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TEEMU VALTONEN

*An insight into collaborative
learning with ICT: Teachers' and
students' perspectives*

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ABSTRACT: AN INSIGHT INTO COLLABORATIVE LEARNING WITH ICT: TEACHERS' AND STUDENTS' PERSPECTIVES

This dissertation concentrates on collaborative learning with information and communication technology (ICT) from teachers' and students' perspectives. The development of learning with ICT has evolved from software supporting students' individual learning based on mechanical drills to more advanced micro-worlds, cognitive tools and learning environments. Especially the advantages of ICT for supporting students' collaborative learning have broken through; different ICT solutions provide tools for collaboration both in the classroom setting and on distance courses. This dissertation discusses the topic from two perspectives. Teachers' perspective focuses especially on the research area of teacher thinking. Students' perspective focuses on the phenomenon of net generation. The aim is to provide an insight into collaborative learning with ICT in the Finnish context, to identify the strong areas and limitations in order to provide information and concrete building blocks for developing collaborative learning with ICT in schools.

The first part of the dissertation discusses two studies that focus on teacher thinking, concentrating especially on conceptions of learning and technological pedagogical content knowledge (TPCK). These studies shed light on how the theories of collaborative learning show in teachers' thinking and work. The second part of the dissertation presents three studies that focus on students' perspectives on collaborative learning with ICT in the context of the net generation phenomenon. Net generation students are assumed to have unique ways of learning and ways of using different technologies. These assumptions align with the theories of collaborative learning with ICT. The aim of the second part is to illustrate how the assumed characteristics of the net generation show in eastern Finland.

In all, this dissertation consists of five studies. Two of the studies draw on qualitative methods (studies I and II), one study is based only on quantitative methods (study V) and two studies employ both qualitative and quantitative methods, i.e., a mixed method (studies III and IV). In general, this dissertation can be defined as a mixed method study. Methods to gather and analyse research data are based on the specific features of the research topics and aims of the studies. Research data was gathered from different school levels. Research data in studies discussing teachers' perspective was gathered in polytechnic and upper secondary schools. Data for studies concentrating on net generation was gathered in upper secondary and vocational schools and in a

university. Methods employed for gathering data were online questionnaires, recorded interviews and course design sessions, and teachers' essays. Data also included online courses made by upper secondary level teachers and learning unit descriptions made by student teachers.

Results concerning teacher thinking are somewhat contradictory to the theories of collaborative learning with ICT. The results indicate that teachers' conceptions of learning and technological pedagogical content knowledge do not necessarily fully correspond with the theories of collaborative learning. Results indicate that even though collaborative learning has been described as a mantra for knowledge age education, it is not evident for all teachers. The first study indicates that online courses at the upper secondary level left collaborative learning in a minor part. The courses and online learning environments designed by teachers mainly supported the transmission of knowledge from teacher to students. Collaborative learning activities were only taken advantage of on few courses. Mostly, collaborative learning activities seemed to appear as an extra element at the side of the main learning activities that were based on transmitting of knowledge. Challenges of collaborative learning with ICT also came up in the second study. Teachers' conceptions of learning varied from conceptions stressing teachers' central role in transmitting knowledge to the students to conceptions of learning that stress the importance of students' active role in the learning process, making decisions and collaborating with their peers.

Even though collaborative learning with ICT seems challenging, the results open interesting possibilities for the future. The results from study II indicated that some teachers experienced online learning environments as a "change agent" triggering reflective thinking about teaching methods. ICT changed teachers' normal working environments leading them to reconsider their teaching methods and the nature of learning. This result provides interesting possibilities for developing teaching and learning in schools toward a more collaborative direction with ICT.

Results from studies III, IV and V are twofold: while they contradict some of the assumptions concerning the net generation, some of the results are consistent with them. It seems that most of the students are familiar with different social software. Most of the students also evaluate their ICT skills rather high. Also, student teachers' pedagogical knowledge indicates emphasis toward collaborative teaching and learning practices. However, it seems that students do not necessarily see the possibilities of ICT and different online environments as tools for learning. This is a challenge. Although the assumptions presented in earlier writings argue that the net generation students would prefer and be willing to study with ICT, the results of these studies reveal a slightly different picture regarding students' preferences and ICT skills. What the results do indicate, however, is that there is potential that schools and teachers should take advantage of.

In sum, based on the results of the five studies, it seems that collaborative learning with ICT poses challenges mostly for teachers. However, the results brought up features that can be used for developing teaching and learning in schools toward a more collaborative direction by taking advantage of different ICT tools, students' skills and available software. First, for some teachers ICT prompted reflective thinking leading them to reconsider and evaluate their ways to teach and support students' learning. New tools and a new environment directed them to question their teaching routines. Second, most of the students seem to have fairly good ICT skills. Most of the students also seem to be familiar with using and communicating in different online environments, especially

social software. These results indicate that even though they are not necessarily taking advantage of ICT when it comes to learning, they have a good starting point to do so. Different social software that students are already fairly familiar with can be seen as one possibility for activating teachers' thinking and thus developing teaching and learning toward collaborative practices with ICT.

Valtonen, Teemu

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ABSTRAKTI: YHTEISÖLLINEN OPPIMINEN TIETO- JA VIESTINTÄTEKNOLOGIAN AVULLA: OPETTAJAN JA OPISKELIJAN NÄKÖKULMIA

Tämä väitöskirja käsittelee yhteisöllistä oppimista tieto- ja viestintäteknologian (TVT) avulla opettajien ja opiskelijoiden näkökulmista. TVT:aa on hyödynnetty opettamisen ja oppimisen tukena erilaisilla tavoilla alkaen mekaaniseen toistamiseen ja palautteeseen perustuvista ohjelmistoista edeten kehittyneempiin mikromaailmoihin, kognitiivisiin työkaluihin ja oppimisympäristöihin. Varsinkin TVT:n mahdollisuudet yhteisöllisen oppimisen tukena ovat nousseet vahvasti esille. Erilaiset TVT:n sovellukset tarjoavat välineitä yhteisöllisen työskentelyn tueksi sekä kontaktiopetukseen että etäopetukseen. Tämä väitöskirja keskittyy yhteisölliseen oppimiseen TVT:n avulla kahdesta näkökulmasta. Opettajien näkökulma keskittyy opettajien oppimiskäsityksiin sekä teknologispedagogiseen sisältötietoon. Opiskelijoiden näkökulma keskittyy puolestaan ns. nettisukupolvi-ilmiöön. Tavoitteena on tarjota näkökulmia yhteisölliseen oppimiseen TVT:n avulla suomalaisessa kontekstissa, tunnistaa vahvoja alueita ja mahdollisia ongelma-alueita tulevan opetuksen ja oppimisen kehitystyön tueksi.

Väitöskirja koostuu viidestä tutkimuksesta. Ensimmäiset kaksi tutkimusta keskittyvät opettajien oppimiskäsityksiin sekä teknologispedagogiseen sisältötietoon. Tutkimukset kuvaavat yhteisöllisen oppimisen teorioiden näkymistä opettajien ajattelussa ja työskentelyssä. Loput kolme tutkimusta käsittelevät yhteisöllistä oppimista tieto- ja viestintäteknologian tukemana ns. nettisukupolven näkökulmasta. Nettisukupolven opiskelijoilla oletetaan olevan valmiudet erilaisten TVT:n sovellusten käyttöön sekä oppijakeskeisiin ja yhteisöllisiin työskentelytapoihin. Nämä oletukset sopivat hyvin yhteen TVT:llä tuetun yhteisöllisen oppimisen kanssa. Tutkimukset kuvaavat, kuinka nettisukupolven liittyvät oletukset näkyvät itäsuomalaisten opiskelijoiden keskuudessa.

Viidessä tutkimuksessa käytetään hyvin erilaisia tutkimusmenetelmiä. Tutkimuksista kaksi (tutkimukset I ja II) on tehty käyttäen pelkästään laadullisia tutkimusmenetelmiä, yksi tutkimus (tutkimus V) on tehty pelkästään kvantitatiivisia menetelmiä käyttäen. Loput kaksi tutkimusta (tutkimukset III ja IV) on tehty käyttäen molempia menetelmiä. Kokonaisuutena väitöskirja voidaan siten nähdä edustavan ns. mixed methods -tutkimusta. Valitut tutkimusmenetelmät ja tavat kerätä aineistoa perustuvat eri tutkimusten tutkimusongelmiin sekä käytännön mahdollisuuksiin.

Tutkimusmateriaalia kerättiin eri kouluasteilta. Opettajien näkökulmaa käsittelevien tutkimusten kohderyhminä toimivat ammattikorkeakoulu- ja lukio-opettajat. Nettisukupolvi teemaan liittyen kohderyhminä olivat lukio- ja ammatillisen puolen opiskelijat sekä opettajiksi opiskelevat opiskelijat. Tutkimusmateriaalia kerättiin verkkokyselyillä, haastatteluilla, kirjoitelmilla sekä videoiduilla kurssien suunnittelusessioina. Tutkimusmateriaaleina toimivat myös lukio-opettajien suunnittelemat verkkokurssit sekä opettajiksi opiskelevien opiskelijoiden suunnittelemat opetuskokonaisuudet.

Opettajien näkökulmaa käsittelevät tutkimukset tuovat esille, etteivät yhteisöllisen oppimisen käytänteet ja toimintatavat ole useinkaan osa opettajien normaalia työskentelyä. Tuloksista nousee esille, että vaikka yhteisöllistä oppimista on pidetty jonkinlaisena tietoyhteiskunnan opettamis- ja oppimiskulttuurin mantrana todellisuus ei tyypillisesti vastaa yhteisöllisen oppimisen teorioita. Ensimmäinen tutkimus tuo esille, että lukio-opettajien suunnittelemat ja toteuttamat verkkokurssit perustuivat opettajajohtoisiin menetelmiin. Opettaminen ja oppiminen näillä kursseilla perustuivat vahvasti tiedon siirtämiseen ja opettajan keskeiseen rooliin. Yhteisölliset toimintatavat olivat tyypillisesti pienemmässä roolissa. Usein yhteisöllisyyttä tukevat osiot olivat eräänlaisena lisänä muun työskentelyn jälkeen, eikä kurssin varsinainen työskentelytapa. Yhteisöllisen oppimisen haasteet nousivat esille myös seuraavassa tutkimuksessa. Opettajien käsitykset oppimisesta vaihtelivat opettajakeskisistä, tiedon siirtämiseen perustuvista oppimiskäsityksistä oppijakeskeisempiin käsityksiin, joissa oppijan rooli on aktiivisempi ja itseohjautuvampi.

Vaikka yhteisöllinen oppiminen näiden tulosten mukaan näyttää haastavalta, nousi tuloksista myös mielenkiintoisia mahdollisuuksia opetuksen ja oppimisen jatkokehitystyöhön. Tutkimuksen II tulokset toivat esille, että osa opettajista koki TVT:n käyttöön ottamisen eräänlaisena muutosagenttina, joka käynnisti näiden opettajien reflektiivisen ajattelun. Tieto- ja viestintäteknologian ottaminen keskeiseksi osaksi opetustyötä sai kyseiset opettajat pohtimaan omia opetusmenetelmiään ja rutiinejaan. Tämä tulos kannattaa huomioida jatkossa uusien sovellusten käyttöön ottamisen yhteydessä, sekä tarjota opettajille tukea ja rohkaisua omien käytänteiden pohtimiseen osana uusien sovellusten käyttöä.

Tutkimukset III, IV ja V tarjoavat puolesta ja vastaan tuloksia nettisukupolvi oletuksiin nähden. Näyttäisi siltä, että suurin osa opiskelijoista käyttää ainakin muutamia sosiaalisen median sovelluksia aktiivisesti eli viikoittain sekä päivittäin. Opiskelijat myös arvioivat omat TVT:n käyttöaitonsa sangen hyväiksi. Lisäksi opettajiksi opiskelevien, nettisukupolven kuuluvien opiskelijoiden suunnittelemissa opetuskokeiluissa korostuivat oppimisen yhteisölliset ja oppijan aktiivista roolia korostavat elementit. Kuitenkin näyttäisi siltä, etteivät nettisukupolven opiskelijat näe TVT:aa oppimisen ja opiskelun välineenä. Vaikka aikaisempi tutkimus väittää, että nettisukupolven opiskelijat käyttävät aktiivisesti TVT:aa osana opiskeluaan, ei tämä väittäjä saanut vahvistusta näissä kolmessa tutkimuksessa. Tuloksista kuitenkin nousee esille mahdollisuus, joka opettajien ja koulujen pitäisi huomioida. Nykyisillä opiskelijoilla on paremmat valmiudet käyttää erilaisia TVT:n sovelluksia, jotka puolestaan tarjoavat monipuolisia mahdollisuuksia yhteisöllisen oppimisen välineiksi.

Viiden tutkimuksen tulokset nostavat esille TVT:lla tuetun yhteisöllisen oppimisen haasteellisuuden. Kuitenkin tuloksista nousi välineitä myös haasteiden ylittämiseen. Muutamien opettajien kohdalla TVT:n käyttöön ottaminen käynnisti omien opetusmenetelmiä ja rutiineja arvioivaa reflektiivistä ajattelua. Tätä mahdollisuus pitää

tietoisemmin hyödyntää ja tukea varsinkin erilaisissa kehittämishankkeissa ja koulutuksissa. Uusien sovelluksien avulla, esimerkiksi eri sosiaalisen median välineillä joille tyypillistä on käyttäjien aktiivinen ja yhteisöllinen työskentely, voidaan tukea opettajia kehittämään omaa opetustyötään kohti yhteisöllisempiä opetus- ja oppimismenetelmiä. Reflektiivisen ajattelun tukemisen lisäksi opiskelijoiden rooli osana opettamisen ja oppimisen kehittämistä, pitää tuoda paremmin esille. Nykyisellä ja tulevilla opiskelijasukupolvilla on paremmat valmiudet käyttää erilaisia TVT:n sovelluksia oppimisen tukena. Tieto- ja viestintäteknologian käyttö osana oppimista vaatii kuitenkin opettajan ja koulun tukea, opiskelijat eivät välttämättä itse näe eri verkkosovellusten mahdollisuuksia oppimisen välineinä. Opiskelijoille pitää ylipäänsä tarjota mahdollisuuksia käyttää TVT:aa kouluissa osana oppimista. Olennaista TVT:n opetuskäytössä on kuitenkin pohtia syitä eri sovellusten käyttöön, minkälaista oppimista haetaan, minkälaiseen toimintaan pyritään. Yhteisöllisen oppimisen teoriat tarjoavat näitä lähtökotia opetustyön kehittämiseen joihin TVT:a tarjoaa monipuolisia ratkaisuja.

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Read this very carefully, I will write this only once!

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The preparation of this dissertation has been a joyride that I recommend for everyone who wish to add excitement to their lives! For those about to DODT¹, I salute you!

Joensuu, April 2011

Teemu Valtonen

¹ Defend one's doctoral thesis.

Original articles

This dissertation is based on the following studies:

I Valtonen, T. Kukkonen, J., & Wulff, A. (2006). High school teachers' course designs and their professional knowledge of online teaching. *Informatics in Education*, 5(2), 301-315.

II Valtonen, T. Kukkonen, J., Puruskainen, T., & Hatakka, O. (2007). Verkko-oppimisympäristöt opettajien oppimiskäsitysten haastajina. *Kasvatus*, 39(5), 444-453.

III Valtonen, T., Kukkonen, J., Dillon, P., & Väisänen, P. (2009). Finnish high school students' readiness to adopt online learning: questioning the assumptions. *Computers & Education*, 53(3), 742-748.

IV Valtonen, T., Pöntinen, S., Kukkonen, J., Dillon, P., Väisänen, P., & Hacklin, S. (2011). Confronting the technological pedagogical knowledge of Finnish net generation student teachers. *Technology, Pedagogy & Education*, 20(1), 1-16.

V Valtonen, T., Dillon, P., Hacklin, S. & Väisänen, P. (Accepted). Net generation at social software: challenging assumptions, clarifying relationships and raising implications for learning. *International Journal of Educational Research*.

