them.

With the introduction of new learning theories and new pedagogies, focus has shifted from teaching to learning. This emphasis on learning in the language is likely to gradually affect practice as well. This, however, does not mean that learning

should take place without teaching and without teachers. It does not mean that students should be left alone with their learning tasks. What it means is more teaching, more challenges for teachers.

Admittedly, constructivism is sometimes taken to extremes in its notion of student-managed learning. Educators may leave the whole learning process up to students with a general instruction to define their goals, collaborate with other learners, decide on what and how they are going to study, how they are going to assess their learning, and present the outcome (the author's own experience from different teacher training courses). No doubt, highly motivated students with metacognitive and self-regulation skills could cope with such a very open assignment. Most of us, however, might find too much independence frustrating.

Teachers can provide students with scaffolding and support on their way to a more self-directed learning. In addition to teaching the content, teachers should be able to teach students to learn. Students may not be self-directed, autonomous learners when they come to polytechnic, but they could be when they graduate. They should be, if we aim for life-long learning. "*The primary objective for vocational education should be the development of students' self-management abilities*" (Ruohotie 2002b).

This is a challenge for teacher training and teachers' continuous education. It seems safe to assume that at present, polytechnic teachers are more focused on the content than learning skills (see also Pulli 2003). Further education of teachers should better take into consideration the need for student guidance and tutoring (Mahlamäki-Kultanen et al. 2006; Rauhala 2004, 65). How to teach metacognition, reflective thought, and self-regulation is too often overlooked in short training courses, or left for teachers to find out for themselves. According to Rogers (2001), the need for faculty to deeply understand and apply reflective processes is paramount so that they can model such practices for their students.

Teachers may have picked up new terminology, such as "scaffolding," for instance, but may not really understand how to "scaffold" in their own subjects. The results of the study draw attention to the importance of revealing teachers' prior conceptions and possible misconceptions in continuous teacher training. This is also one of the central principles in constructivism.

In the following sections, a few practical solutions are suggested to help teachers transform their conceptions of teaching and learning, make changes in their practice, and overcome the novelty of ICT in instruction. It is suggested here that, to accomplish the first two goals, teachers could engage in teacher-based action research or similar collaborative study of their work in order to acquire knowledge about the new theories of learning. With regard to learning more about ICT, teachers are advised to immerse themselves in the "online culture."

Teachers to change their conceptions

The dilemma alone does not seem to suffice to make learners question their existing conceptions and assumptions. It seems that dialogue does not take place automatically, either. Thus, teachers need the right kind of scaffolding, especially during the transition phase so that misconceptions could be prevented from occurring.

Results of the research indicate that in order to foster transformative learning with teachers, it would be important: 1) to have an expert consultant (or rather an expert teacher) to initiate and help maintain dialogue between teachers, 2) to provide enough mutual time for dialogue, and 3) to ensure that teachers' have sufficient theoretical understanding of teaching and learning.

Theoretical understanding is the basis for dialogue and critical self-reflection. In light of present and previous research (Leinonen 2007; Martti 1996; Pulli 2003), lack of theoretical understanding of the central concepts in teaching and learning seriously impedes the change in teachers' pedagogical thinking, which is liable to show in their online solutions as well. These conclusions are supported by Tella's and Mononen-Aaltonen's (1998) three cornerstones in the learning process: 1) dialogue, 2) theoretical knowledge, and 3) communication.

In group learning, all three cornerstones come in to play. Here three group learning methods that can be employed to foster transformative learning are suggested: Action Research, Collaborative Inquiry and Action Learning (Yorks & Marsick 2000; Taylor 2000). They are participatory, systematic, action-based methods for improving practice and developing new knowledge.

Elliott (1991) and Elliott and Adelman (1996) recommend action research conducted by teachers themselves to overcome the expert defensiveness against new theoretical knowledge. Action research promotes the kind of self-monitoring of one's own practice, which is necessary for recognizing the need for change. In action research theory and experience, scientific methods and practical experiments, are combined into teacher-generated knowledge of an alternative to traditional pedagogy. This helps counteract expert defensiveness and the resentment of theory that is produced by outside experts, and which, therefore, may feel too generalized or derived from ideal circumstances that are not realistic (see also Elliott 1991; Elliott & Adelman 1996; Kaikkonen & Kohonen1999).

In collaborative inquiry, the participants are also researchers and the researched (Taylor 2000, 320). Collaborative inquiry consists of episodes of reflection and action with peers working and learning together on a common project (Yorks & Marsick 2000, 266).

Marsick (1990) sees Action Learning in the workplace conforming to Mezirow's three concepts: instrumental learning, communicative learning, and transformation of personal frames of reference. Marsick (ibid.) notes that instrumental learning will always be a primary focus in the workplace. For it to be meaningful, learners are to

rely on their personal experience. The action learning model combines reflection with learning from experience, thus minimizing the risk of repeating mistakes.

Ho et al. (2001) introduce a conceptual change approach, which they tested in a relatively short programme. The programme's strengths seem to be its focus on the critical processes that develop teachers' metacognition: self-awareness process, confrontation process, exposure to alternative conceptions, and commitment building process.

What all the above methods have in common is an attempt to force teachers to reflect on their teaching approaches critically, in order to recognize possible out of date conceptions, and with the help of growing theoretical understanding of the learning process become aware of the need to change. Collaboration projects such as suggested above also provide a safe environment to experiment with alternative approaches with emotional support from peers.

Teachers to learn technology

In the online project reported in this paper, the starting point was that technical support was available for the teachers. Therefore, these teachers did not have the requirement to master the technical realization of their online courses. They could fully concentrate on the content and pedagogy. This kind of production process of online courses can be likened to film making, where the teacher only provides the manuscript, and the film-making crew takes care of everything else (Pesonen, Sihvola & Tiihonen 2000). This view is usually readily accepted by teachers.

It could be argued, however, that in this era of information and communication technologies, having the technical skills required to produce an online course, to maintain it and to make the necessary changes is a new professional qualification for teachers. Bennett and Lockyer (2004) also emphasize the importance of teachers' technical skills in managing the technology-rich learning environments and in the use of computer-mediated communication tools. It is a challenge not merely for teachers with non-technical minds, but also for the designers of educational technologies. The technology should be more user-friendly than it is today for teachers as well as students, so much so that teachers would not need a technical "interpreter" to interpret their pedagogical ideas into an online course (Susimetsä 2006, 188; Järvelä et al. 2006, 9).

Results show that not having sufficient knowledge about the technical solutions seriously impeded flexible use of the online material. It may have affected pedagogical decisions, as well. If teachers could make their own online courses from start to finish in the way they see pedagogically fit, a lot of time otherwise spent on explaining ideas could be saved. It would also be an empowering experience for teachers to be able to take charge of their own work, instead of having to rely on somebody else

to finalize it for them. As discussed before, having to surrender in the face of technology contributes to feelings of powerlessness.

The best teachers of ICT in Instruction to other teachers would be experienced online teachers, who have learnt to master the pedagogy as well as the technology. The ICT training for teachers provided by the National Board of Education (OPE-Fi levels I–III) also has this objective. Teachers, unlike technical support personnel, have the pedagogical skills to teach how to make use of, for instance, a new platform that the school has decided to use. The approach is then pedagogical rather than that of the user's manual that focuses more on the different technical functions available.

Teaching in a virtual environment necessitates knowing the environment as well as possible, not merely the technology but its operating principles, its culture. The web is instant, fragmented, revealing, distant, "layered" (Ihanainen 2002, 154–157), and presents certain, more or less unspoken, rules that one is expected to follow. Computer-mediated communication in itself requires special skills and strategies, as it needs to be more explicit and detailed in the lack of immediacy, absence of non-verbal cues and the formality of written language (Bennett & Lockyer 2004). Without going into more detail about the special character of a virtual environment, it is safe to say that it is very different from a physical classroom.

Coming back to the analogy of interpreting, it is suggested here that learning to teach in this new environment can be like learning a new language. This metaphor may help to understand the complexity of the situation that teachers face in online instruction. With the help of metaphors a new and strange concept can be made more understandable as it is likened to something familiar of which people have experience (Mahlamäki-Kultanen 1998, 10).

When learning a foreign language, one can only say simple things first. One cannot express all one's ideas; the words just do not come out of one's mouth in desired form – the actual realization does not correspond to the plan. As a result, one's personality may shrink; one may even sound more monotonous than in one's mother tongue.

The aim in learning a new language is to learn not to translate directly from one's mother tongue, but rather to learn to express oneself in a way that is idiomatic in the new language; to learn to think in the target language. Similarly, giving an inspiring lecture in a face-to-face situation cannot be translated into lecture notes scanned on a web page. Classroom practices do not necessarily work at all in the virtual learning environment.

In order to learn the "language" of online teaching, teachers need to spend time in that environment, they need to immerse themselves in this new culture to learn to understand and practise it; surf on the Internet, engage in text messaging, etc. The more teachers use the Web themselves, the more they will see the possibilities it offers. Students are likely to be more conversant with the Web than teachers, in this respect.

However, all this "reading, writing and oral" practice is based on the theory of language, the rules and concepts of grammar. In online instruction the rules consist of online pedagogies, and the new concepts (autonomous learning, self-directedness, facilitation, interaction…) to be learnt. In addition to grammar, one also needs to master the basic vocabulary at the very least, i.e. the online tools one has at one's disposal, one's technical skills (making hyperlinks, html, etc).

Finally, one cannot properly learn a new language in isolation; others are required for effective practise and learning to take place.

Suggestions for further research

One direction for future research could be in the area of collaborative methods such as described above for fostering transformative learning with polytechnic teachers. Involving teachers in the research of their own work would serve multiple purposes: solidifying the theoretical foundation of teaching and learning, encouraging interdependence and collaboration, promoting critical reflection and dialogue, and development of metacognitive skills.

The role that affective factors play in teacher development is another area that would benefit from more research (see also Taylor 2000). This research represents an attempt to provide an emotionally-safe experience for participating teachers, but missed the opportunity to study the impact affective factors make on conceptual change or teaching itself.

Transformative learning as an experience may generate feelings of frustration, even fear when one lets go of the familiar and launches into the unknown (Kohonen 1999). Emotions involved in conceptual change in general, as well as in different processes, such as dialogue, that promote change, may hinder or support the process. As Burbules (1993, 36–41) notes, feelings of affection and intimacy belong to true dialogue. Would teachers become more affectionate towards their students, demonstrate pedagogical love, if they adopted more constructivist conceptions and along with it were capable of true dialogue? There are indications in this study (Courses 2, constructivist teacher) and another study by Leinonen (2007) of transformed teachers who speak about their students with affection and respect as opposed to the very traditional teacher in this study, who saw students as faceless mass. At the very least this kind of research at a polytechnic setting might increase awareness of the role affective factors play in teaching and learning in polytechnics.

Finally, this study focused on polytechnic teachers who were soon to begin their online instruction. It would be interesting to follow these teachers' development as they become more experienced. Results show a transition phase. Will their conceptions continue to change towards a more constructivist orientation?

Research on experienced online teachers in general would provide comparisons that might shed more light on conceptual change. An interesting question remains:

Will each new teacher who begins online instruction have to learn through trial and error, or would it be possible with the help of research and the right kind of support, to skip the early stages of misconceptions and unsuccessful solutions and move straight to offering meaningful learning experiences online?