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1. Introduction

Information and communication technology (ICT) provide several ways to support teaching and learning (Koschmann, 1996, 2001; Lehtinen, 2006). Since the end of 1960s, the ways to use ICT for supporting learning have changed along with the evolving of theories of learning and developing technologies. Development has advanced from software supporting students' individual learning based on mechanical drills to more developed cognitive tools (Jonassen, 1992) and collaborative learning environments (Stahl et al., 2006). ICT in teaching has manifested in various forms from traditional computer labs and presentation technologies to online learning environments, social software and personal learning environments. Also, the development of mobile technologies has provided new flexible ways to use ICT for supporting learning (Naismith et al., 2004). The advantages of ICT have especially been noted in regard of supporting students' collaborative learning activities (Stahl et al., 2006; Stahl, 2003). Different ICT solutions provide tools for supporting collaborative learning in face-to-face teaching situations (Scardamalia & Bereiter, 2003, 2008), and within distance learning (Harasim, 2000). It has even been proposed that ICT will transform schools into knowledge building communities (Scardamalia & Bereiter, 2003; Mylläri et al., 2010).

Possibilities of information and communication technology (ICT) and collaborative and constructivist learning approaches have also been taken into account in the Finnish school system. The important role of ICT can be seen in the national strategies and curriculums. According to the Ministry of Education (2004) and the National Curriculum (Finnish National Board of Education, 2003, 2004), ICT should be used in education throughout the school system. Curricula of basic and secondary levels stress the use of ICT as part of schools' learning environments along with the constructivist and collaborative teaching and learning practices (Finnish National Board of Education, 2003, 2004). Students should be provided with skills required in the information society. The important role of ICT in education can also be seen in the aims of the National Board of Education to support teachers' ICT skills. The National Board of Education has funded teachers' in-service training since the 1990s. This so called Ope.Fi -training consist of three levels starting from basic ICT skills, proceeding to skills needed for teaching with ICT and further to expert skills, i.e., teaching the use of ICT to other teachers. The goal is to use ICT for developing pedagogically sound teaching and learning methods and to support the development of students' ICT skills, skills that are required of citizens of the information society.

ICT, and specifically the possibility for online learning, plays an important role in schools in the rural areas of Finland (Ministry of education, 2008). Schools are facing challenges due to the changing population structure and financial position. Decreasing numbers of students and the recession period are challenging, especially for small schools. Schools may have to reduce the amount of different courses they offer, which favours larger schools that have resources to offer more courses. This situation is

problematic; according to the Ministry of Education (2008), students should have equal possibilities for learning throughout the country. To reach this goal, ICT and online learning have been suggested as one possibility. This can be seen in different development programs and projects that have been firmly established in the school system, especially in eastern Finland. An example of a well-designed network is ISOVerstas (www.isoverstas.fi) which is a network of over 60 upper secondary schools and vocational schools mainly in eastern Finland. ISOVerstas provides schools with shared online courses, providing students with more variety of courses. Because of the online courses, the location of the schools does not affect their possibilities for learning and choosing the courses. ISOVerstas also provides in-service training for teachers and tools for sharing learning materials. In addition to ISOVerstas, there is a Virtuaaliluokka (Virtual classroom) –project that concentrates on developing practices for using recorded classroom teaching sessions to support distance learning. These networks provide well functioning examples of using ICT to support learning and overcome the challenges of schools in rural areas.

Making use of ICT in education has also become appealing because of the assumptions concerning today's student generation. Today's student generation has been portrayed as net generation or digital natives, indicating that they have lived their whole lives with different technologies (Tapscott, 2008; Prensky, 2001). The assumption is that students are used to think, act and learn with different technologies. In other words, technology has become an integral part of their everyday life. These assumptions pose interesting possibilities for designing teaching and learning environments. Students of the net generation are assumed to be ready to work collaboratively and to be able to use different ICT tools, especially different online environments (Oblinger & Oblinger, 2005; Hartman et al., 2007). These assumed abilities of today's students suit well with collaborative learning with ICT (Stahl, 2003; Harasim, 2000).

Net generation students are also assumed to be familiar with different online environments and especially with tools of social software (Hartman et al., 2007). Social software contains several features that can be used for supporting students' collaborative learning online and in face-to-face teaching situations (Cress & Kimmerle, 2008; Dron, 2007; Ferdig, 2007; Alexander, 2006). Social software contains elements that provide users with an active role as creators and publishers of contents, users are able to produce materials online and to provide feedback of each others' work and ideas. Social software provides possibilities especially for communicating and collaborating (Alexander, 2006; Boyd, 2003). With different ICT applications, including different mobile technologies and social software, we can create learning environments that support collaborative learning in a way that has been difficult before. For example, we can bring elements of collaborative learning into situations where it has traditionally been challenging, such as lectures (Valtonen et al., in press).

Even though these assumptions sound promising, they might also be seen as challenges for school and for teachers. In fact, the use of ICT in education in Finland seems not to be as common as expected (Kankaanranta & Puhakka, 2008; Ministry of Education and Culture, 2010 a). Schools do not necessarily have technology resources to meet those challenges and teachers' technological skills and skills to use new technologies in pedagogically sound ways are not necessarily sufficient. Kirsti Lonka

referred to this problem in her speech at the Finnish Annual Congress of Educational Research. She argues that the situation is problematic when pupils are used to employing different technologies but when they come to school they have to leave these “thinking prosthesis” home and adapt to traditional learning methods (Lonka, 2008). This is a challenge for schools and teachers that they have to respond to.

Using ICT for collaborative learning relates to a research area described as teacher thinking (Clark & Peterson, 1986), discussing for example technological pedagogical content knowledge (Mishra & Koehler, 2006; Koehler & Mishra, 2009) and conceptions of learning and teaching (Bulton-Lewis et al., 2001; Marton et al., 1993; Kember, 1997). Technological pedagogical content knowledge (TPCK) refers to an entity, a mixture of three knowledge areas concerning pedagogically sound ways to use appropriate technologies to enhance students’ learning (Mishra & Koehler, 2006; Koehler & Mishra, 2009). Research concerning TPCK relates closely to research on different conceptions of learning, especially pedagogical knowledge. Both these areas refer to teachers’ understanding about the nature of learning, providing frames for teachers’ concrete work and pedagogical solutions (Bulton-Lewis et al., 2001; Mishra & Koehler, 2006; Koehler & Mishra, 2009). Conceptions of learning and TPCK provide a research frame for describing the possibilities and challenges of using ICT for teaching, especially for supporting collaborative learning.

This research was conducted between 2003 and 2010. This dissertation is a descriptive study using both cross-section survey strategy and a case study strategy consisting of five studies discussing the above mentioned topics. The five studies were conducted using quantitative and qualitative research approaches as well as the mixed method research approach. The first two studies discuss teachers’ conceptions of learning and technological pedagogical content knowledge. These studies concentrate on teacher thinking, providing insight into teachers’ conceptions of learning and TPCK and how they align with supporting students’ collaborative learning with ICT. The last three studies focus on the net generation phenomenon, providing information on the appearance of the net generation phenomenon in eastern Finland. These studies concentrate especially on students’ ways to see the possibilities of ICT in education and their use of social software.

These five articles are connected to my work with teachers’ in-service training and with different development projects. Collaborative learning with ICT has always been an interesting topic for me. The interest rose especially from the tension between literature emphasising the collaborative nature of learning and the challenges this seems to set for everyday teaching and learning in schools. The research area of teacher thinking was especially interesting from this perspective, providing tools and knowledge about how this development could be supported with training and other resources, how teachers saw collaborative learning with ICT, its possibilities and its challenges. The first two studies in this dissertation are based on this work.

As the research progressed, two new interesting topics started to gain attention in the literature and conferences concerning teaching and learning with ICT. These topics were social software and net generation. Both seemed to provide new possibilities and also demands for developing teaching and learning in schools. I found these topics, especially net generation, important because of the assumptions they made about student skills in using ICT and preferences for student-centered and collaborative

learning activities. My expectation was that students, through their abilities and preferences, could be change agents in collaborative learning with ICT. The expectations arising from the literature concerning the net generation were strongly indicating the need for more research and research especially in the Finnish context. The last three studies concern the need for local information on the net generation. Altogether, these five studies provide insight into collaborative learning with ICT from two perspectives. The aim is that this insight can be used for further developing teaching and learning with ICT in a more collaborative direction.

The dissertation links closely to different development projects within the area of ICT in education and also to the work done with teachers' in-service training and teacher student training in the university of Eastern Finland TOTY unit (Tietotekniikan opetus käytön tutkimus -ja kehittämissyksikkö / Research and development center for information technology in education). In this dissertation, the ISOverkosto-project (nowadays ISOverstas) and Verkkosalkku II-project have been in central position providing viewpoints on the challenges and possibilities that using ICT for teaching and learning poses. Especially the work with teachers' in-service training has provided a point of view on the reality of teaching with ICT. These projects have also allowed gathering research material focusing on teachers' and students' perspectives. In addition to different projects, collaboration with teacher training has also provided interesting research material and a picture of future teachers and their ideas regarding the possibilities of ICT in education.

2. *Theoretical framework*

This dissertation concentrates on perspectives of teacher thinking and the net generation phenomenon within the context of collaborative learning with ICT. Theoretical framework proceeds in four phases describing the development phases of using ICT for teaching and learning, theoretical background of collaborative learning, teacher thinking and the net generation phenomenon. The first phase describes the development history of ICT in education, focusing on development from the pedagogical and technological perspectives. This phase emphasises the strong relation between collaborative learning and teaching and learning with ICT. The second phase focuses on the theoretical background of collaborative learning, defining the characteristics and mechanisms of learning that build the basis for collaborative learning practices. The aim of the first two phases is to compose a background for studying the elements of collaborative learning with ICT from the perspective of teacher thinking and the net generation phenomenon.

The third phase of the theoretical framework concentrates on teacher thinking, building a summary of different ways to describe teacher thinking. The summary proceeds from abstract conceptions of learning to more concrete actions in a teaching situation. The aim of this summary is to provide a background for studying collaborative learning with ICT from teachers' perspective in the Finnish context. The fourth phase concentrates on the net generation phenomenon. There is a current trend of describing characteristics common for the generation that has grown up with technology. The characterisations, i.e. alleged assumptions concerning the net generation give reason to expect certain preferences of learning and using ICT. This, in turn, opens possibilities for developing collaborative learning with ICT. Net generation will also be discussed in the context of social software and mobile computing which are assumed to be familiar to the net generation students.

2.1. DEVELOPMENT OF ICT IN EDUCATION

This chapter provides an overview of different phases of development in the use of ICT in education, starting with the descriptions by Koschmann (1996; 2001), Lehtinen (2006) and O'Malley et al. (2003) and adding recent approaches of using ICT for education. There have been several phases in the development of ICT in education. Koschmann (1996; 2001) refers to these phases as paradigms using the model of scientific revolutions by Kuhn, indicating that new paradigms emerge challenging the previous ones and possibly leading to the abandonment of one paradigm over another. Starting from the end of the 1960s, Koschmann (1996) describes the development of ICT in education with four paradigms. Lehtinen (2006) describes similar phases of development referring to them as "utopias". By utopias, he refers to the strong positive

expectations that have been connected to learning with certain technologies and with certain ways of using those technologies. O'Malley et al. (2003) focus on learning theories, describing the history of learning theories and their influence on teaching and learning with ICT.

The first phase of the development was based on the behaviouristic theory of learning suggesting that learning goals must be divided into smaller pieces, i.e. smaller tasks that students accomplish. Accomplishing these smaller tasks will eventually lead to achieving the original learning goal. ICT provides students with a "tireless trainer" that gives instant feedback and control over separate tasks. Typically, software has been so called drill-and-practice software. Koschmann (1996; 2001) refers to this phase as "Computer-Assisted Instruction (CAI) paradigm", while Lehtinen (2006) describes this phase as "utopia of tireless and individual trainer".

The second phase emerged in the 1970s–1980s and has been described as "utopia of intelligent tutor" or "ITS paradigm", referring to development based on theories of artificial intelligence (AI) and theories of information processing. The assumption was that it is possible to design software that emulates the thinking and problem solving of domain experts. The idea was that these "intelligent" technologies can also work as skilled teachers or tutors, providing every student with personal tutors that follow the progress of learning and provide feedback and support when needed. Although these first two phases of development have distinct features, the basic ideas of learning and knowledge are similar, as Koschmann (1996) defines it "the first is implicitly behaviouristic and the other explicitly cognitive", both of them consider learning as delivery or transmitting of information.

The next phase, "utopia of the micro-worlds" (Lehtinen, 2006) or "Logo-as-Latin Paradigm" (Koschmann, 1996; 2001), began in the early 1980s and is grounded in the constructivist theories of learning. Instead of learning as delivery, learning was seen as subjective construction of knowledge. ICT was used for providing students with environments for active inquiry and discovery. With ICT it was possible to make students' thinking "visible", students could see the results of their problem solving, how it worked in practice. Roles of the students and the computer changed, students were the ones making decisions and trying ideas, computer providing a safe environment for working and testing ideas. Typically, these environments were different micro-worlds and simulations, such as for example Logo programming language.

The next phase of the development of ICT in education has been described as "Computer Supported Collaborative Learning (CSCL) Paradigm" (Koschmann, 1996; 2001) or "utopia of collaborative learning" (Lehtinen, 2006). This phase emerged in the early 1990s, emphasising the collaborative and social factors of learning. According to Koschmann (1996), the difference between CSCL and Logo-as-Latin paradigms is in the "situating of the mind". Where Logo-as-Latin paradigm views mind as "residing within the head of the individual", CSCL paradigm places the mind within socio-cultural environment. In addition to changes in theories of learning, also the development of technologies provided new possibilities for collaborative learning with ICT. Probably the best known example of new technologies for supporting students' collaborative learning and knowledge building was the Computer Supported Intentional Learning Environment (CSILE) which provided tools for supporting students' collaborative

knowledge building. Later, especially with the development of the Internet, several different online environments (Moodle, FLE, Blackboard, Verkkosalkku) that can be used for supporting collaborative learning have emerged. The aim of ICT was to support students' collaborative work, sharing and explicating ideas and unique knowledge structures, to provide a means for communication and inquiry and collaborative creations of knowledge.

Along with these phases, Lehtinen (2006) also describes utopias of multimedia and virtualisation. "Utopia of multimedia" refers to an idea that new technologies provide possibilities to effectively and interactively illustrate difficult content areas for students. "Utopia of virtualisation" refers to development of the Internet and providing students with possibilities for learning regardless of time or place.

These approaches to ICT and education still show in different theories of learning and different technologies that address different learning needs (O'Malley et al., 2003). Naismith et al. (2004) describe the use of mobile technologies for different purposes varying from simple drill-and-practice software to software supporting students' collaboration. Also Lyytinen et al. (2009) have showed the possibilities and effects of drill-type software for helping students to overcome problems with reading and spelling difficulties. It seems that different technologies are available and used flexibly, without emphasising paradigmatic categorisation. For example, where Logo-as-Latin paradigm was based on personal inquiry and discovery, similar tools are nowadays actively used for supporting students' collaborative learning, allowing students to program robots in small groups (Eronen et al., 2002). As Lehtinen (2006) notes, technology itself does not affect learning, the important thing is how different technologies are used and for what purposes. This notion emphasises the important role of teachers and students who decide how ICT is used for supporting learning.

Nowadays it seems that the role of collaboration is central within teaching and learning with ICT. According to Scardamalia and Bereiter (2008), "Collaboration has become something of a mantra for Knowledge Age education". Emphasis on collaborative learning goes well with the emergence of web 2.0. Web 2.0 has provided several online environments, i.e., social software that set users in an active role producing contents and collaborating and interacting with each other (Alexander, 2006). According to Ferdig (2007), these tools provide numerous possibilities that are in accordance with the theories of collaborative learning (more details in chapter 2.3.3.). Also, different mobile technologies provide tools for supporting collaborative learning. Even though the use of mobile technologies is often connected with one-to-one computing, i.e., one computer for each student, the aim has still been in fostering the collaboration (Looi et al., 2009). Mobile technologies provide interesting ways for taking advantage of ICT wherever needed, extending the classroom to different online environments (more details in chapter 2.3.4.). With mobile technologies and social software it is possible to take advantage of collaborative learning in a way that has previously been difficult. For example, in a pilot study by Valtonen et al. (in press), students were provided with a possibility to write their lecture notes in a shared online environment. The idea was to connect typical lecture teaching and social software using mobile technologies to provide collaborative elements to lectures.