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APPENDICES

Questionnaire in Finnish

Tämän kyselyn tarkoitus on selvittää, minkälaista koulutusta opettajat tarvitsevat ja toivovat tukemaan tietotekniikan ja tietoverkkojen opetuskäyttöä. Kyselyn tietoja käytetään LAMKin opettajien täydennyskoulutuskurssin suunniteluun. Samalla tämä tutkimus on päättötyöni Master of Education -tutkintoon Loughborough:n yliopistossa Englannissa. Kaikki tiedot pysyvät luottamuksellisina.

Taustatietoja:

    Olen   nainen/mies.
    Ikäni on ……..……
    Opetan ……………………………………………………………… (oppiaine/-aineet)
    …………………………………………………………………………… laitoksella.

Valitse vain yksi vaihtoehto. Jos mikään ei sovi, kirjoita vastauksesi tyhjään kohtaan.

Tietotekniikan saatavuus:

1. Onko sinulla kotona tietokone ja internetyhteys?
   a. minulla on tietokone
   b. minulla on tietokone ja internetyhteys
   c. ei ole tietokonetta.
   d.

2. Mitkä ovat mahdollisuutesi käyttää tietokonetta työpaikallasi?
   a. minulla on oma tietokone työhuoneessani.
   b. minulla on yhteinen tietokone työtoverin/-tovereiden kanssa.
   c. minulla ei ole tietokonetta työhuoneessani.
   d.

3. Kuinka vanha työpaikan koneesi on?
   a. alle vuoden vanha
   b. 1–2 vuotta
   c. 3–4 vuotta
   d.

Tietokoneen käyttö:

4. Osaatko tallentaa tiedostoja omiin kansioihinsa?
   a. osaan
   b. en osaa
   c. en osaa tehdä kansioita.
   d.

5. Miten muotoilet tekstiä?
   a. fonttien kautta
   b. tyylien kautta
   c. en muotoile tekstiä
   d.

6. Mitä näistä ohjelmista käytät? (voit valita useamman vaihtoehdon)
   a. front page
   b. power point
   c. excel
   d.

Internetin käyttö:

7. Kuinka usein luet sähköpostisi?
   a. monta kertaa päivässä
   b. kerran päivässä
   c. silloin, kun muistan
   d.

8. Osaatko laittaa liitetiedoston sähköpostiin?
   a. osaan
   b. en ole kokeillut
   c. en osaa
   d.

9. Löydätkö tarvittaessa juna-aikataulut internetistä?
   a. löydän helposti
   b. luulen löytäväni
   c. en löydä
   d.

Tietotekniikka opetuksessa:

10. Kuinka usein käytät tietokonetta opetustilanteissa?
    a. erittäin paljon
    b. joskus
    c. en koskaan
    d.

11. Käytätkö internettiä opetuksessasi? (jos vastaat kieltävästi, siirry kohtaan 15)
    a. käytän
    b. en käytä
12. Miten käytät tietoverkkoja opetuksessasi? (voit valita useamman vaihtoehdon)
    a. annan tehtäväksi etsiä tietoa internetistä
    b. lähetän ja/tai vastaanotan tehtäviä verkon kautta
    c. olen tehnyt materiaalia verkkoon opiskelijoita varten
    d.
13. Oletko opettanut verkossa?
    a. olen opettanut kokonaisen kurssin/kursseja
    b. olen opettanut sia kurssista/kursseista
    c. en ole opettanut verkossa
    d.
14. Oletko opiskellut verkkokurssilla?
    a. olen
    b. en ole

Opetusmenetelmät:

15. Miten aloitat kurssin?
    a. kerron ryhmälle kurssin sisällön ja tavoitteet.
    b. annan ryhmän päättää sisällön ja tavoitteet
    c. päätämme yhdessä ryhmän kanssa sisällöstä ja tavoitteista
    d.
16. Miten annat oppilaille tehtäviä?
    a. määrittelen tehtävän selkeästi.
    b. jätän tehtävän mahdollisimman avoimeksi.
    c. määrittelen tehtävän, mutta jätän yksilöllistä liikkumavaraa.
    d.
17. Mikä seuraavista vastaa parhaiten opetustyyliäsi?
    a. annan heti monimutkaisen ongelman.
    b. etenen yksinkertaisesta monimutkaisempaan.
    c. käytän kumpaakin tapaa aiheesta riippuen.
    d.

18. Seuraavassa on opettamiseen, oppimiseen ja opiskeluun liittyviä väitteitä. Ilmoita mielipiteesi ympyröimällä sopivin vaihto: 1= eri mieltä 2 = jokseenkin eri mieltä, 3 = ei eri mieltä, eikä samaa mieltä, 4= jokseenkin samaa mieltä, 5 = samaa mieltä

    a. Mielestäni sähköposti on mukava viestintäväline.   1 2 3 4 5

    b. Haluan mieluummin opiskelijoiden harjoitustyöt paperilla kuin liitetiedostona.   1 2 3 4 5

    c. Verkko-opetus kiinnostaa minua   1 2 3 4 5

    d. Haluan lisää koulutusta verkossa opettamisesta   1 2 3 4 5

    e. Tietoverkot opetuksessa soveltuvat lähinnä materiaalin jakamiseen.   1 2 3 4 5

    f. Olen tyytyväinen opetusmenetelmiini.   1 2 3 4 5

    g. Haluaisin tietää enemmän uusista oppimiskäsityksistä.   1 2 3 4 5

    h. Hyvä suhde oppilaisiin on tärkeä oppimistulosten kannalta.   1 2 3 4 5

    i. Suora opetus on tehokkainta minun aineessani.   1 2 3 4 5

    j. Opettajan merkitys oppimistavoitteiden saavuttamisessa on suuri.   1 2 3 4 5

    k. Oppimista helpottaa, jos aihe on jaettu pieniin loogisesti eteneviin osiin   1 2 3 4 5

    l. Opiskelijat eivät itse tiedä, mitä heidän pitää oppia.   1 2 3 4 5

    m. Opetuksen lähtökohtana tulisi olla oppijan käsitykset opittavasta aiheesta   1 2 3 4 5

    n. Ennen kuin voi suunnitella verkko-opetusta, pitää hallita verkkotyökalut   1 2 3 4 5

    o. Pyrin kattamaan opetussuunnitelmani mukaiset asiat jokaisella kurssilla   1 2 3 4 5

Millaista lisäkoulutusta verkkokurssien suunnitteluun ja opettamiseen haluaisit?