The development of ICT in education will continue with different pedagogical approaches and different ICT solutions. A notion by Chan et al. (2006) provides a view

on the fast development of ICT in education when they describe the possibilities of one-to-one approach and note that after some years, the term one-to-one may lose its meaning when personal mobile technologies become a seamless part of everyday teaching and learning. According to Naismith et al. (2004), the next challenge will be taking advantage of students' mobile technologies: "educators should seek to exploit the potential of the technologies children bring with them and find ways to put them to good use for the benefit of learning practice". This way, we would be aiming at so called "digital wisdom" Prensky (2009), i.e. extending cognitive capacity with different technologies (Prensky, 2009).

In this dissertation, the aim is to describe collaborative learning with ICT from teachers' and students' perspectives. The reason for not using the term CSCL is based on the rather strong paradigmatic weight of CSCL described above. When collaborative learning with ICT is mentioned in this dissertation, it refers to the same pedagogical approaches and theories of learning that the CSCL paradigm (see next chapter), the difference being mainly the technological perspective. While the different paradigms presented above carry a notion that certain technologies are connected with certain paradigms, the aim here is to describe collaborative learning with ICT without limiting the technologies and software used for supporting collaboration.

2.2 COLLABORATIVE LEARNING WITH ICT

The development of ICT in education indicates a connection between collaborative learning and ICT. The important role of collaborative learning also comes up in research concerning technology integration (Ertmer, 1999; Becker, 2000). Ertmer (1999) describes barriers that a teacher has to overcome when integrating technology into teaching. One of these is teacher's beliefs concerning teaching and learning. The assumption is that integration of ICT into teaching demands teaching and learning methods based on constructivism and collaboration. The same requirement can be seen in the research concerning teacher thinking, especially as part of teachers' technological pedagogical content knowledge (TPCK) (Mishra & Koehler, 2006; Koehler & Mishra, 2009). According to Mishra & Koehler (2006), TPCK should contain a vision about how to combine technology, pedagogy and content to support constructivist learning. The same requirement also shows in online learning (Harasim, 2000). According to Syh-Jong (2006), web-based learning environments are based on constructivist and collaborative approaches to learning, for example the Moodle learning environment is designed to "create online courses with a focus on interaction and collaborative construction of contents" (Wikipedia, 2010). The link between the use of ICT in education and collaborative learning practices has created expectations of that the use of ICT will eventually change teaching practices in schools. For example, Scardamalia & Bereiter (1994) describe CSILE as a tool for changing the whole school into a knowledge building community, stressing students' collaborative work. Dillenbourg (1999) describes collaborative learning as a "situation in which particular forms of interaction among people are expected to occur, which would trigger learning mechanisms".

Theoretical influences of collaborative learning mainly derive from socio-constructivist and socio-cultural approaches to learning (Weinberger, 2003; Dillenbourg et al., 1996).

2.2.1 *Socio-constructivist approach*

Socio-constructivist approach describes the mechanisms of learning with different cognitive processes. Even though the point of view is on individual level, the collaborative practices have an important role as triggering elements for individual cognitive processes. According to socio-constructivist theory, people's knowledge structures, so called schemas, direct people's attentions, actions and learning. The assumption is that people search for logical coherence in understanding to maintain coherence between their knowledge structures and their contexts. This process is called *equilibration*. People have numerous intertwined schemas based on their earlier experiences and learning. These structures provide people with tools for different situations and for accomplishing different tasks and problems. (Dillenbourg, 1999; Weinberger, 2003)

In situations where one cannot comprehend a new phenomenon based on earlier knowledge, one has to reconstruct, or update, knowledge structures to better correspond with the new situation. Updating of knowledge structures is based on processes called assimilation and accommodation. Assimilation refers to situations where people redefine their knowledge structures based on a new perception or experience, incorporating new information to earlier structures. Accommodation refers to a situation where a new experience or perception is not compatible with earlier knowledge. This situation means that a person has to change his or her schemas to create new knowledge structures. (Limo'n, 2001; Weinberger, 2003)

A central process concerning learning is the so called cognitive conflict which links closely to the search for logical coherence and assimilation and accommodation. Cognitive conflict refers to situations where a new situation or experience does not correspond to earlier knowledge. These situations may be collaborative involving other people's opinions and ideas or simply new situations that are not familiar, demanding new ways to act. This indicates that every situation demands some level of updating of knowledge structures because each situation is unique. In other words, cognitive conflict refers to a situation demanding substantial changes leading to assimilation or accommodation. Cognitive conflict can be seen as a triggering event to restructuring the knowledge structures. (Dillenbourg, 1999, Limo'n, 2001; Weinberger, 2003)

Unique situations together with individual knowledge structures create favourable circumstances for cognitive conflicts. When an individual is not able to understand a new situation, one has to ask questions, find new information or reflect his or her own knowledge structures in order to solve the conflict. One has to assimilate or accommodate knowledge structures, i.e., learn and create something new. Although new situations are expected to trigger conflicts and thinking, the new situation has to be within learner's range of knowledge structures. The learner must have some knowledge structures to deal with the new situation to be able to understand and interpret it. Without earlier knowledge one does not comprehend the situation and the cognitive conflict is not meaningful (Limo'n, 2001; Posner et al., 1982). A new, unfamiliar situation may also lead to a so called cognitive overload, indicating that the situation

demands too much of the cognitive capabilities. These situations call for strong support for the learner in order to accomplish the tasks (Limo'n, 2001).

Based on the socio-constructivist theory of learning, collaborative methods provide good possibilities for cognitive conflicts and for negotiation of different perspectives for solving those conflicts (Derry, 1996). Weinberger (2003) describes externalisation as a method supporting the generation of cognitive conflicts and learning. Externalisation refers to a situation where students explicate their knowledge structure. This way, their conceptions and possible misconceptions become accessible for other learners in the group, which possibly leads to cognitive conflicts. This method is also essential because it brings up possible "cognitive gaps", the areas that a student needs to know. This promotes students' reflective thinking, the awareness of one's knowledge structures and also awareness of possible conflicts. In addition to students explicating – talking or writing about their ideas – they have to rethink and convert their knowledge structures in a more linear and solid form. The other method for generating cognitive conflicts is called elicitation (Weinberger, 2003). Elicitation links closely to externalisation, referring to a situation where students use their peers as a learning resource by asking questions. This method promotes awareness of one's knowledge structures and reveals cognitive gaps and elicits cognitive conflicts.

2.2.2 Socio-cultural approach

The other main approach concerning collaborative learning is the socio-cultural approach (Weinberger, 2003). Socio-cultural approach stresses the importance of socio-cultural activities, the inter-relation between individual and the environment. An essential part of learning and knowledge construction is the interdependence between individual and social processes leading to the development and use of conceptual and material tools, e.g. language, concepts, software, formulas etc. These tools are culturally and historically located; each generation modifies and develops them according to the socio-cultural circumstances in which they are working. Individuals have access to these tools and products by engaging in the practices of their communities. These tools mediate interaction between individuals and social contexts; with these tools, people are able to participate in and further develop them. Learning and development is thus placed in the context that is culturally and historically shaped. (John-Steiner & Mahn, 1996)

According to Vygotsky (1978), learning takes place on interpersonal and intrapersonal levels. First, the process of learning appears on interpersonal level which refers to the social level between people and artifacts mediated by conceptual and material tools. Next, the learning process appears on the intrapersonal level, as part of individual understanding. This process is called internalisation. The interpersonal processes become intrapersonal as a result of the process where interpersonal and intrapersonal levels mutually inform each other. People become able to carry out actions without any apparent external assistance. Internalisation is a process that happens through the use of the conceptual and material tools – psychological tools. (Dillenbourg et al., 1996; Dillenbourg, 1999; Lantolf, 2000)

The concept of internalisation with separated inter and intra levels has also received criticism as a model that defines learning as a dualistic process where something external is transmitted to the learner (Säljö, 2001; Rogoff, 1995). Instead of

this “one way” model, learning can be described as culturally mediated practical intersubjectivity where both the learner and teacher are in an active role in the learning process, creating the learning environment with their earlier knowledge and ideas (Dillon, 2004). Säljö (2001), Rogoff (1995) and Hartikainen (2007) use the term appropriation, fostering a more active role of the learner and the continuous interaction of interpersonal and intrapersonal levels. According to Rogoff (1995), the term appropriation has been used in literature with three different meanings:

- Something external is imported
- Something external is imported and fitted to the purposes of the new owner - more than transformation – appropriation of cultural resources and tools
- Participatory appropriation – a person is participating in an activity and thus becoming part of the activity – the social world is not an external entity

The first two meanings relate closely to the concept of internalisation. The third, participatory appropriation, stresses the active role of the individual as part of the social world, fading the distinction between external and internal. Rogoff (1995) describes appropriation as a dynamic approach, stressing thinking, remembering and planning as an active process linked to the events and activities that people participate in. Participation demands effort for understanding and contributing, being able to bridge between the different ways of understanding the situation. This involves adjustments between the participants and stretching their understanding through which people reach a shared understanding and accomplishing something together.

Participation and appropriation become more concrete with the concept of zone of proximal development (ZPD). ZPD refers to the distance between the levels of the tasks that a student is able to carry out independently and the potential level that the student can accomplish under the guidance of an expert or in collaboration with more capable peers (Säljö, 2001; Silvonon, 2004). With the support of a more experienced person, a group of peers or learning materials, the student is able to participate and appropriate, i.e., learn. The idea of ZPD as a student’s personal level has been updated toward a shared ZPD, indicating that instead of individual students’ ZPD, ZPD can be understood as the potential of a group (Wells & Claxton, 2002). Mercer (2002) refers to a similar idea using the concept of Intermental Development Zone (IDZ) which means students’ and teacher’s shared frame concerning the activities in which they are engaged in, considering the knowledge, skills and motivation of all participants. Also, Dillon (2004) stresses the importance of the more reciprocal relationship between the students and the environment. This indicates that the student also affects the environment. In other words, working on the ZPD is not only a “change” that the student experiences. Learning is based on interaction and transactions between persons, environment and culture (Dillon, Wang & Tearle, 2007).

Lave and Wenger (1991) describe communities of practice indicating different communities that are organised around some common interest, particular activity or knowledge. These communities have shared ways of working, shared activities, norms giving the sense of identity. Newcomers participate in the activities with more experienced persons, bringing their earlier knowledge, skills and ideas with them. Newcomers participate actively in the practices of the community and learn as they

participate. As they learn, they move toward the “center” of the community, bringing their own effort and knowledge to the community thus supporting the further development of the community.

2.2.3 Common elements and challenges

Socio-constructivist and socio-cultural approaches describe learning from different angles. Socio-constructivist approach describes learning from an individual point of view with cognitive conflicts leading to assimilation and accommodation, reorganising and creating students’ knowledge structures. Socio-cultural approach describes learning from a cultural point of view as appropriation of different tools developed through the history of culture. Students become able to use the tools and to develop them further. Socio-constructivist and socio-cultural approaches both stress the importance of collaboration activities in the learning process. Socio-cultural theory refers to collaboration as a tool for students to bridge between different ways of understanding the situation, involving adjustments between participants and stretching shared understanding. Socio-constructivist theory refers to the same phenomenon with solving the cognitive conflicts, meaning that students deal with different interpretations and find ways to understand and overcome these differences. Both theories also stress the importance of learners’ earlier skills and knowledge level to be able to comprehend a learning situation, to learn and apply their knowledge. According to socio-cultural theory, the new areas have to be within students’ zone of proximal development. Socio-constructivist theory refers to the same challenge with students’ adequate knowledge structures, so that they are able to understand, interpret and learn about new situations. These processes are expected to lead to learning. According to socio-cultural theory, we can talk about appropriation and according to socio-constructivist approach we refer to assimilation and accommodation. All these terms refer to a situation where students become capable of using the studied contents as part of their activities.

These theories examine learning on a fairly abstract level. More concrete outcomes of collaborative learning can be seen in different development projects and models based on mechanisms of learning described above. For example, in the CSILE project (Computer Supported Intentional Learning Environments) and later, in the Knowledge Forum, ICT tools were produced to foster students’ knowledge building by supporting and scaffolding students’ higher level thinking and collaborative activities (Scardamalia & Bereiter, 2008). Technology provides tools for preserving, sharing, revising and superseding of ideas aiming at knowledge building and advancing the frontiers of knowledge between students (Scardamalia & Bereiter, 2003). Theories of collaborative learning are also concretised in the model of progressive inquiry (Hakkarainen et al., 1999). The model of progressive inquiry describes students’ collaborative activities in order to achieve higher level thinking using a cyclic model with different overlapping phases. The phases provide a picture of the nature of inquiry and collaboration and provide a concrete suggestion about how to use inquiry as a tool for learning.

ICT can work as a tool helping to create learning environments and learning situations to put the above mentioned theories of learning into practice. ICT has been used as a source for collaborative activities, inquiry, dialogue etc. The source can be a simple web page as a shared point of reference or a more complex simulation, virtual

world, game etc. ICT also provides different platforms for collaborative activities supporting students' shared knowledge building. These platforms like Moodle, Blackboard, Blogger, Wikispace etc. can be used to support collaborative activities within classrooms or online courses. In my opinion, an interesting "new" development with ICT and education is the possibility to capture, bring up and share students' knowledge, knowledge gaps, unique interpretations, opinions etc. as resources for further learning. This kind of approach fits especially well with different mobile technologies and social software. Mobile technologies are constantly with students, providing them with access to the Internet and to the social software designed for sharing ideas and thoughts. Students can bring up their ideas and thinking by writing, taking pictures or videos etc. in different learning situations from lectures to work practices and share them with their peers and teachers. This opens up interesting possibilities also for teachers to get a better understanding of students' learning processes. (More about social software and mobile technology in chapter 2.4.)

Another interesting "new" feature with online environments, especially using different social software, is the possibility to interconnect them to each other using feeds such as RSS and ATOM. With these connections, students and teachers can be made more aware of each others' work, ideas and goals. Tools used for learning in schools can be integrated into students' everyday online environments. With RSS feeds, the development for example in the blogs used for learning projects can be brought to students' everyday software, such as Facebook i.e. to bring schools closer to students' world outside school (Valtonen et al., 2011). My expectation is that easy access to and the active presence of school activities, especially activities done with their friends, might support and motivate students' engagement in their school work. A greater presence of peers' work would also provide active channels for interaction, changing of ideas and knowledge construction. Still, the question is how students react to situations where school activities become more visible parts of their spare time.

2.2.4 Motivations and emotions in collaborative learning

Descriptions of collaborative learning above provide a rather cognitively accentuated view about learning, without motivational and emotional factors. Pintrich et al. (1993) describe a cognitively stressed view about learning as cold and overtly rational and emphasise the importance of motivational and affective factors, i.e., intrinsic and extrinsic learning goals, students' personal interest, self-efficacy, beliefs etc. Meyer and Turner (2006) argue motivations and emotions important, affecting students' participation in collaborative activities and learning. Motivational and emotional factors can be considered both facilitators and obstacles for learning affecting students' participation and interaction and also focusing students' work and cognitive engagement (Pintrich et al., 1993; Meyer & Turner, 2006).

According to Jones and Issroff (2005), there is strong evidence of collaborative learning as a motivating and rewarding approach to learning. However, collaborative learning where students are working with other students with their unique motives and emotions can also pose challenges for learning. Students must cope with their own motives and emotions and at the same time, consider motives of other students (Järvenoja & Järvelä, 2009). Also, a collaborative learning situation may be new for students causing changes in students' motivational orientation (Järvelä et al., 2000).

Järvelä et al. (2010; 2008) discuss the dynamics of the motivational factor concerning collaborative learning. Motivational factors can be described within a socially influenced approach and a socially constructed approach. Socially influenced approach defines motivation as a psychological, individual phenomenon which is affected by social context. Socially constructed approach indicates that motivation emerges in the social context through interaction between members of the group. According to Järvelä et al. (2010), even though these approaches have been typically studied separately, the individual and social aspects should be seen as parallel factors affecting learning

Motivational and emotional factors are part of students' experiences of belonging and identification to a group (Thompson & Fine, 1999). Jones and Issroff (2005) refer to social affinity and safe environment as elements for supporting successful collaborative learning. Rovai (2002) refers to this phenomenon as sense of community. Sense of community means feeling of belonging to a group, feeling that members of the group matter to one another. This feeling affects students' participation and interaction, students should be able to trust the community, so that they have the courage to bring up their own and unique ideas and opinions. Students with a low sense of community typically feel isolated and they are at risk of dropping out of the course (Rovai & Jordan, 2004). Sense of community can be challenging to achieve especially on online courses where students do not necessarily know each other. In these cases, building the sense of community, getting to know each other during a short course is a difficult, although important task. According to Tolmie and Boyle (2000), in order to create a working community, the members of the community need knowledge of other participants, knowledge about how they work and about their earlier experiences and ideas.

Theories of collaborative learning provide possibilities and challenges for teachers. They also provide guidelines for designing learning, although collaborative teaching and learning practices may be difficult to carry through in practice. This is especially difficult if teachers' conceptions of learning do not align with theories of learning stressing the importance of collaboration and students' active role. This topic will be discussed in more detail in the next chapter.

2.3 TEACHER THINKING

Socio-cultural and socio-constructivist theories provide approaches to learning based on educational research. These theories can be described as "scientific theories". In addition to "scientific theories", there are teachers' own unique interpretations and conceptions about the nature of learning and teaching. These conceptions may or may not reflect the scientific theories of learning described above. They are teachers' subjective interpretations about the nature of learning. Conceptions of learning are assumed to direct teachers' work, providing a frame for teachers' decisions and ways to design, conduct and evaluate courses and classes. This topic is important when considering collaborative learning with ICT. As Lehtinen (2006) argued, technology itself does not affect learning but the ways and purposes the technology is used for.

2.3.1 Levels of thinking

Teachers' thinking has been studied in numerous studies using various terminologies. Typically, teacher thinking has been described using different levels (Clark & Peterson, 1986; Aaltonen & Pitkäniemi, 2001; Calderhead, 1996). Clark and Peterson (1986) describe teacher thinking using three domains. The first domain is teachers' planning (pre-active and post-active thoughts) which refers to planning before the teaching and also, to reflective thinking after the teaching session. The second domain, teachers' interactive thoughts and decisions, refers to the actual teaching situation where teachers have to apply their plans but also react to the changing situations in the classroom or in some other learning environment. The third domain, teachers' theories and beliefs, refers to teachers' knowledge about the nature of teaching and learning, providing frames for interactive thinking and pre-active and post-active thinking (Clark & Peterson, 1986). Kansanen (1995, 1993) refers to the model by König and describes teachers' work using three different levels, namely action level, first thinking level and second thinking level. Action level refers to the actual teaching situation. The first thinking level consists of so called object theories, referring to theoretical models concerning the action level. Object theories form the second thinking level, i.e. metatheory. Metatheory refers to a "potential totality", i.e. an abstract theory of education providing frames for object theories and the action level. Aaltonen and Pitkäniemi (2001, 2002) describe teacher thinking using four different levels. They divide thinking to practical theories, scripts, agendas and interactive thinking. Practical theories indicate teachers' subjective theories and knowledge about teaching and learning, providing a frame for the following levels. Scripts and agendas indicate more concrete knowledge about how some particular topic should be taught to certain students. The last level, interactive thinking, refers to actual teaching situations.

The terminology regarding teachers' thinking has often been overlapping (Aaltonen & Pitkäniemi, 2002). Common for all these descriptions is that different levels form a structure so that "upper levels" create frames for "lower levels". Upper levels, i.e., teachers' theories and beliefs (Clark & Peterson, 1986), metatheories (Kansanen, 1995, 1993) or practical theories (Aaltonen & Pitkäniemi, 2001, 2002) contain knowledge that affects teachers planning and interactive thinking by setting the frames for conducting teaching and choosing different teaching practices (Aaltonen & Pitkäniemi 2001, 2002; Clark & Peterson 1986). Typically, the "upper level" knowledge is rather abstract and difficult to articulate, implicit knowledge. "Lower level" information, i.e., interactive thinking (Clark & Peterson 1986), scripts and agendas (Aaltonen & Pitkäniemi, 2002; Putnam 1987) and activity level (Kansanen, 1995, 1993) refers to more concrete representations of teachers' knowledge, containing information about teaching methods, aims of the teaching, evaluation etc. Typically, these levels are easier to articulate and better acknowledged.

Changing conceptions of learning is a challenging and time consuming task (Boulton & Lewis, 2001; Briscoen, 1991; Appleton & Asoko, 1996). Schön (1987) refers to teachers' thinking by the term knowing-in-action and reflection-in-action. Knowing-in-action refers to the actual teaching situation and reflection-in-action refers to evaluation of the teaching. The assumption is that teaching experiences would contribute to teacher thinking, i.e., knowing-in-action (Schön, 1987) or teachers' theories (Clark & Peterson, 1986) or practical theories (Aaltonen & Pitkäniemi, 2001). However, the

development is a slow process. According to Shullman (1986), experiences of teaching situations tend to remain momentary realisations that do not necessarily consolidate teacher thinking. Changing teacher thinking demands special strategies and actions.

In this research, the upper level knowledge of teachers' thinking is described as conceptions of learning. Conceptions refer to abstract entities that provide a frame for people's actions and ways to interpret different occasions (Pratt, 1992; Häkkinen, 1996). In this research, conceptions of learning are understood as rather abstract entities regarding the nature of learning. They are tacit by nature and difficult to articulate. The assumption is that conceptions of learning frame teachers' pedagogical practices in their actual teaching work. Research on conceptions of learning has focused both on students' conceptions (Marton et al., 1993; Säljö, 1979; Tynjälä, 1997) and teachers' conceptions (Bulton-Lewis et al., 2001). As a related topic, conceptions of teaching have also been studied with congruent results (Kember, 1997; Kember & Gow, 1994). Conceptions of learning provide an interesting background for teacher thinking, describing different perceptions of the nature of learning and how these align with collaborative teaching methods.

2.2.2 Conceptions of learning

Conceptions of learning have been studied in order to describe different ways to understand and conceptualise learning. Results of the studies have proved congruent, despite the varied target groups. Säljö (1979) studied students' conceptions of learning ending up with five conceptions. Later, Marton et al. (1993) repeated the research adding one more conception and ending up with six different conceptions:

- Increasing one's knowledge
- Memorising and reproducing
- Applying
- Understanding
- Seeing something in a different way
- Changing as a person

Similar research has been conducted with teachers. Boulton-Lewis et al. (2001) studied secondary teachers' conceptions of teaching and learning and Kember and Kwan (2000) studied lecturers' approaches to teaching. Kember (1997) also conducted a review research concerning university academics' conceptions of teaching, resulting in the following concepts:

- Imparting information
- Transmitting structured knowledge
- Student teachers' interaction / apprenticeship
- Facilitating understanding
- Conceptual change / intellectual development

The results typically indicate two tendencies concerning the nature of teaching and learning. First, there are conceptions that see learning mainly as transferring of information, setting the learner to a rather passive role of absorbing information. In

other words, teaching is seen as transmitting of information. Contrasting tendency places students in a more active role and participators in the learning process. Learning is seen as a more comprehensive process where students construct new understanding and thus become able to understand and see things in a new way. In other words, learning means intellectual development and changing as a person. Teacher's role is mainly to facilitate and support these processes. These two main tendencies form the ends of a continuum. Depending on the respective definition of learning, conceptions of learning lean toward either end of the continuum. (Kember & Kwan, 2000; Boulton-Lewis et al., 2001; Marton et al., 1993; Kember, 1997)

2.3.3 Technological pedagogical content knowledge

Teachers' conceptions of learning direct their teaching practices, providing a pedagogical frame for teaching methods they use. Conceptions of learning relate closely to the concept of pedagogical content knowledge (PCK). The concept was introduced by Shulman (1986, 1987) who describes teacher knowledge as a mixture of pedagogical knowledge and knowledge about the content. According to Shulman (1986, 1987), teaching demands more than knowing pedagogy and contents, it demands a combination of these in order to transform the content, the subject to be taught, into a form that is easy to access and understand by students. Compared to conceptions of learning, PCK provides a more concrete approach to teaching, including knowledge about students' typical misconceptions, difficult subject areas, knowledge about analogues and examples of demonstrating the content etc. In this dissertation, the assumption is that teachers' conceptions of learning align with their PCK, framing their teaching methods and practices.

Pedagogical content knowledge has been developed further to include a view of using ICT in teaching, resulting in the concept of technological pedagogical content knowledge (TPCK) (Mishra & Koehler, 2006; Koehler & Mishra, 2009). Technological pedagogical content knowledge provides insight into the ways that teachers employ ICT to transform their content knowledge in a form that is easy to comprehend. According to Koehler & Mishra (2005, 2009), TPCK adds the following elements to pedagogical content knowledge:

- **Technology knowledge:** this indicates teachers' skills to use different technologies and awareness of the different possibilities and constraints that technologies have. Technology knowledge can also be seen as a larger entity, indicating also interest in technological development and different technologies. An example would be awareness of and interest in social software; knowing what kind of software there are, for what purposes and how to use them.
- **Technological content knowledge:** refers to understanding of the connection between different technologies and knowledge about the content area. Technological content knowledge means teachers' understanding of which technologies and software work with certain topics, how the technology used and content to be taught influence and possibly constrain each other.
- **Technological pedagogical knowledge:** this area of teacher knowledge means understanding how teaching and learning changes when introducing and using

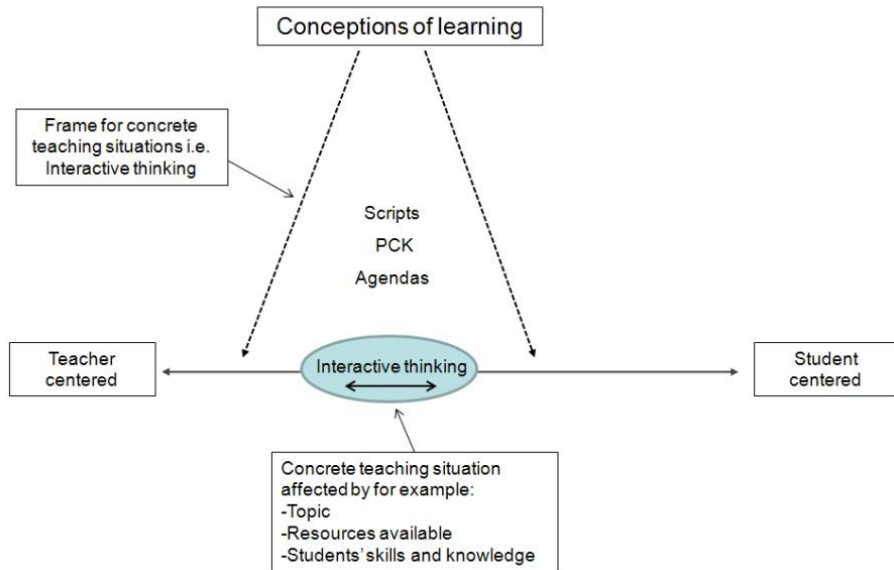
different technologies. Technological pedagogical knowledge refers to understanding of the benefits and constraints of different technologies when using them in teaching, indicating deep understanding of the characteristics of technologies available. This area of knowledge is important when we consider software used in teaching. Software such as social software or office tools is rarely designed specifically for teaching. This leaves the teacher to decide and apply them in teaching based on his or her judgment on the benefits of different tools for learning.

The three elements merge in the concept of technological pedagogical content knowledge, which refers to the ideal interaction of content, pedagogy and technology knowledge for supporting students' learning and understanding of a subject matter. TPACK refers to teachers' understanding of the relation, possibilities and constraints of these three dimensions. TPACK means knowledge that is more than separated knowledge areas, knowledge that extends beyond the knowledge of pedagogy, technology and content. It means teacher's ability to navigate between these elements in order to transform the content as accessible as possible for students with technologies most suitable for the purpose.

2.3.4 Teacher thinking in this dissertation

In this dissertation, teacher thinking encompasses the theories and assumptions described above. The theories are combined into a model (Figure 1) that presents teacher thinking from abstract conceptions of learning to interactive thinking in concrete teaching situations. Conceptions of learning create a frame for an actual teaching situation. In figure one, this means that interactive thinking can move between teacher-centered and student-centered extremes within the frame of conceptions of learning. For example, if teacher's conceptions of learning lean toward teacher-centered ideas, the teaching situation is likely to build around teacher's lecturing or other similar methods where students are mostly in a passive role. Similarly, if teacher's conceptions of learning lean toward student-centered ideas, the outcome is likely to contain collaborative elements, such as for example inquiry based activities. The final outcome, interactive thinking, can move between the frames of conceptions of learning depending on, for example, the topic, resources available, students' skills and earlier knowledge, etc.

Figure 1. Teacher thinking



Teachers' conceptions of learning and technological pedagogical content knowledge provide a frame for studying collaborative learning with ICT from teachers' perspective. Conceptions of learning and technological pedagogical content knowledge will be the topics of three studies in this dissertation. The first study "High school teachers' course designs and their professional knowledge of online teaching" describes upper secondary level teachers' ways to use the Moodle online learning environments on online courses. Thirteen courses were analysed in order to reflect them in the light of TPCK. The second study "Verkko-oppimisympäristöt opettajien oppimiskäsitysten haastajina" concentrates on polytechnic teachers' conceptions of learning in a situation where they were first starting to use online learning environments. With these studies, the aim is to examine how the assumptions of ICT and collaborative learning show in reality in teachers' conceptions of learning and their designed online courses.

2.4 NET GENERATION

Teachers' thinking and their teaching methods affect students' ways and possibilities to learn in schools, although the characteristics of students also affect teachers' choices and ways to teach. According to Shullman (1986, 1987), pedagogical content knowledge contains information about the students and their abilities and skills. The characteristics of today's students have been gaining more attention recently. Today's youth have been described as net generation (Tapscott, 2008) and digital natives (Prensky, 2001), based on the idea that through their lives, they have been influenced by different technologies. According to Prensky (2001), there is a gap between the digital natives, students, and their teachers, the digital immigrants. Prensky assumes that this gap poses challenges

for schools and teachers. According to Prensky (2001), the problem is that “our Digital Immigrant instructors, who speak an outdated language (that of the pre-digital age), are struggling to teach a population that speaks an entirely new language”. Net generation is also interesting from the collaborative learning point of view. Assumptions concerning students’ preferences for learning and using ICT align with the ideas of collaborative learning with ICT.

2.4.1 Net generation and learning

Several assumptions about the net generation have been presented, especially in regard of their ways to use ICT and their preferred ways to learn. These assumptions are interesting because they have several convergent points with the pedagogical approach of collaborative learning with ICT. Net generation students’ ways of learning are characterised as:

- Learning in groups with their peers
- Learning by doing rather than passively listening, learning through discovery
- Hypermedia learning
- Seeking to interact with others – online or face-to-face
- Not just consuming information but creating and re-creating it
- Goal and education oriented

(Frاند, 2000; Prensky, 2001; Oblinger, 2003; Oblinger & Oblinger ,2005; Hartman et al., 2007; Philip, 2007; Barnes et al., 2007)

The assumptions suggest that students of the net generation seek to interact with each other, either face-to-face or online. They prefer learning in groups with their peers. They are also supposed to be active in the teaching and learning process. Rather than listening to lectures, students prefer learning by doing, learning through discovery. Students’ active role also comes up in their preference for working with information from different sources. Students prefer the so called hypermedia learning, using multiple sources of information. They are willing to connect information from different sources and to create new instead of consuming readymade information. All these elements align with the pedagogical approach of collaborative learning, where students are supposed to actively interact with each other to participate in collaborative activities (Dillenbourg, 1999; Weinberger 2003). Philip (2007) suggests knowledge building paradigm as an answer to the demands of the net generation. Knowledge building paradigm refers to the idea of transforming schools into knowledge building communities, engaging students in the process of creating knowledge collaboratively, advancing “the frontiers of knowledge” (Scardamalia & Bereiter, 2003). The assumptions concerning the net generation are also interesting from the motivational point of view. According to Barnes et al. (2007), net generation students are extremely goal and education oriented; they find learning important and want to do well in their studies.