……………………………………………………………………………………

……………………………………………………………………………………

……………………………………………………………………………………

……………………………………………………………………………………

Kiitos vastauksistasi!

Haastattelen osan vastanneista. Laita tähän yhteystietosi, jos suostut haastateltavaksi.

……………………………………………………………………………………

Sisko Mällinen

Questionnaire in English

The purpose of this survey is to investigate what kind of support or training teachers feel they need in order to design and teach online courses. The information will be used in the planning of an in-house training course for the teachers of Lahti Polytechnic. This survey is also part of my dissertation for the Master's degree in Education at the University of Loughborough in England. All information remains confidential.

Personal data

I am   female/male.
I am   ………… old.
I teach   ……………………………………………………………. (subject/s) at
the Faculty of ………………………………………………………………………

In the following circle one alternative. If there is not a good alternative, write your own answer in the space left empty.

Access to IT

1. Have you got a computer and an Internet connection at home?
   a. I have got a computer at home.
   b. I have got a computer with an Internet connection at home.
   c. I don't have a computer at home.
   d.

2. What are your possibilities to use a computer at work?
   a. I have a PC in my office.
   b. I share a PC with a colleague in our office.
   c. I don't have a PC in my office.
   d.

3. How old is your PC at work?
   a. less than a year
   b. 1–2 years
   c. 3–4 years
   d.

Computer know-how

4. Can you save files in their own folders?
   a. Yes, I can.
   b. No, I can't.
   c. I don't know how to make folders.
   d.

5. How do you modify your text?
   a. I select 'fonts' and change that.
   b. I use the formatting definitions under 'styles'.
   c. I don't modify my text.
   d.
6. Which of these programs do you use?
   a. front page
   b. power point
   c. excel
   d.

The Internet

7. How often do you read your email?
   a. many times a day.
   b. once a day.
   c. whenever I remember.
   d.
8. Do you know how to add attachments to your email?
   a. Yes, I do.
   b. I have never tried.
   c. No, I don't.
   d.
9. Do you think you will find train timetables on the Internet if necessary?
   a. Yes, I will find them easily.
   b. I think I would find them.
   c. No, I won't find them.
   d.

Information technology in instruction

10. How often do you use a computer in instruction?
    a. frequently
    b. sometimes
    c. never
    d.
11. Do you use the Internet in instruction? (if your answer is 'No', please go to question number 15)
    a. Yes, I do.
    b. No, I don't.

12. How do you use information networks in instruction? (here you can select more than one alternative)
    a. I ask the students to search for information on the Internet.
    b. I send and/or receive assignments via the net.
    c. I have made material for my students on the net.
    d.

13. Have you done online teaching?
    a. I have conducted an entire web-based course/entire web-based courses.
    b. I have supplemented my course/s with web-based modules.
    c. I haven't done any online teaching.
    d.

14. Have you studied on a web-based course?
    a. Yes, I have.
    b. No, I haven't.

Teaching approach

15. How do you begin a new course?
    a. I tell the group what the contents and the goals of the course are.
    b. I let the group decide on the contents and the goals.
    c. We decide together what the contents and the goals will be.
    d.

16. How do you give assignments?
    a. I specify the assignment.
    b. I leave the assignment as open as possible.
    c. I specify the assignment but allow individual freedom to some extent.
    d.

17. Which of the following best describes your teaching style?
    a. I start with a complicated problem.
    b. I proceed from the simple to the more complicated.
    c. I use both 'a' and 'c' depending on the situation.
    d.

18. In the following you will find statements about teaching, learning and studying. Give your opinion by circling the best alternative: 1 = strongly disagree, 2= disagree, 3 = neither agree or disagree, 4 = agree, and 5 = strongly agree.

    a. I like email.   1 2 3 4 5
    b. I prefer receiving students' assignments on paper to
       email attachments   1 2 3 4 5
    c. I am interested in online teaching   1 2 3 4 5
    d. I want training in online teaching   1 2 3 4 5
    e. Information networks in instruction are best used for
       the delivery of materials.   1 2 3 4 5

f. I am happy with my teaching methods.   1 2 3 4 5
g. I would like to know more about new learning theories.   1 2 3 4 5
h. A good relationship between teacher and students plays
    an important role in student outcomes.   1 2 3 4 5
i. Direct teaching is the most effective method in my subject.   1 2 3 4 5
j. The teacher plays an important role in learning achievement.   1 2 3 4 5
k. Dividing the subject into small logical steps makes learning
    easier.   1 2 3 4 5
l. Students do not know themselves what they need to learn.   1 2 3 4 5
m. The starting point of teaching should be students' prior
    assumptions about subject.   1 2 3 4 5
n. Mastering the tools is necessary before one can start
    planning online teaching   1 2 3 4 5
o. I try to cover the same curriculum on every course   1 2 3 4 5

What kind of support or training would you like to have for designing and teaching web-based courses?

………………………………………………………………………………………
………………………………………………………………………………………
………………………………………………………………………………………
………………………………………………………………………………………

Thank you for your answers!

I will interview part of the respondents. Please give your contact information here, if you agree to be interviewed.