In addition to these merely positive assumptions described above, characterisations of the net generation also contain rather negative aspects with regard to learning. According to Barnes et al. (2007), net generation students’ skills for critical thinking and information literacy are often weak. They also argue that net generation

students' attention span is often short. These features pose challenges for schools and teachers because students are easily bored with "traditional learning methods" (Barnes et al., 2007).

2.4.2 Net generation and technology

When we think about students of the net generation as users of technologies, the assumptions are that they:

- Are fascinated by new technologies
- Prefer social networking and resource-sharing sites
- Prefer using the Internet as social technology
- Prefer ubiquitous connection
- Use technology as tools for exploring, communicating, and socializing
- Use technology as part of their learning - as "thinking prosthetics"
- Are able to intuitively use a variety of IT devices and navigate the Internet
- Move seamlessly between physical and virtual interactions

(Frand, 2000; Oblinger, 2003; Oblinger & Oblinger, 2005; Lorenzo et al., 2007; Hartman et al., 2007)

Based on these assumptions, it seems that students are able and willing to use the Internet and different online software, computers and different technologies have become an integral part of their life. Students seem to perceive the Internet as a social tool, as Hartman et al. (2007) point out saying that students of the net generation have turned the Internet as the nexus of their social life. Students prefer social networking and resource-sharing sites that are usually noted as tools of social software (Boyd, 2003). From the collaborative learning point of view, these features provide possibilities that should be considered. Use of technology as a tool for exploring, communicating, and socialising provides readiness for learning with ICT, which in turn provides a starting point for collaborative activities with ICT. Tolmie and Boyle (2000) also indicate the importance of prior experience of using different online environments as a factor affecting the success of collaborative learning, especially online. The assumptions concerning the net generation allow us to presume that these students have the skills to communicate and collaborate using online environments.

2.4.3 Critique of the assumptions

Literature concerning the net generation paints an interesting picture of today's students. Based on the assumptions it seems that these "multi talent" students are ready, able and extremely motivated to learn collaboratively and to use ICT for collaborative purposes. Writings of Marc Prensky and Don Tapscott provide an almost trancelike view of the net generation students working, acting, learning and changing the world. These assumptions and research concerning the topic have also received criticism. Bennet et al. (2008) and Bullen et al. (2009) criticise the ambiguous research on which these assumptions are based on. Bennet et al. (2008) note that these overtly dramatic writings are typically based on author's observations instead of actual research. Also, Bullen et al. (2009) note that the research behind the assumptions is either totally absent or the research data has been skewed. For example, research

material for the study by Tapscott (2008) was gathered using online environments. This method is very likely to affect the results when evaluating use of the Internet.

Another problem with these writings is the tendency to over-generalise the phenomenon, to extend it to the whole generation solely based on birth year. Net generation has been defined differently by different authors. Oblinger & Oblinger (2005) define net generation as students born between 1982 and 1991, while Tapscott (2008) considers net generation students born between 1977 and 1997. Further, Jones et al. (in press) define net generation as everyone born after 1983. To connect the assumptions described above to people of certain age poses challenges and an assumption that the generation would be rather homogenous. This has been criticised indicating that there are differences among students of the net generation, especially in their ways to use different technologies. Kennedy et al. (2007) reported that not all students of the net generation are users of the tools of web 2.0, i.e., social software and only a minority of students was actively using these tools. Jones et al. (in press) provided similar results criticising the assumption that all students use technologies in similar ways. They were especially sceptical of the expected use of social software on a daily basis. Research also shows that in addition to age, there are other relevant factors that affect the ways to use technologies, such as gender (Aslanidou & Menexes, 2008; Li & Kirkup, 2007).

Criticism has also been levelled at the assumptions of the net generation students' enthusiasm and skillfulness concerning technologies and the Internet. Especially the use of ICT for learning seems to be problematic. Lorenzo et al. (2007) showed that net generation students' ICT skills do not cover the tools used in higher level learning, such as Excel or SPSS. Also, they noted that the net generation students need support in information literacy skills, i.e., critical thinking and ability to search reliable sources. It would seem, therefore, that excessive time spent with technological gadgets has not turned this generation into an information specialist. Similar results came up in a research by Kvavik (2005), indicating that net generation students do not have ICT skills required for academic activities, but they need guidance and support much like the previous generations. Aslanidou and Menexes (2008) noted that the net generation students use the Internet merely for entertainment purposes, not school work.

Bennet et al. (2008) criticise how the writings about the net generation phenomenon fan the flames of "moral panic", referring to a situation where "a particular group in society, such as a youth subculture, is portrayed by the news and media as embodying a threat to societal values and norms". According to Bennet et al. (2008), the net generation phenomenon has been described as a threat demanding broad changes especially in schools. Other points of view have also been proposed to explain the net generation phenomenon and the gap between generations. Although Oblinger and Oblinger (2005) have to some extent confirmed the hype about net generation, they also admit that in addition to a certain age, the phenomenon could also be linked to the time actually spent using computers and the Internet. Guo et al. (2008) question the gap in the ICT skills between the net generation and the older generation and suggest that instead of differences in ICT skills, there might be a psychological barrier affecting older people's ways of using ICT. Also Waycott et al. (2010) see the gap between generations problematic. They noticed that older generations were also using

different technologies and the Internet and suggest that differences between generations are based simply on different life stages of adults and young people. Also Marc Prensky, the initiator of the debate concerning the gap between digital natives and digital immigrants, has later changed his focus from observing the generational differences to observing the notion of “digital wisdom” as a pan-generational phenomenon. By digital wisdom, he refers to different ways to use technology to support and extend people’s thinking and cognition. Prensky (2009) argues that this wisdom is a skill that needs practicing and support, digital wisdom is not something that can be taken for granted even in regard of the net generation students.

2.4.4 Net generation, social software and learning

The net generation phenomenon is connected to tools of social software. Students of the net generation are assumed to be active users of social software. Furthermore, they are assumed to use the Internet especially for socialising (Hartman et al., 2007). Social software is part of the development of web 2.0. Web 2.0 refers to the ideas presented by O’Reilly (2005) who described it as a turning point of the Internet, providing new approaches for software development and also, for the roles of users. Web 2.0 is described as a change from packaged software to online services. From the software development point of view, the users will be in a central role as co-developers and evaluators. Beta versions of these software are brought out to users in an early stage of development in order to see which new features are used and how they are used, to get feedback for further development. Users’ important role also extends to developing contents. Users add data to an application, creating so called hard-to-create data sources which are then turned into system services. Tools of web 2.0 are based on participation, the systems improve more the more people use them. In other words, users add value by producing data. (O’Reilly, 2005)

Users’ active role also shows in the ways different applications work. With traditional web pages, users have a rather passive role reading readymade materials. Web 2.0 provides users with tools to participate and to create, and this feature works especially well with social software. *Social software* can be seen as a major component of Web 2.0 (Alexander, 2006). Typically, social software is associated with blogs and wiki-environments. However, the field of social software is vast, containing hundreds of online tools for different purposes. White (2007) has categorised these tools into 10 categories based on their common purposes. The categories divide tools into social games, communication tools, file sharing, blogs, social networking, video sharing, collaborative authoring, image sharing, calendaring and social bookmarking. Although the purposes are varied, there are common characteristics that connect all social software. The common features have been described as follows:

- Tools for supporting collaboration
 - Users as producers of contents
 - Tools for providing feedback
 - Tools for supporting the sharing of resources
 - Tools for communicative and explicit working
 - Emphasising online profiles
- (Boyd, 2003; Bryant, 2006; Sinclair, 2007; Alexander, 2006)

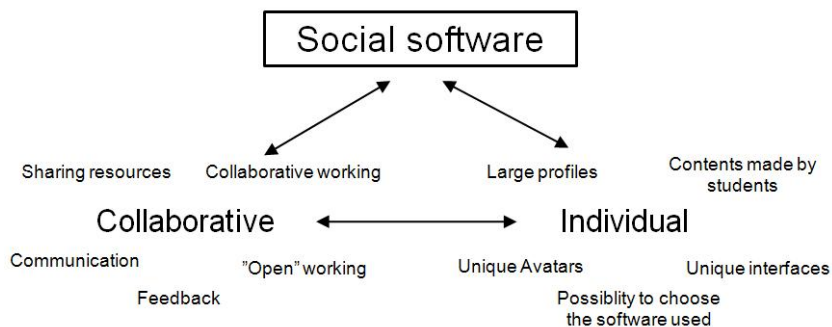
Tools of social software provide interesting possibilities for supporting learning, collaboration, interaction, and creation of contents. These go well with the principles of socio-constructivist and socio-cultural theories of learning. Ferdig (2007) outlines different ways to use social software for supporting students' learning:

- Social software can be used as an environment for scaffolding students at their upper boundaries of zone of proximal development. Students can be scaffolded by their peers, teacher or content experts.
- Social software can be used as a space for collaborative and co-operative learning, providing students with possibilities to actively participate in shared endeavors.
- Tools of social software provide possibilities for publishing their artifacts of learning and to get feedback and reflection.
- Social software provide tools for building learning communities, and possibilities for students to participate and learn through legitimate peripheral participation

As Ferdig (2007) points out, these examples do not cover all range of using social software in teaching. The characteristics that stress students' interaction, participation, content creation and providing feedback go well with the principles of collaborative learning, providing possibilities for designing learning environments. According to Stahl et al. (2006), technology used for computer supported collaborative learning (CSCL) should be fundamentally social. Based on the descriptions of social software above, social software seems a suitable technology for collaboration.

The examples provided by Ferdig (2007) stress collaborative features of social software. These elements are important from an educational point of view, providing good possibilities for teaching and learning. In addition to collaboration, tools of social software also provide possibilities for highlighting students' unique and individual characters.

Figure 2. Social software



There are many different tools of social software. This allows students to choose the tools that are familiar to them and that correspond with their aims and goals. Students are also able to edit the interfaces and the appearance of the tools.

Students can, for example, change the format of the tools and add elements that are not in default settings. Uniqueness also shows in the contents that are made by students. Students can choose what they want to publish online and what to keep for themselves. Social software also allows extending the online profiles, i.e., users can extend their profiles to include materials in different format, e.g. pictures, videos and sound files. The special role of profiles shows especially in 3D-environments such as Second Life where users can design the appearance of their Avatars.

This individual aspect of social software provides a foundation for creating digital identities. Attwell et al. (2008) define digital identity as everything that one has produced in different online environments, including everything that other people have produced online concerning that person. Digital identity covers all the activities that one has accomplished in different online environments. Here, we extend the concept of digital identity to contain the repertoire of software people choose to use, for what purposes, and also, how they modify the functions and appearance of the software. 3D-environments open further possibilities for building digital identity allowing users to edit the appearance of their Avatar, or other 3D character, to look and act as they want. These online identities provide new tools for supporting collaborative learning and especially, collaboration online. Instead of only a small picture and a name, online identity contains more information about the person. According to Tolmie & Boyle (2000), for the collaboration to be successful it is important that members of the group have knowledge about the other participants. Jones and Issroff (2005) refer to social affinity as a factor supporting collaborative learning. These ideas relate to a sense of community, the feeling of belonging to a group and a safe environment for students to collaborate (Rovai & Jordan, 2004). Digital identities built with different social software contain more profound personal information about the members of the group, providing students with information about each other and possibilities to get to know each other, thus supporting social affinity. The individual aspect of social software is also visible in the research area concerning personal learning environments (PLE). The idea of PLE is to encourage students to use social software in building learning environments that best suit their learning purposes (Laakkonen & Juntunen, 2009). Numerous tools with possibilities to act as administrators allow students to build learning environments that are unique and personal.

2.4.5 Net generation, mobile technology and learning

The popularity of mobile technologies such as mobile phones, laptop computers with wireless networks etc. has attracted a significant interest in taking advantage of these technologies in teaching and learning. This trend is interesting especially from the net generation point of view. After all, it is the generation assumed to be fascinated by new technology and preferring constant and ubiquitous connection online (Jones et al., 2010; Oblinger, 2003; Lorenzo et al., 2007).

Sharples et al. (2005) describe mobile learning personalised, stressing the learners' central role and the situated, collaborative and ubiquitous nature of learning. Mobile technologies provide students with personal tools, i.e., phones, laptops, PDA that they have constantly with them. This allows students to move from one situation to another and collaborate with other students. Sharples et al. (2005) also describe mobile learning as a lifelong process, mobile tools are where the students are and even though

the technologies change, the materials produced remain and develop. According to Naismith et al. (2004), mobile technologies offer a flexible range of learning methods from drill-and-practice activities to collaborative learning practices. Mobile technology is a current topic in schools because according to Naismith et al. (2004), "mobile devices are finding their way into the classroom in children's pocket". Instead of seeing them as disruptive, teachers should find ways to take advantage of these tools for supporting learning (Sharples, 2003).

Employing personal mobile technology for learning purposes parallels with the so called "one-to-one computing". One-to-one technology enhanced learning (Chan et al. 2006) or one-to-one computing (Looi et al., 2009; DiGangi et al., 2007) refers to the idea that all students have their own personal tool with access to the Internet. Soloway et al. (2003) stress the importance of one-to-one computing suggesting that full potential of ICT in education will be achieved only when all students have their own personal computer ready-at-hand. Mobile technologies provide an opportunity for a fundamental change in schools. Instead of occasional use of computer in the labs, mobile technology allows embedding technology into learning (Naismith et al. 2004). Soloway et al. argue (2003) "As long as computers are down the hallway and up the stairs, teachers consider them irrelevant to learning and teaching".

One-to-one computing provides new ways for supporting learning. For example, Looi et al. (2009) provided Pocket PC applications for students working in small groups. Barak et al. (2006) supported teaching in lecture halls by activating assignments that students completed on their laptops in a wireless network. Vavoula et al. (2009) used mobile phones as tools for connecting a classroom and a museum, allowing students to produce material in museums and work with it later in the class. Mobile technologies are also used for connecting face-to-face teaching and an online environment, bringing elements of collaborative learning to lectures. Wireless minilaptop computers were used as tools for writing lecture notes in a shared online environment, providing students with an access to the ideas and opinions of their peers (Vesisenaho & Valtonen, 2010; Valtonen et al., in press).

2.4.6 Net generation in this dissertation

As we can see, literature concerning the net generation provides inconsistent results. However, the topic is interesting as it aims to define trends that characterise today's generation and future generations of the information society. The net generation theme is the focus of three studies presented in this dissertation. The first study "Finnish high school students' readiness to adopt online learning: Questioning the assumptions" discusses net generation students and their beliefs about online learning. The research gives insight into how they see and understand the possibilities of online learning and what are their attitudes toward online learning. The second study "Confronting the technological pedagogical knowledge of Finnish Net Generation student teachers" deals with net generation student teachers. This study concentrates on describing student teachers' willingness to incorporate different technologies in their teaching. The study also discusses the notions by Marc Prensky, who points out that "unless we want to just forget about educating Digital Natives until they grow up and do it themselves, we had better confront this issue [...] So if Digital Immigrant educators really want to reach Digital Natives – i.e. all their students – they will have to change". The study

evaluates how the net generation student teachers prefer to use different technologies to support learning – now that they have grown up. The third study “Net Generation at social software: challenging assumptions, clarifying relationships and raising implications for learning” concentrates especially on the net generation students’ activity of using social software.

3. Aims and research methods of the dissertation

This dissertation consists of two topics that are closely related to the use of ICT in collaborative learning. The first concentrates on the use of ICT from teachers' point of view, providing insight into how the possibilities and challenges of collaborative learning with ICT show in practice. This topic consists of two studies on teachers' conceptions of learning and technological pedagogical content knowledge (TPCK). The second topic focuses on the net generation phenomenon in the Finnish context, namely the appearance of the alleged characteristics of the net generation. This topic consists of three studies that discuss students' beliefs about online learning, student teachers' TPCK and students' activity in using social software. Together, these two topics provide insight into collaborative learning with ICT from teachers' and students' perspective. This dissertation aims to present teachers' and students' perspectives on the principles of collaborative learning with ICT in practice. The aim is to identify the strong areas and limitations of the current practices, from the viewpoints of teacher thinking and net generation phenomenon. Identifying strong areas and limitations provides information and concrete building blocks for developing collaborative learning with ICT in schools.

This dissertation is a descriptive study using both a cross-section survey strategy and a case study strategy concentrating on above mentioned topics. Five different studies were conducted in different phases and in different projects. Studies I and II are case studies using qualitative research methods. Study I was part of ISOverkosto –project and study II was part of Verkkosalkku II –project. Both of these studies were conducted in order to provide information for the projects for further development of teaching and learning using online learning environments. As such, these studies were the first parts of a larger design research project. On the other hand, studies III and V are surveys done within the ISOverstas project in order to provide quantitative data about how Eastern Finland students see the possibilities of online learning and how actively they use social software. Study IV was also a case study in order to describe today's teacher students' TPCK in the context of teacher training.

The studies presented in this dissertation draw on quantitative and qualitative methods and a combination of these. From this perspective, the dissertation can be described as research based on a mixed method approach using both quantitative and qualitative research methods. Much like the development of ICT in education, also the development of research in social and behavioral sciences has undergone different development paradigms (Powel et al., 2009). The first paradigm was based on traditional research methods employing quantitative measurements based on objectivistic epistemological assumptions. The next paradigm was based on subjectivist epistemological assumptions and use of qualitative research methods. Two paradigms

lead to the coexistence of both quantitative and qualitative research as competing and separate paradigms (Powel et al., 2009; Niaz, 2008). The dichotomy of quantitative and qualitative approaches (strong paradigmatic view) emphasises strong differences in the ontological and epistemological assumptions (Heikkinen et al., 2005). Even though the strong paradigmatic view criticises the use of quantitative and qualitative approaches in the same study, the last phase of development is based on combining the quantitative and qualitative methods aiming to produce superior and more accurate research outcomes (Powel et al., 2009). This third phase is referred to as mixed methods. Niaz (2008) purposely describes the third phase as “mixed method research programmes (not paradigms)” indicate applying both qualitative and quantitative methods in the same study instead of strong and separate paradigms.

The mixed method approach is nowadays commonly accepted (Creswell, 2003; Leech & Onwuegbuzie, 2009; Niaz, 2008). Leech and Onwuegbuzie (2009) define mixed methods research as research that involves collecting, analysing and interpreting both qualitative and quantitative data in the same research. According to Creswell (2003) mixed method approach is based on pragmatic epistemology, indicating that knowledge claims are connected with research situation, stressing the importance of research problem. Instead of committing research methods to any one epistemological or ontological assumption, researcher chooses the research method that best meets the needs of the research (Creswell, 2003). Niaz (2008) and Pring (2000) also emphasise the importance of the coexistence of the two research approaches. According to Pring (2000), quantitative and qualitative approaches can complete each other. Niaz (2008) indicates that the research problem should be the one defining the methodology used, not the other way round.

Mixed method allows using both quantitative and qualitative research methods in the same study. Different methods provide possibilities for confirming findings with different data sources and expanding the understanding, providing deeper insight into the research topic (Creswell, 2003). Leech and Onwuegbuzie (2009) define different designs of mixed method with three elements: levels of mixing, time orientations and level of emphasis. Level of mixing refers to the ways of mixing quantitative and qualitative methods. In other words, it tells whether the methods are mixed during the research process or in the interpretation stage. Time orientation refers to the occurrence of qualitative and quantitative phases, whether they are synchronous or successive. Emphasis refers to the equality of the approaches, whether they are equally important or one is dominant. Also, Creswell (2003) describes similar ideas by defining different strategies of mixed method inquiry based on implementation, priority, integration and use of theoretical perspective. Implementation refers to the collection of data, whether the data is collected concurrently or sequentially. Priority indicates the dominant method, or whether both methods and data are equally important. Integration refers to the phase of mixing different data. The theory perspective indicates the use of theoretical frame guiding the design of the research, whether the theory is implicit or explicit. In this dissertation, mixed methods approach is used in studies III and IV.

Different methods come up within five different studies. Two of the studies (I and II) are based on qualitative methods and one (V) on quantitative methods. Two studies (III and IV) employ both quantitative and qualitative methods, i.e., mixed

methods. This indicates that research methods and ways to collect and analyse the data have been chosen based on different research questions that align with pragmatic knowledge claims and the mixed methods approach (Creswell, 2003). The studies were conducted in different contexts with different target groups. Studies I, III and V were conducted within the ISOVerstas context, i.e., on upper secondary level. Study II was conducted on polytechnic level and study IV was conducted on high school level. The studies concerning teachers were conducted on upper secondary and polytechnic levels. The studies on net generation were conducted on upper secondary and high school levels

Studies I and IV were based on similar research methods using content analysis that can be categorised as document and artefact analysis (Savenye & Robinson, 2004, 2005). According to Savenye and Robinson (2004), research material can be different materials created by the target groups. Especially within ICT and teaching, the artifacts of interest can be written materials, materials created in online environments etc. These studies concentrated on technological pedagogical content knowledge. Research data in study I were online courses in the Moodle learning environment produced by upper secondary level teachers, and in study IV, learning module descriptions by student teachers. Artifacts were analysed by coding the materials in order to bring out different expressions of TPCK. The units of analysis varied from short descriptions of one separate technology to extensive descriptions of the pedagogical approaches employed.

Study II was also conducted with qualitative methods using a phenomenographic approach (Marton et al., 1993). The topic of the study, teachers' conceptions of learning was challenging due to the nature of conceptions. Conceptions of learning are typically abstract and often implicit, which makes them difficult to describe. To avoid the so called espoused theories i.e., what the teachers expect the researcher wants to hear or commonly appropriate answers, data was gathered using three different methods. The research data thus consisted of teachers' essays on the nature of learning, teachers' videotaped course design sessions, where they designed a course in small groups, and interviews to complete materials from essays and design sessions.

Study III was mainly based on quantitative methods and study V was conducted employing only quantitative research methods. The studies had similar phases of analysis as both employed online questionnaires containing statements with five point scales. In study III, statements concerned beliefs about online learning and in study V, statements concerned the activity of using social software. The first phase of the analysis in both studies was principal component analysis. Principal component analysis is typically used for condensing several statements to subcomponents (Afifi & Clark, 1996; Metsämuuronen, 2006). According to Metsämuuronen, principal component analysis is often used when there is no indication of which statements are going to load into the same subcomponents. Results of the principal component analysis produce subcomponents for the next phase of the analysis, which was cluster analysis. Cluster analysis is typically used for clustering respondents into groups – clusters being based on some character (Afifi & Clark, 1996). In these studies, cluster analysis was used to group students based on their beliefs about online learning and their activity of using social software.

Studies III and IV can also be seen as mixed methods studies containing both qualitative and quantitative research methods. Compared to the definitions by Creswell (2003), study III and IV can be described as so called concurrent nested strategy studies. Concurrent nested strategy refers to studies where two different methods for collecting data are used simultaneously: in study III, quantitative and qualitative materials were gathered using the same online questionnaire and in study IV, student teachers produced qualitative materials in the form of learning module descriptions and quantitative data by filling in an online questionnaire. In studies based on concurrent nested strategy, research data are typically mixed during the analysis phase so that one, qualitative or quantitative, is in dominant position and the other one is “nested”. In study III, materials were mixed in the analysis phase so that quantitative data was in dominant position: students were grouped in three groups based on their beliefs about online learning. The qualitative data was used to provide more information about how students in different groups in their own words understand the possibilities and limits of online learning. In study IV, the situation was opposite. The qualitative data learning module descriptions were used as the dominant data source when describing student teachers’ TPCK. Quantitative method was used for providing broader information about student teachers’ technological knowledge. (Creswell, 2003)

Table 1: A summary of the data collection and data analysis

Study	Subjects	Research topic	Data source	Data-analysis
Study I	Secondary school teachers N=13	TPCK	Moodle courses	Qualitative content analysis
Study II	Polytechnic level teachers N=6	Conceptions of learning	Essays, videotaped design sessions, interviews	Qualitative analysis, phenomenographic approach
Study III	Secondary school students N=300	Belief about online learning	Online questionnaire with 1-5 scale statements and open questions (Appendix 1)	Mixed method, mainly statistical analysis, Concurrent nested strategy
Study IV	Student teachers N=74	TPCK	Learning module descriptions and online questionnaire with 1-5 scale statements (Appendix 2)	Mixed method, mainly qualitative analysis, Concurrent nested strategy
Study V	Secondary school students N=1070	Use of social software	Online questionnaire with 1-5 scale statements (Appendix 3)	Statistical analysis

4. An overview of the empirical studies

4.1 STUDY I

Valtonen, T. Kukkonen, J., & Wulff, A. (2006). High School Teachers' Course Designs and Their Professional Knowledge of Online Teaching. *Informatics in Education*, 5,(2), 301-315.

The first study concentrates on teachers' ways to conduct a distance course using the Moodle online learning environment. The theoretical frame is built on technological pedagogical content knowledge (TPCK) and criteria of meaningful learning by Jonassen et al. (1999). From the TPCK point of view, the study concentrates especially on the role of pedagogical knowledge and technological pedagogical knowledge. The purpose of the study is to explore how principles of collaborative learning show in reality and whether the principles of collaborative learning come up in online courses as theories of computer supported collaborative learning suggest.

The context of this study is the ISOverkosto-project (nowadays ISOVerstas), an upper secondary school network of 36 schools in eastern Finland. The research material of this study contains 13 distance courses in the Moodle learning environment. Research data consist of all the materials in the Moodle environment: instructions for the students, learning assignments, learning materials, etc. Also, public materials created by students are used as research data. The analysis employs theory-based qualitative content analysis.

Results of the study indicate three course categories. Courses in the first category are based mainly on students' independent learning under teachers' active tutoring and feedback. The second category contains more collaborative elements, typically discussions of a topic defined by teacher. In this category, teachers' role is central, directing the learning process. The third category is students' independent learning using materials made by teachers. The students work alone and the teacher is available if needed. Results indicate that courses based on collaborative theories of learning are absent. Courses rely on teacher-centered activities with minimal interaction between students. This indicates demands for developing teachers' TPCK toward providing students with more possibilities for participating and collaborating with peers, providing possibilities for cognitive conflicts.

4.2 STUDY II

Valtonen, T. Kukkonen, J., Puruskainen, T. & Hatakka, O. (2007) Verkko-oppimisympäristöt opettajien oppimiskäsitysten haastajina [Online learning challenging teachers' conceptions of learning]. *Kasvatus* 39(5), 444-453.

The second study concentrates on teacher thinking, especially teachers' conceptions of learning. Conceptions of learning are rather abstract and difficult to articulate, containing teachers' subjective knowledge about teaching and learning. Conceptions of learning are assumed to form a frame for teachers' work, actions and decisions (see Figure 1). The purpose of this study is to describe how teachers' conceptions of learning match with collaborative teaching, especially in a situation where using online learning environments is new to teachers.

The context of this study is the Verkkosalkku II-project that aims at developing a new online learning environment called Verkkosalkku. The project and the study are conducted on polytechnic level. The target group consisted of six teachers who were testing the Verkkosalkku-learning environment. Research data was gathered using three different methods in order to be able to describe conceptions of learning that are often implicit and difficult to describe. First, teachers were asked to write about how they understand learning and how they describe a successful learning experience. Second, design sessions where teachers designed a course in groups of three to four people were videotaped. Last, teachers were interviewed. The interviews were based on the videotaped design sessions, aiming to gain more information about the events happening during the design sessions. Materials were analysed using the phenomenographic approach, aiming at describing the different ways teachers interpret and understand learning.

Results of the study indicate five conceptions of learning. Conceptions vary from teacher-centered conceptions to student-centered conceptions. Teacher-centered conceptions stress learning as a process of transmitting information to students. In other words, it is a so called delivery model where students' role is to digest information presented by teachers. Student-centered conceptions define learning as a process where interaction between students and students' own role as leaders of the learning process are central. Results indicate that teachers' use of collaborative learning methods cannot be taken for granted, even when teaching with ICT. Teachers with conceptions defining learning more as delivery of information may find collaborative learning methods new and challenging. Results also imply that for some teachers, introducing online learning environments in teaching result in reflective thinking of their teaching methods. This result is important for the future indicating the possibilities of ICT as a tool for supporting teachers' reflective thinking and evaluation of their conceptions of learning.

4.3 STUDY III

Valtonen, T., Kukkonen, J., Dillon, P., & Väisänen, P. (2009). Finnish high school students' readiness to adopt online learning: questioning the assumptions. *Computers & Education* 53(3), 742–748.

The third study examines the use of ICT in teaching from students' point of view, concentrating on students' beliefs about online learning. This is the first of the three studies that observe the net generation phenomenon. There are several assumptions about net generation and their ways to use ICT and online environments and ways to study and learn. This study describes upper secondary students' beliefs about the nature of online learning and how they understand the possibilities of online learning.

The study was conducted within the context of ISOVerstas network of upper secondary schools. Research data was gathered by an online questionnaire, the number of respondents being 300. The questionnaire contained statements on a scale of one to five concerning the nature of online learning and open questions where respondents could define characteristics of online learning in their own words (Appendix 1). Analysis of the data was carried out in two phases. The first phase employed quantitative methods in order to group students based on their beliefs about online learning. The second phase employed qualitative methods, categorising students' written texts to provide further information about students' beliefs.

Results indicate that students have different beliefs about online learning. Approximately a quarter of the respondents evaluated online learning rather negatively, indicating that they do not prefer learning online. Also, approximately one quarter of respondents evaluated online learning positively. They see online learning as a possibility that could suit their purposes. The rest, approximately half of the respondents had rather neutral beliefs about online learning. Results indicate that even though respondents can be categorised as net generation, for the majority of respondents learning online is not the preferred way of learning. Also, results show that students' knowledge about the possibilities of online learning is quite vague, indicating very simplified and false ideas about online learning. This is an important result for the future, indicating the importance of providing students with information about different possibilities of online learning. Bringing into students' (and teachers') consciousness the full potential of online learning would quite possibly enhance its attractiveness, making online learning a prospective way of learning in the future.

4.4 STUDY IV

Valtonen, T., Pöntinen, S., Kukkonen, J., Dillon, P., Väisänen, P. & Hacklin, S. (2011). Confronting the technological pedagogical knowledge of Finnish Net Generation student teachers. *Technology, Pedagogy & Education*. 20(1), 1–16.

The fourth study is the second study linking to the net generation phenomenon. The study examines student teachers' technological pedagogical content knowledge

(TPCK), concentrating especially on technological pedagogical knowledge. The aim is to describe the net generation student teachers' way to see ICT as a tool for teaching and learning.

Research data was gathered in a university context on an obligatory course on ICT in education. Target group was first year student teachers (N=74) who, by age, represent net generation. Students were instructed to design a learning module, i.e., a project or a smaller learning unit, such as one lesson. The instructions asked students to use ICT in some way in their learning modules and base the topic on the Finnish curriculum. Students worked in small groups and produced descriptions of the modules. These descriptions were the main research data in this study. Material was also gathered using an online questionnaire concentrating on students' acceptance of new technologies as part of their technological knowledge (Appendix 2). Analysis of the data was carried out using qualitative content analysis, an open coding approach. Descriptions of the learning modules were coded based on pedagogical and technological approach and by a combination of technology and pedagogy presenting technological pedagogical knowledge. The analysis of the quantitative data from the questionnaire was conducted using principal component analysis, in order to transform the original variables into condensed subscales. The mean values of these subscales were used for measuring the students' acceptance of new technologies. The analysis of the questionnaire added depth to the results of the qualitative analysis.

The results indicate that student teachers' way of using ICT is rather "traditional" in that instead of innovative new ways of using ICT and innovative pedagogical solutions, they merely tend to "update" teaching methods familiar to them with ICT. Here, updating means replacing old methods with new technologies. For example, instead of going to the library, students prefer the Internet or instead of picking plants for their herbarium, they prefer digital cameras for taking pictures for an online collection. These results indicate that student teachers need pedagogically sound examples of different ways to use ICT to support learning.