………………………………………………………………………………………

Sisko Mällinen

Responses to the Likert scale statements in the questionnaire survey

Direct teaching is the most effective method in my subject

Dividing the subject into small logical steps makes learning easier
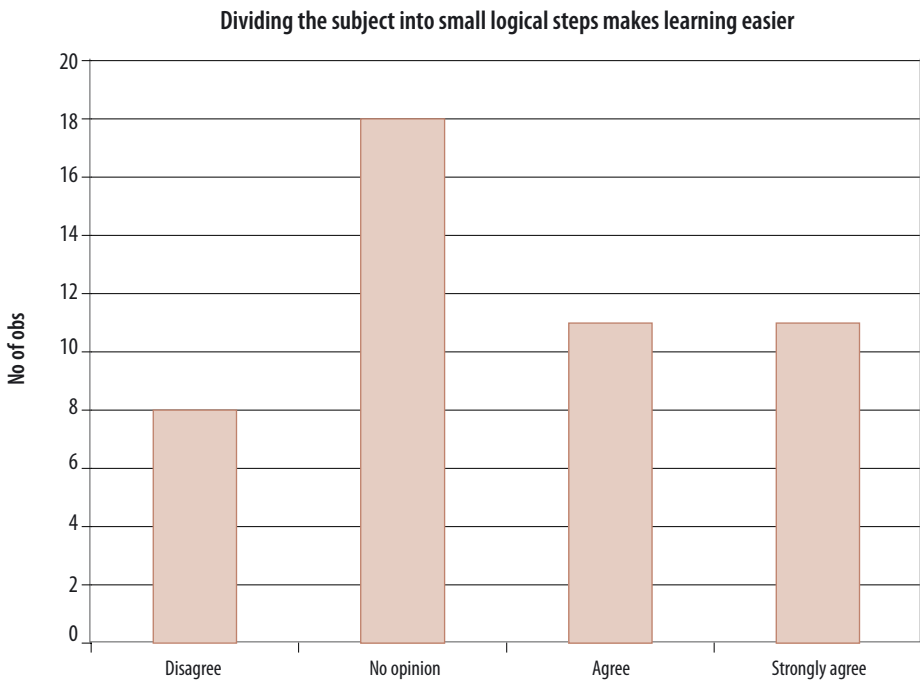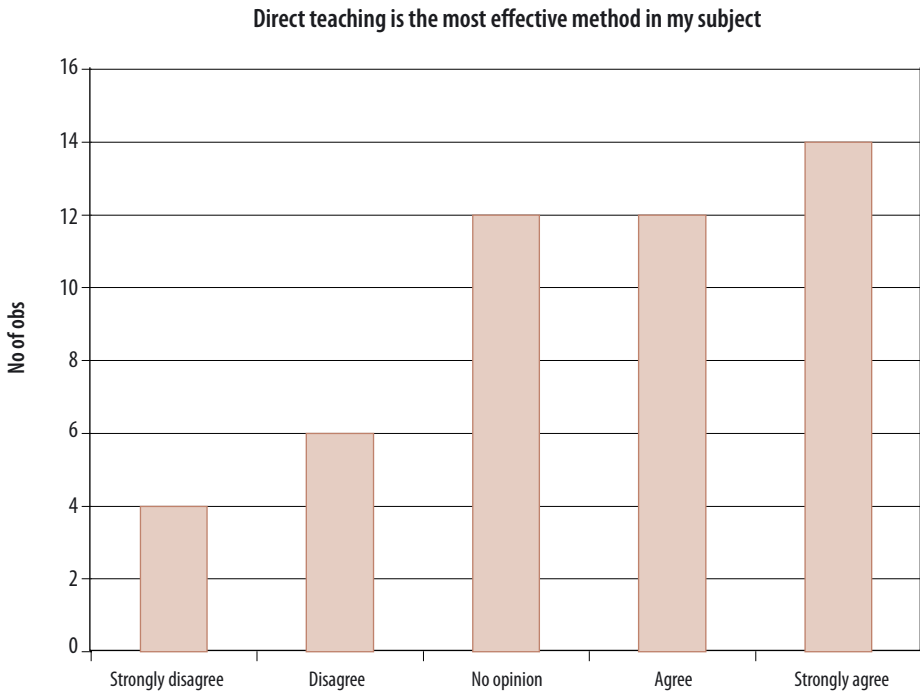
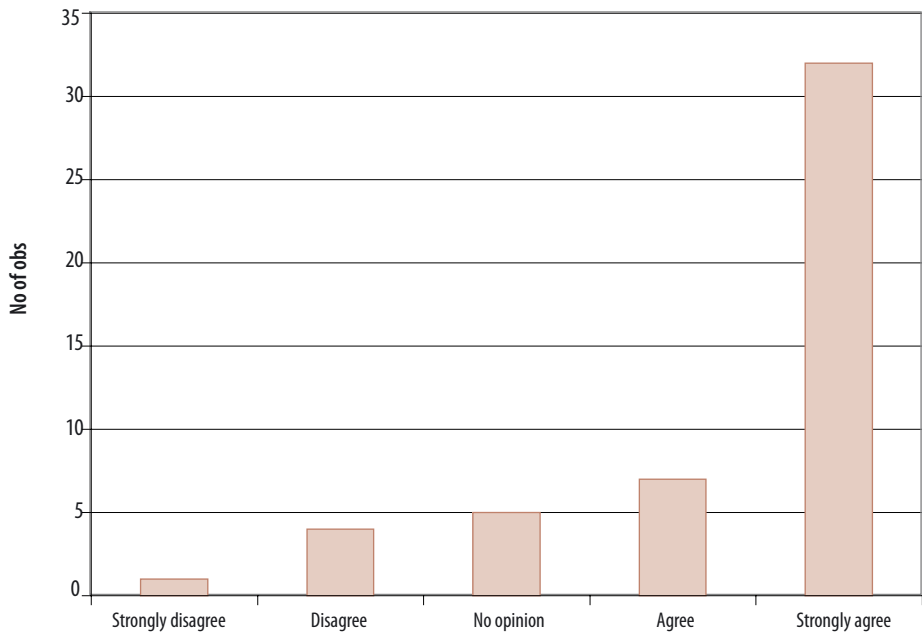## Students do not know themselves what they need to learn