4.5 STUDY V

Valtonen, T., Dillon, P., Hacklin, S. & Väisänen, P. (accepted). Net Generation at social software: challenging assumptions, clarifying relationships and raising implications for learning. *International Journal of Educational Research*.

The fifth study is the last of the studies concerning the net generation. The study discusses net generation students as users of social software. The aim of the study is to survey what social software students use, how actively they use it and whether there are differences between the net generation students. An assumption based on earlier research is that the net generation students actively use social software and that they have turned the Internet as the nexus of their social life.

Research data was gathered by an online questionnaire within the context of the ISOverstas network of schools. Number of respondents was 1070. The questionnaire contained statements about the use of social software, asking students to evaluate how

often they used different software. Analysis was conducted in three phases. The first phase was creating subcomponents about the different software students use. The second phase was grouping students according to their activity of using the software in the subcomponents. The third phase was further profiling the groups according to gender distribution, ICT-skills and time spent using the Internet and watching television.

Results indicate that describing net generation as one homogenous group especially focusing on their use of social software is rather problematic. Differences between the net generation students are noticeable. Results also indicate that most of the respondents are familiar with at least some of the social software, although the range of known software is rather limited. These results provide possibilities for schools and teachers for taking advantage of students' skills for learning collaboratively with ICT. Social software can be used as a tool for supporting students' collaborative learning. Students' skills and familiarity with social software should be considered, giving students a more active role in the process of designing learning environments. This could also encourage and engage those students that are not familiar with social software.

5. Results

This chapter provides an overview of the results from the five studies. These five studies provide a “still shot” of teacher thinking and the net generation phenomenon in the late 2000s. The assumption is that both topics develop and change over time, especially the net generation phenomenon. Chan et al. (2006) argued that the term one-to-one will lose its meaning when mobile technologies become a seamless part of everyday learning in schools. The same thing is likely to happen with the net generation phenomenon as a new generation will be born and also, the older generation will become more and more involved in the information society and using different technologies. The uniqueness of the net generation will fade over time and future generations. However, discussion on the net generation as part of challenges of the information society is important, highlighting the need for schools and teachers to adapt to the requirements of today's world.

The results of these studies indicate that teachers' conceptions of learning and technological pedagogical content knowledge do not necessarily correspond with the theories of collaborative learning. The results also provide challenging views concerning the assumptions about the net generation. The results from the Finnish context are both consistent with and contradictory to the assumptions presented of the net generation. Although the collaborative learning and the positive assumptions about the net generation did not come up as strongly as expected, the results provide important information for developing teaching and collaborative learning with ICT.

5.1. TEACHER THINKING

The first study “High school teachers' course designs and their professional knowledge of online teaching” describes teacher thinking on a practical level, concentrating on teachers' TPACK in an online context. Results indicate that teachers use Moodle, a web-based learning environment, mainly for transmitting information. Ways to use Moodle can be categorised roughly in three different categories. The courses in the first category are “Teacher-centered, individual learning” indicating that interaction during the course is mainly between a student and the teacher, not between students. Courses are clearly pre-planned and the structures are easy to follow: students read materials, do learning assignments and send them to the teacher. Teacher evaluates assignments and provides feedback. Teacher and the learning material are in a central position. The second category is “Teacher-centered collaborative learning” that emphasises more students' collaborative work and interaction between students. Typically, these courses are designed to combine independent studying and collaborative assignments in that students go through the content by themselves and then engage in collaborative assignments, typically discussions. Within these collaborative assignments, students

express their understanding of the topic through conversation. Also, on these courses, teachers' role is important as a provider of learning materials and tutoring the collaborative assignments. The third category "Learner-centered individual learning" refers to a self-study course consisting of learning materials, instructions for students and self evaluation materials and assignments. Students study independently following instructions and self-evaluation materials. Teacher is available on request, typically via email.

These results are challenging for the future development of teaching and learning with ICT. Although several analysed courses contained collaborative elements, the courses were mainly designed based on information delivery. This way of teaching online may relate to a phenomenon described by Pearson and Naylor (2006) who argue that using different standardised tests for measuring school performance on secondary level is leading to a so called "risk averse culture"; teachers are reluctant to try new, innovative teaching methods. A similar phenomenon has been noticed with integration of ICT in teaching. According to Becker (2000), "teachers feel pressure by administrator expectations for content coverage, particularly content covered on high-stakes tests". This tendency may also show in the Finnish upper secondary school context. The pressure to cover the contents required in the matriculation examination may lead to teaching and learning methods based on information delivery. Currently, the importance of matriculation examination in the process of applying to higher education is under discussion, the tendency seems to be to increase its weight in the process (Ministry of Education and Culture, 2010 b), which might further reinforce the risk averse culture in schools.

The results from the second study concerning teachers' conceptions of learning provide five different conceptions. They also align with the results of earlier studies about conceptions of learning and teaching (Boulton-Lewis et al., 2001; Kember, 1997). The first two conceptions "learning as transmitting information" and "learning as firmly guided students' action" can be seen stressing teachers' central role as the determiners of the proceeding of the teaching and learning process. On a more concrete level, this typically means lecturing or defining strict guidelines for students' own work. These conceptions are based on delivering information to students in a way decided by teacher. The last two conceptions "learning as a teacher led knowledge construction" and "learning as students' own active work" place students in a more central role in the learning process. Students' own ideas and their earlier knowledge about the topic are essential. According to the "learning as a teacher led knowledge construction" conception, an essential part of learning is to encourage students to bring out their knowledge and earlier ideas so that they can be processed and used as a source for further learning. The conception "learning as students' own active work" is also based on students' earlier ideas and knowledge, stressing students' central role as leaders of the learning process. Learning is seen as a long term process, stressing the interaction between students and students' active participation in the learning process. In addition to these conceptions, there is one conception that can be seen as a connecting component. The conception "learning as applying of facts" refers to learning as a process that contains two phases. The first phase refers to transmission of knowledge to students, so that students are familiar with the central "facts" of the topic.

The second phase stresses students' active role as the ones applying those facts to some exercises or projects.

Results of the second study also reveal that teachers with more student-centered conceptions of learning have a wider array of teaching methods. Their teaching methods contain collaborative methods stressing students' active role and the importance of students' earlier knowledge and ideas. However, these teachers seem to be able to employ a wider array of teaching and learning methods, adopting also more teacher-centered methods when needed. By contrast, teachers with teacher-centered conceptions mainly resort to teaching methods that stress transmission of information to students. A similar tendency has also been reported by Coffey and Gibbs (2002); teachers with a more student-centered conception of learning have wider and more flexible approaches to teaching.

Results also indicate that when first starting to use online environments in teaching, some teachers tend to evaluate and question their teaching methods. This phenomenon is important because being implicit, conceptions of learning are typically difficult to articulate (Clark & Peterson, 1986; Aaltonen & Pitkaniemi, 2001) and teaching practices change and evolve slowly (Shulman, 1987). These findings suggest that introducing ICT in teaching can be seen as an opportunity to enhance teachers' reflective thinking and proceeding toward more learner-centered teaching methods. ICT can trigger cognitive conflicts questioning teachers' teaching routines. New tools for teaching and new environments for learning act as change agents, causing conflicts that teachers have to solve.

To sum up, these two studies indicate that collaborative learning with ICT is challenging. Even though Scardamalia and Bereiter (2008) suggest collaboration as a mantra of the education in the knowledge age, reality provides a different picture. Teachers' conceptions of learning do not necessarily correspond with theories of collaborative learning. As the results indicate, teachers' conceptions may support different ways of transferring information from teacher to student instead of collaborative learning where students control the learning process. Also, teachers typically designed online courses with the mere purpose of delivering learning materials and receiving students' assignments. In contrast, theories of CSCL are based on peer interaction, students sharing their ideas and knowledge and teachers scaffolding socio-cognitive processes; in other words, seeing teaching and learning as knowledge building communities (Lipponen, 2002; Weinberger, 2003; Scardamalia & Bereiter, 2008). On the analysed courses, teachers' and ready-made materials' central role was rather dominant compared to learning as communities of knowledge building.

The result indicating that some teachers experienced online learning environments as a "change agent", triggering teachers' reflective thinking of their teaching methods is important and opens possibilities for developing teaching and learning methods. Especially tools of social software can be seen as one option for change agents. Social software supports users' creation and publishing materials and enhances interaction between users (Alexander, 2006; Boyd, 2003). These characteristics suit well with theories of collaborative learning (Stahl et al., 2006). Still, according to Soloway et al. (2001) and Naismith et al. (2004) computers will remain a separate part of learning in schools if they are in a computer class or away from teachers' normal working environment. One-to-one approach and wireless networks can be seen as one

possibility for taking full advantage of computers, social software and other “change agents” as part of normal teaching and learning practices wherever needed. The role of technology as a triggering factor for teachers’ reflective thinking and cognitive conflicts provides interesting possibilities for developing teaching and learning toward a more collaborative direction. The other “change agent” could be net generation. Net generation is assumed to prefer certain ways of learning and using ICT that align with the approach of collaborative learning with ICT. Teachers need to update their ways to work in order to keep up with the net generation and information society and also, to allow students to take advantage of their assumed skills. However, this demands support, resources and long term in-service training for teachers. As Lehtinen (2006) argued, technology itself does not affect learning but the ways it is used. With support, training and resources, especially time, and taking advantage of technology and net generation as change agents, teaching and learning can be developed from transmitting of information toward more collaborative learning practices with ICT.

5.2. NET GENERATION

The second part of the dissertation concentrates on the net generation phenomenon and assumptions connected to students of the net generation. Net generation phenomenon is discussed in three studies. The first study focuses on the net generation students’ beliefs about online learning, the second study is about the net generation student teachers’ technological pedagogical content knowledge and the last study is about the net generation students as users of social software. Results of these studies both contradict and confirm the assumptions concerning the net generation.

The main difference between the results of these studies and the assumptions of the net generation are in the ways to portray the net generation. Writings about the net generation typically describe them as a rather homogenous group. The tendency is to see the whole generation as one unit with similar characteristics, especially in regard of using technology and learning (Tapscott, 2008; Prensky, 2001; Oblinger & Oblinger, 2005). Results from the three studies concerning the net generation students’ beliefs about online learning and their activity to use social software indicate that there are clear differences between students in these areas. This questions the typical way of describing net generation students as one homogenous group. Instead, the phenomenon needs further studies about the commonalities and differences between students of the net generation.

Results from the first study concerning the net generation students’ beliefs about online learning indicate three different groups of students. Approximately one quarter of respondent students (N=60) have quite negative beliefs concerning online learning. These students do not see the possibility of online learning important, neither suitable for them. On the other end of the continuum, approximately a quarter of the respondents have very positive beliefs concerning online learning. They found the possibility of learning online important and they also believe that learning online would be suitable for them. The rest of the respondents (N=140) have rather neutral beliefs about learning online. Although the assumptions concerning the net generation give a reason to assume that students of the net generation prefer learning with ICT

(Oblinger & Oblinger, 2005) and are familiar with different online environments (Hartman et al., 2007), these results show that this is not the case with all the students of the net generation. These results align with the study by Kvavik (2005) who showed that students of the net generation did not prefer online classes but face-to-face teaching with ICT.

Results of the study reveal that the respondent students have rather limited knowledge about online learning, especially about the possibilities of different online learning solutions. Students' typical way to define online learning is "learning tasks online". They also define online learning as an independent and intentional way of learning with a tutoring teacher available. Online learning is also considered challenging, demanding self-discipline and a rather lonely activity with limited interaction with peers and teachers. The positive elements of online learning are flexibility of learning and an option for a greater variety of courses. These results indicate that online learning is not familiar to the respondent students. It seems that students have rather inadequate ideas about the possibilities of learning online, reminding more a correspondence course than a collaborative course with active interaction with peers. This indicates that students need more information about the possibilities of online learning so that they are able and willing to take advantage of the possibilities of learning online and especially of the larger variety of courses.

The second study provides insight into how the net generation student teachers see the possibilities of using ICT in teaching and learning, targeting their technological pedagogical content knowledge (TPCK). Referring to the gap between generations, Prensky's (2001) states: "So unless we want to just forget about educating Digital Natives until they grow up and do it themselves, we had better confront this issue ...". Now that they have grown up and entering working life, we have a reason to expect interesting and innovative ways to use ICT for teaching. Within this research, students were instructed to design a learning module, i.e., a project or a smaller learning unit, such as one lesson and to include ICT in their module in a way they prefer. The TPCK context was defined especially by technological and pedagogical aspects.

Results both support and contradict the assumptions concerning the net generation. From the pedagogical knowledge point of view, the courses that students created were mainly based on collaborative learning activities, the course instructions typically focusing on pair work or working in small groups. This aligns with the assumptions of the net generation preferring learning collaboratively and, rather than following strict guidelines, preferring to construct their own learning and assembling information from a variety of sources (Prensky, 2001; 2008; Oblinger & Oblinger, 2005). Results concerning technological knowledge are slightly more contradicting with the assumptions of the net generation. Instead of highly innovative ways of using different technologies to support collaborative and discovery based learning, the students tended to merely update traditional ways of teaching with different technologies. This means, for example, using the Internet instead of library, or using PowerPoint instead of paper and pencil. In other words, use of ICT was quite restrained. Use of social software and different learning environments or tools to introduce difficult concepts and content were virtually absent. This is something that must be taken into consideration especially in teacher education. Roberts (2005) notes that net generation students have

not necessarily seen examples of the possibilities of ICT in education. It would seem that teacher education must take into consideration providing the future teachers with these models and the required TPCK instead of expecting it to be an innate skill.

Net generation is also discussed in the third study that concentrates on the net generation students as users of social software. Typically, writings concerning the net generation have led us to assume that net generation students are actively using social software (Hartman et al. 2007). It seems that most of the respondents in this study are familiar with at least some social software. The number of familiar software is, however, not very large and social software is not necessarily used on a daily basis. Results indicate four different profiles of net generation students according to their activity of using social software. For the first group, "non users", most of the tools of social software were unfamiliar and the ones that they knew they rarely used. The second group, "social users", used social software designed for communicating and networking, such as Facebook and Messenger, on a daily basis. Other software seemed to be rather unknown to these students. The third group, "general users", used different social software most actively. They were familiar with almost all the social software mentioned in the questionnaire and used most of them on a weekly or daily basis. The last group, "not interested", knew most of the social software but did not seem to use them very actively, only seldom or on a weekly basis.

Results also indicate gender differences and differences in ICT skills between these groups. It seems that females were in a dominant position in the category "social users", using mainly software designed for communicating and networking. Males were dominant in groups "general users" and "not interested". Within these categories, there were also highest self-evaluations concerning ICT skills. The "non users" group contained equally females and males evaluating their ICT skills the lowest. Results also show that the Internet has become more popular than television. Excluding students in group "not interested", all the respondents spent more time using the Internet than watching television.

To sum up, results from these three studies both contradict and confirm the assumptions concerning the net generation. It seems that most of the students were familiar with different social software and most students also evaluated their ICT skills quite high. Also, student teachers' pedagogical knowledge indicated emphasis toward collaborative teaching and learning practices, although the target group was small and specified, consisting of students studying to be teachers. Still, this supports the assumptions concerning the net generation students' preference for collaborative learning activities and learning by discovery. What is challenging is that the students did not see the possibilities of ICT and different online environments necessarily as tools for learning. Unless schools provide students with possibilities to take advantage of their skills to use ICT for learning, the situation is likely to remain as suggested by Aslanidou and Menexes (2008): ICT and online environments are used for pleasure and learning in schools will continue employing more traditional equipment.

5.3. CONCLUSION AND IDEAS FOR THE FUTURE

Learning collaboratively with ICT poses challenges for teachers. According to Koehler and Mishra (2009), it requires knowledge about the content to be taught, the pedagogy and different technologies. Supporting learning collaboratively with ICT demands a mixture of these, each knowledge area supporting the others. Based on the first two studies, it seems that the reality of teaching and learning does not necessarily correspond to the theories of collaborative learning. However, the results indicated that technologies may act as change agents triggering reflective thinking and cognitive conflicts. This result provides interesting possibilities for developing teaching and learning toward collaborative practices with ICT. Also, the characteristics of net generation can be seen as another change agent, motivating teachers to develop their teaching and learning methods in order to allow students to take advantage of their skills and ways to use ICT for learning at schools.