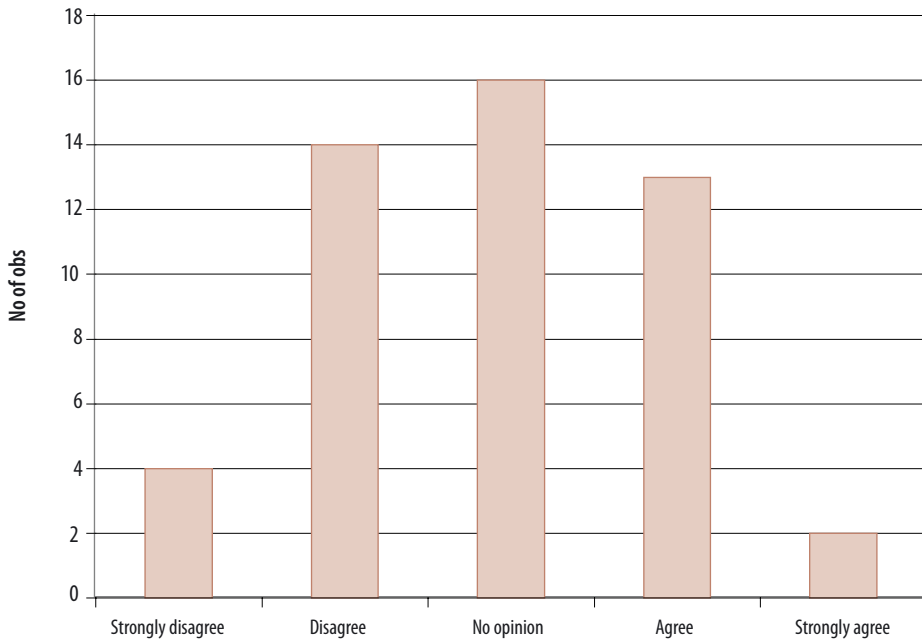
The starting point of teaching should be students' prior knowledge about subject
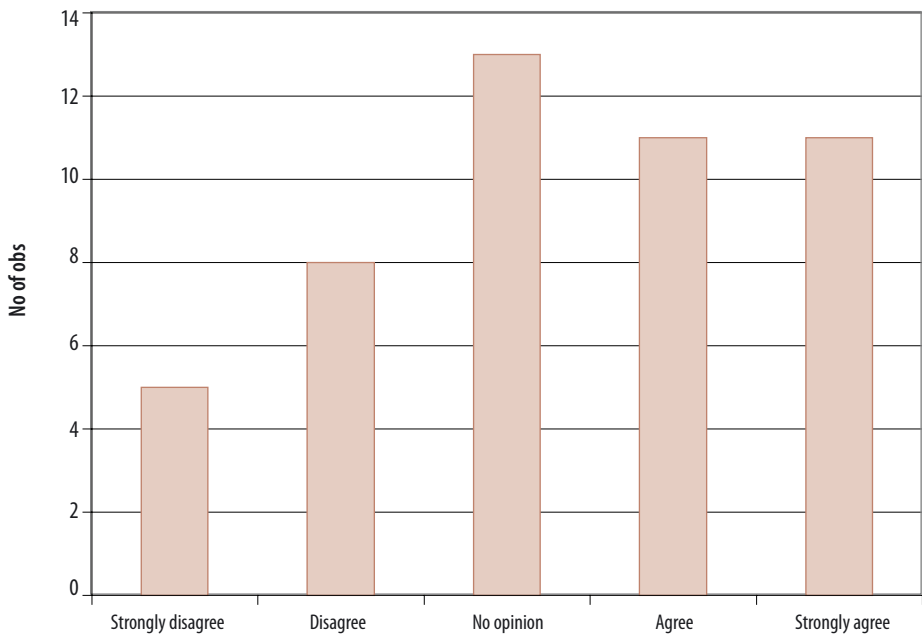
I try to cover the same curriculum on every course
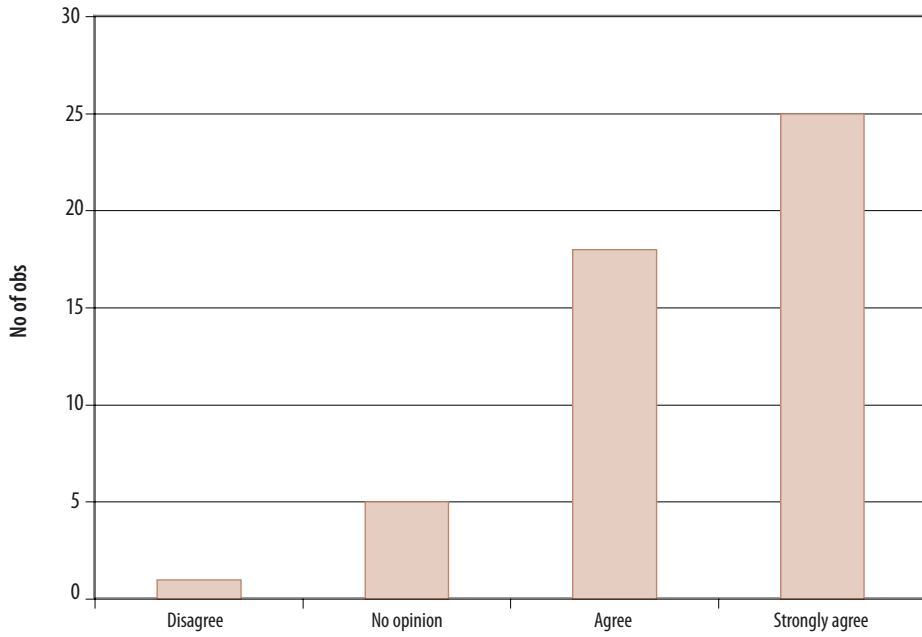
Mastering the tools is necessary before planning online teaching

Programme for in-house teacher training 2002

Objectives

The teacher will master online pedagogical planning.

The teacher knows how to make a manuscript for online instruction, both for the technical realization and the contents.

Own online material.

Knowledge of the production process and the starting point of planning: student-centredness, individual choices, learning to learn

6 March

Theme: Open learning and learning environments

Lecture: Producing online material

Reflect: What is it that you want to do online? Who is it for? Why online?

13 March

Theme: Open learning

Lecture: Planning an online course

Workshop: discussing ideas for your own course

Reflect: Examine your own teaching. Which open or closed solutions do you use? Do you see a need to increase openness? If so, how?

14 March–10 April

Independent workshops: planning your online teaching

Task: produce a synopsis of your online course and post it to the Studium environment for the other participants to see.

10 April

Theme: Tutoring

Lecture: Instructive material and tutoring

Workshop: planning the instructive material to your own course

Presentation of ideas and general discussion

Reflect: How can you tutor through learning material?

17 April

Theme: Teacher's role

Lecture: Social interaction online

Workshop: looking at your own role on your course

Discussion on ideas for social interaction on the participants' courses

Reflect: Do you recognize your own role? How self-directed are your students? How to anticipate students' role expectations?

18 April – 14 May

Independent workshops: making your own online material, peer and self evaluation.

Task: Produce a course manuscript, produce material

15 May

Theme: Presentation of online materials

Peer feedback

22 May

Theme: Instructions for evaluating the production process

Lecture: Topic provided by learners later

Reflect: How to take into account and respond to students conceptions of teaching and learning if they are very different from your own?

23 May–25 September

Producing online material, peer feedback

25 September

Theme: Presentation of online courses and materials, peer feedback, evaluation of the process

This programme only gives the guidelines, the Studium learning environment contained suggestions for reading, more reflection tasks and ideas for discussions.

Analysis of teacher and student roles in the course manuscripts

	Course 1	Course 2	Course 3	Course 4	Course 5
Teacher	• decides on contents and objectives • provides study material and quizzes • gives final test • assesses	• decides on overall contents and learning goals • partly provides material • seeks to understand students' conceptions • gives individual assignments • gives advice • lectures • gives and collects feedback • assesses	• decides on contents and objectives • provides study material and questions • gives feedback • gives advice • gives final test • assesses	• decides on contents and objectives • provides study material and exercises • gives advice • gives and collects feedback • assesses	• decides on contents and objectives • provides study material; and questions • lectures • gives advice and feedback • gives final test • assesses
Student	• takes quizzes • works independently • starts group project • holds meetings	• partly provides study material • makes decisions • writes reports • works in laboratory • attends seminars • learns from other students • takes final test	• answers questions • works independently • interacts • takes final test	• interacts • does exercises • writes own abstract • assesses self and peers • gives feedback to other students and teacher	• answers questions • works independently • works in laboratory • writes reports • interacts • takes final test

Analysis of teaching approach in the manuscripts

	Course 1	Course 2	Course 3	Course 4	Course 5
Constructivist	• group work	• from whole to parts • students' prior knowledge as basis • flexible curriculum • student-centred • learning by doing • social interaction • creating new knowledge • continuous assessment • self and peer assessment • focus on understanding	• students' prior knowledge is mapped out • social interaction • students have some choice	• from whole to part • social interaction • students construct their own knowledge • learning by doing • continuous assessment • self and peer assessment	• prior knowledge is mapped out • social interaction • learning by doing • students have some choice • continuous assessment
Behaviourist	• from part to whole • correct answers validate learning • course is fixed; and same for all students • assessment is based on end behaviour • teacher control • programmed; teaching		• right answers validate learning • course is fixed and same for all • assessment is based on end behaviour • teacher control	• course is fixed • teacher control	• course is fixed and same for all • right answers validate learning • teacher control

Example of finding the grammatical subjects in the interviews

COURSE 3

Passive voice 16

Tää on nyt toteutettu.

Tää toteutettiin niin

Ja sen pysty suorittamaan niin, että ei ollut fyysisesti kululla,

Alussa on alkukartoitus, jossa kysellään opiskelijoiden lähtötiedot.

Mutta siinä vaiheessahan ei sitten oikeastaan pääse vaikuttaan siihen kurssin sisältöön, koska se kurssi on verkkoon jo tehty.

tämä oli tavallaan pakko opettaa, kun se oli resurssoitu se lähitunti määrä.

biopolttoaineissa kyseltiin esim. että mitä on biokaasu ja miten se syntyy.

niin tässä on ajateltu, että case on käytännön valmistusprosessi,

eli mitä asioita tässä käsitellään.

Tää kurssi on rakennettu sen mukaan

ja mun ymmärtääkseni näillä kysymyksillä ja tän kurssin rakentamisellakin pyrittiin siihen että ne asiat niinku täyttyy.

se teoria tavallaan opiskeltiin niitten kautta,

arvosanaa ei saanut ennen kuin kaikki tehtävät oli tehty.

yritettiin vain, että nää perusasiat käydään läpi.

tää oli rakennettu kuitenkin niin, että opiskelu tapahtuu kysymyksien kautta.

mun aika oli sidottu siihen ajankohtaan

Existential and generic structures 22

nyt kun oli verkko käytössä, niin siinä sai niinku monipuolisemman sen aineiston.

Opintojaksossa oli lähitunnit ja verkko-osuus.

Se perusmateriaali on verkossa ja se teoria.

Se tapahtuu verkkokaavakkeella, jonka he täyttivät

jatkossa voi tietysti vaikuttaa siihen, että miten sitä sitten toteuttaa.

Kun siellä oli yleensä linkki, josta sinä hait se vastauksen siihen.

Niitä tehtäviä kannattaa miettiä semmosia, että niitä joutuu miettimään enemmän,

Sit sen löysi sieltä jostakin.

siitä ei silloin ollut saatavilla kirjallisuutta oikeastaan ollenkaan,

Siellä oli case-tyyppisiä ja sitten oli tämmösiä kysymyksiä.

siellä oli yksi Testaa tietosi koko kurssista.

Siinä oli kymmenkunta kysymystä, annettu kolme vaihtoehtoa.

tähän kuului ekskursio,

No se meni oikeastaan sen mukaan, kuin se on se opintojakson sisältökaavake

Näitä oli kymmeniä näitä kysymyksiä,

Pääasiassa arvosana tuli loppukokeen perusteella,

Niistä ei oikein voinut niinku, tai ei mitään mielipiteitä tai semmosta kysellä…

Se on helpompi sun kysyä, kun rueta lähetteleen kirjallisessa muodossa.

eihän siinä pystynyt tarkistaan yhtään niitä tehtäviä, kun sinä olit tunnilla.

Siinä oli vähemmän tehtäviä ja ne ei liittyneet siihen verkkomateriaaliin.

Siinä oli ensin paljon sitä teoria-asiaa,

Siinä piti ottaa joku saha tai huoltamo tai muu sellainen ja piti ottaa huomioon kaikki

Nää viis erillistä tehtävksiantoa oli verkossa,

Other

Mutta kun nää on niinku tyttöjen tekemät tonne,

Teacher 25

Kaksi vuotta sitten olin pitänyt saman kurssin perinteisenä lähiopetuksena.

minä siellä tarvittaessa ohjasin ja avustin.

Siellä verkossa oli se keskustelukanava, jota minä käytin informaatiokanavana sitten. (yksipuolista viestintää)

Mun mielestä nämä ei kyllä mitään varsinaisia caseja oo,

Minun mielestä tää ei oo mikään case.

Minä en sitäkään ole muuten kattonu.

Luin kaikki ja kommentoin.

minä sitten annoin palautteen jokaiseen.

Ja sitten esittelin verkossa sen kanssa ja aikataulut,

kokeessa mulla oli muutamia samoja kysymyksiä,

minä annoin niille ne oikeat vastaukset.

musta tuntu, että tää opetustapa johtu siitä, että mulla oli se Pilaantuneen maan kurssi..

No mulla oli se 21 h,

Minä tietenkin luin ja annoin palautetta sitten illoilla.

olihan siinä mulle enemmän työtä,

tarvittaessa puutun siihen.

ei mun tarvinnut oikeastaan aktivoida,

Laitoin 0 tai 1.

jos ei olllut ihan eksaktisti oikein, niin laitoin, että olisit voinut näitäkin käsitellä

tavallaan laitoin vähän enemmän,

jos sieltä puuttu jotain, niin laitoin, mitä siellä olis pitänyt vielä olla.

Se on kans yks probleema, minkä oon huomannut.

Jotenkin musta itsestä tuntuu, että kun tätä kehittää, niin tekee pikkasen niinku
    monimutkasempia.

Mutta sen mä huomasin,

mitä mä oon ajatellut, että meillä on huonosti ollut siinä mielessä, ettei tiedetä,
    mitä toinen opettaa toisella kurssilla.

Teacher & students = we 6

Ensimmäisellä kerralla me käytiin kurssin sisältö läpi

me käytiin Lahden lämpövoima Oy:ssä.

Ja sit meillä oli vieraileva luennoitsija Päijät-Hämeen jätehuollosta.

nää aikataulut käytiin läpi.

niin sillon niinku pähkäiltiin.

Luokassa kyllä keskusteltiin jonku verran

Students 31

opiskelijat tekivät aika itsenäisesti.

ne toivoi niin, että ne sais tehdä..

Kaikilla oli suurin piirtein sama lähtötaso.

ne jotka halus, tulla koulun koneilla tekemään niitä tehtäviä,

kun kaikilla ei ole omia koneita,

teki suhtkoht itsenäisesti niitä sen verkkomateriaalin kautta

ne ei verkossa juuri kyselleet mitään neuvoja,

nää, jotka vaivautuivat paikalle kyselivät siellä luokassa

ne piti aika simppeleinä niitä tehtäviä.

Niillä oli kansiot, jonne ne palautti

Ja sen alkukartoitus kaavakkeen tekivät siinä samalla.

ne tiesi jo WebCT jutut,

kun ne oli jo aikasemmalla kurssilla mukana,

suurin osa sai yhden pisteen.

oppilaat itse toivoi niin.

ne ajatteli,että jos kaikki näkee ne, niin ne käyttää niitä hyväksi,

kun nehän osaa leikata ja liimata ja kopioida.

kun ne teki nitä tehtäviä,

Yhdessä pohtivat vastauksia ja kyselivät multakin.

Ne teki niitä tehtäviä siinä lähitunneilla.

ne piti sitä aika työläänä kurssina.

Ne katto että se oli työläs, eikä heitä tarvi opettaa verkon käyttöön.

sit ne piti seminaariesitelmän siitä.

ne teki ihan erillään tämän, että kokosivat sen materiaalin ja pitivät seminaariesitelmän siitä.

Palautteessa he toivoivat, että tätä teoriaa ei käytäisi luennoimalla läpi vaan he sais sen itsenäisesti tehdä.

ne on aina sanoneet että se on työläs kurssi.

kun ne oli pakko tehdä, niin ne teki

Jotkut, se joka parhaan numeron sai, sen mielestä ne tehtävät oli vähän simppeleitä.

Toisen mielestä ne oli sopivia…

Ei kun ne sai valita järjestyksen.

mikä oli tunnin aihe, niin sen mukaan ne eteni.