As mentioned earlier, the hype concerning the net generation phenomenon is probably a temporary phase. Gaps between generations have a tendency of fading away over time and new generations. It seems that now and in the future we have the generations where most of the students have ICT competencies ready for different learning purposes. However, as long as ICT in schools remains a "side show", i.e. it is not part of everyday practices, students' potential skills for learning are not put to use. For example Robert (2005) states that students have not necessarily seen examples of ways to use ICT in teaching and learning. Even though they are using different software for interacting and collaborating with their friends, they do not know how or they do not have the opportunities to use these methods for learning in schools. Jones and Issroff (2005) refer to studies by Crook which discuss students' discursive resources, arguing that students' skills acquired outside school should be transferred to school-based tasks. The same logic should be applied with the net generation and their ways to use ICT and the Internet. These specific skills and ways of working could provide opportunities for developing learning in schools.

One interesting possibility is to take advantage of different mobile technologies and social software. Soloway et al. (2003) argue that the only way to make a change in the classroom, to fully take advantage of the possibilities of ICT is to provide each student with their own computer so that they are available whenever needed as part of normal classroom practices. Technology must become a seamless part of everyday work. Mobile technologies (laptops, mini laptops, phones etc.) with wireless networks provide access to different online environments, e.g., learning environments such as Moodle or different social software. This brings together the benefits of face-to-face teaching and online environments, thus supporting students' collaborative learning. This way of connecting online and face-to-face environments by mobile technologies allows taking advantage of the knowledge building ideas presented by Scardamalia & Bereiter (2008) and Mylläri et al. (2010): whenever needed and wherever needed. This also allows capturing students' individual ideas and knowledge during classes, providing resources for collaborative learning. Mobile technologies provide numerous ways to flexibly connect traditional face-to-face teaching and different possibilities of online environments. In the long run, this will be reality, as Naismith et al. (2004) and Sharples (2003) suggest. Technologies are coming

to classrooms in the pockets of the students, indicating that teachers must find ways to take advantage of them. Already mobile phones work as computers providing access to the Internet even by 3G (soon 4G) connections or by connecting to schools' wireless networks. Each student carries their personal learning environment with them all the time, having an access to different online environments and tools for producing contents (pictures, videos etc.). This is a potential that teachers should become aware of.

These ideas of mobile technology and social software for supporting collaborative learning align with the results of this study. If we think about the characteristics of social software as software that supports social construction of meaning, provides new ways of collaborating and tools for creating and publishing materials (Alexander, 2006; Dron, 2007; Cress & Kimmerle, 2008), we can talk about software that is "fundamentally social" as Stahl et al. (2006) describe the software suitable for CSCL. *This software* connected to everyday teaching in a traditional classroom can be used as a change agent to activate teachers' reflective thinking, leading to redesigning their work. From students' perspective, this method is plausible taking advantage of their relatively good ICT skills and experience of social software. Students could also bring their own knowledge and ideas into the process of building learning environments with ICT. This idea has been introduced in an approach called personal learning environments (PLE). The idea of personal learning environments is based on encouraging students to build learning environments suitable for them using the tools they prefer (Laakkonen & Juntunen, 2009). The aim of PLE has been to provide students with possibilities to use methods and software familiar to them for supporting their learning in and outside the school context.

Using different technologies for developing learning practices in schools is important in order to make students better aware of the possibilities of ICT in learning. Schools' role is to provide best practices of using ICT in learning, introducing students to using ICT as part of their everyday learning in and outside schools. This aim relates to so called "digital wisdom" (Prensky, 2009), an ability to extend one's cognitive capacity with different technologies, instead of superficial digital cleverness, as in technical knowledge of how to use some tools. Jonassen (1994) refers to this idea by describing computers and software as cognitive tools, stressing the idea that students should use different technologies for supporting, guiding and extending their thinking processes. These cognitive tools are normal software, for example spreadsheets, computer conferencing and collaborative knowledge building environments. Both Prensky and Jonassen argue that students should learn how to use technologies as tools for learning and to "off-load some of the unproductive memorising tasks to the computer, allowing students think more productively" (Jonassen, 1994). Developing students' "digital wisdom" poses a challenge for schools. This is especially challenging when considering the results of the study V that indicate that not all students actively use ICT. This needs more attention, especially when we think of school's role as a provider of information society skills for students (Finnish National Board of Education, 2003). What makes this challenging however is the range of implementation of ICT or collaborative learning methods in schools. This may lead to students not having equal opportunities to develop their skills for information society.

Collaborative learning with ICT provides challenges and possibilities for facing net generation and more broadly, facing today's society. It seems that some

features of the net generation phenomenon are visible in the Finnish context and these characteristics are likely to strengthen in the future when different technologies become an even more common part of everyday life. The net generation phenomenon at this point can be seen as an indicative signal of the future, pointing the direction of development that schools should take into consideration. With the development of ICT in education, several types of software for different learning purposes have been created. These development phases have provided several technological and pedagogical solutions for teaching and learning with ICT. With wireless networks and mobile technologies it is feasible to integrate these possibilities to everyday teaching and learning. Good examples of this development can be seen in the School of Applied Educational Science and Teacher Education at the University of Eastern Finland where mobile technology (mini laptops), wireless networks, social software and online learning environments extend face-to-face teaching supporting students' collaborative learning. With these practices, student teachers are provided with pedagogically sound examples about how to use ICT for supporting teaching and learning. ICT is turning from teacher's presentation tool to students' learning tool.

5.4. FINAL THOUGHTS

Since 2001 when I started working at the University of Joensuu, I have had an opportunity to observe and participate in the development of ICT in education in practice. My work with different development projects such as Verkkosalkku II and ISOverkosto and also with teachers' in-service training has mainly focused on familiarising teachers with the different new possibilities that ICT can offer for their work and students' learning. With ICT the emphasis has also been on supporting teachers' reflective thinking, and stimulating them to evaluate their teaching practices and routines. For me, developing teaching and learning with ICT in a more collaborative direction has always been a grounding theme. My role in the development of ICT in education has typically been to pass the baton of current research to teachers within the exchange zone provided by projects and in-service training.

During the research process, there have been changes in the trends of using ICT for education. The starting point for my work was the in-service training with basic computer tools, such as office software and the Internet. At the beginning of 2000, different online learning environments and learning management systems (LMS) such as Verkkosalkku, Thule, Blackboard etc. were becoming more and more popular. With LMS, the second noticeable trend was with so called learning objects i.e. small units of learning materials that can be shared between teachers and used in different learning contexts. This trend was popular especially with distance education using LMS. Now, the trend seems to be more toward social software and mobile technologies. The idea of students' own personal learning environments (PLE) built by themselves, using the software they want seems to be the next big development. An important feature of this development has been that within the use of LMS, learning objects and PLEs, the emphasis has always been toward collaborative learning. In my opinion, it seems that

the theoretical frame has stayed much the same while the tools to concretise these theories of learning have changed and will change in the future.

In my opinion, it is important that in future the development of ICT in education proceeds towards one-to-one computing, so that computers become tools that are available when needed without any extra arrangements by the teacher. Computers with appropriate software will be normal and seamless tools as they are in working life. An important question will be about the ownership and administration of the computers, i.e. does it have to be schools that are responsible for the computers or could it be the students? One possibility would be that schools provide students with computers i.e. laptops or mini laptops. Nowadays, there are more and more examples of this kind of approach. This way it would be the students' responsibility to make sure their computers are working, much as students have to make sure they have their books and other learning materials with them. Another way of supporting one-to-one approaches would be to take advantage of students' own personal computers i.e. their mobile phones. The mobile phones that students bring to schools are fully operational computers with access to the Internet via schools network. Since web 2.0., the software is typically online without the need for installing them to the computer, so that access to the Internet provides numerous possibilities for learning. In the near future, instead of computers, schools could provide learning environments with large screens and keyboards that "recognise" students' phones with Bluetooth (or some other) connections. The computer would be in students' pocket, allowing access to schools' wireless network and the Internet with all the materials and tools needed for learning. Students would have their phones with them all the time allowing them to be used for learning also outside schools and in the home. They would have access to their learning environments online and the possibility to communicate with their peers when needed. Instead of a bag full of books, students would have their phones i.e. their personal learning environments, with all materials and tools necessary for learning.

For future research, it is important to make teachers in more central focus in the research process. The situation where teachers can participate in the research design and conduct their own research within their class or online courses will provide them with more ownership of the research and development processes. Also, designing and conducting research could be a method to support teachers' own reflective thinking. My personal interest within the research of ICT in education is to outline pedagogical models and scripts i.e. pedagogically meaningful ways to use different online environments, especially social software and mobile technologies to support learning. An important aspect of these models is how to take into account students' own skills and ideas for learning methods and ways to use ICT. The second, larger area of interest is research and development work with PLEs. PLEs, with student-designed learning environments and self-directed learning, demand changes in schools' and teachers' work and forms an interesting research area. These ideas continue the research with areas described at the beginning of this dissertation aligning with teacher thinking, net generation, mobile technologies, motivation and social software. The aim will be to find ways to design learning environments and activities that align with the theories of learning described in the chapter 2.2 taking also into account the challenges and possibilities brought up by the five studies in this dissertation and also by the earlier research referred to in the theoretical background.

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Appendix 1.

Study III - Questionnaire:

(Vastausohje: 1 = ei pidä lainkaan paikkaansa, 5 = pitää täysin paikkaansa.)

- Voin nykyisellään opiskella kaikkia haluamiani kursseja
- Voisin opiskella pelkästään verkossa:
- Mielestäni oman lukion osallistuminen ISOverkostoon on välttämätöntä opintojeni kannalta:
- Opiskelu verkossa vaatii opiskelijalta vahvaa panostusta opiskeluun:
- Verkkokurssit eivät mielestäni sovi lukioon:
- Opiskelu verkkokurssilla vahvistaa itseluottamustani:
- Nautin opiskelusta verkko-oppimisympäristöissä:
- Verkkokurssin aikana saan palautetta toisilta opiskelijoilta:
- Kirjoittamalla kommunikoiminen sopii minulle:
- Verkkokurssilla saan hyödyntää opiskeltavan aiheen autenttista materiaalia (esim. verkkolehdet, tutkimuslaitosten sivut):
- Verkkokurssilla ohjataan vuorovaikutukseen toisten opiskelijoiden kanssa:
- Verkko-opiskelu sopii hyvin opiskelutyyliini:
- Keskustelualueet auttavat oppimistani:
- Opiskelu verkossa ei sovi minun opiskelutyyliini:
- Verkkokurssilla saan ratkoa todellisia, oikean elämän, ongelmatilanteita:
- Opiskelu verkossa vaatii liikaa opiskelijan omaa aktiivista toimintaa:
- Verkkokurssilla minua häiritsee kasvokkain tapahtuvan vuorovaikutuksen puuttuminen:
- Vuorovaikutus opettajan ja opiskelijoiden välillä on verkkokurssilla yleensä vilkasta:
- Opiskellessani verkkokurssilla pystyn arvioimaan omaa osaamistani:
- Verkkokurssien saatavuus on tärkeää nykyiselle lukiovalinnalleni:
- Opiskelu verkkokurssilla aktivoi omaehtoisen tiedonhankintaan:
- Verkkokurssilla opiskelu perustuu pääosin valmiin materiaalin mieleen painamiseen:
- Verkkokurssilla voin edetä opinnoissani omaan tahtiini
- Opiskelu verkkokurssilla perustuu itsenäiseen tiedon hankkimiseen, arvioimiseen ja muokkaamiseen:
- Verkkokurssilla vuorovaikutus toisten opiskelijoiden kanssa on vähäistä:
- Verkkokurssilla minun on mahdollista opiskella omaan yksilölliseen tapaan:
- Osallistuminen verkkoympäristöissä tapahtuvaan keskusteluun on minulle helpompaa kuin luokassa tapahtuvaan keskusteluun:
- Verkkokurssin oppimistehtävät liittyvät aitoihin tilanteisiin:
- Verkko-oppimisympäristöt ovat mielestäni elottomia ja kaavamaisia:
- Verkkokurssit mahdollistavat omien opintojeni joustavan täydentämisen:
- Verkkokurssilla ei voida koskaan korvata normaalia kontaktiopetusta:

- Opiskelu verkossa kuuluu nyky-yhteiskuntaan:
- Verkko-opetus tarjoaa mielestäni yhtä hyvät mahdollisuudet oppimiselle kuin normaali luokkaopetus:
- Verkkokurssilla opiskelija hyödyntää monipuolisia oppimateriaaleja:
- Verkkokurssilla ohjataan oman osaamisen arviointiin:
- Verkossa opiskelu vaatii vähemmän työtä kuin normaali opiskelu:
- Verkko-opiskelu kuuluu nykyaikaiseen lukio-opiskeluun:
- Verkkoympäristöt ovat monipuolisia ja mielenkiintoisia opiskeluympäristöjä:
- Verkko-opiskelu vaatii opiskelijalta vahvaa itseuria:

Appendix 2

Study IV

Teknologian käyttö (Vastausohje: 1 = ei pidä lainkaan paikkaansa, 5 = pitää täysin paikkansa.)

- Innostun helposti uusien teknologioiden kokeilusta:
- Kehittelen mielelläni itse teknologioiden uudenlaisia käyttömahdollisuuksia:
- Otan käyttöön vain teknologioita, joiden käyttöön on saatavissa muilta käyttäjiltä tukea ja opastusta:
- Moni teknologia näyttää periaatteessa hyvältä, mutta käytännön tekijät estävät tällaisten kokeilujen tekemisen:
- Minulle on tyypillistä kokeilla uusia teknologisia välineitä heti ensimmäisten joukossa:
- Minulla on ystäviä joilta voin kysyä apua uuden teknologian suhteen:
- Seuraan aktiivisesti uutta teknologiaa käsitteleviä verkkosivustoja:
- Autan usein tuttaviani uuteen teknologiaan liittyvissä asioissa:
- Uusi teknologia ei kiinnosta minua:
- Löydän helposti uudesta teknologiasta itselleni sopivia sovelluskohteita:
- Otan käyttööni sellaisia teknologioita, joiden käyttö on yleistä ystäväpiirissäni:
- Seuraan aktiivisesti uutta teknologiaa käsitteleviä aikakauslehtiä:
- Vältän teknologian hankkimista kaikin mahdollisin keinoin:
- Käyttötaitoni eivät riitä uuden teknologian hyödyntämiseen:
- Uudet teknologian sovellukset ovat useimmiten pelkkiä ohimeneviä muoti-ilmiöitä:
- Hankin uutta teknologiaa vasta kuultuani toisten käyttökokemuksia:
- Pelkään, että uusi teknologia särkyvät käytössäni:
- Teknologiavälineiden mukana tulevat käyttöohjeet ovat minulle tärkeitä:
- Käytän mielestäni uutta teknologiaa enemmän kuin ystäväni:
- Kysyn usein tuttaviltani apua uuteen teknologiaan liittyvissä ongelmissa:
- Käytän uutta teknologiaan vain, jos muita mahdollisuuksia ei ole:
- Hankin teknologiaa, vaikka en sitä välttämättä tarvitsisi:
- Hankin teknologiaa vain hyvin tuntemistani yrityksistä:
- Minulta kysytään usein apua teknologiaan liittyvissä asioissa:
- Pelkään, että uusi teknologia menee jumiin käyttäni seurauksena:
- Teknologiaa ostaessani hankin vain hyvin tuntemiani tuotemerkkejä:
- Hankin uutta teknologiaa usein verkkokaupoista:

Appendix 3

Study V

Miten usein käytät seuraavia sovelluksia

0= En tunne kyseisiä ohjelmistoja

1= Tunnen ohjelmistot, mutta en käytä

2= Käytän ohjelmistoja harvoin

3= Käytän ohjelmistoja viikoittain

4= Käytän ohjelmistoja päivittäin

-Blogit (esim. Blogger, Vuodatus):

-Wikit (esim. Wikipedia, Wikispaces):

-Googlen työkalut (esim. Gmail, Google dokumentit):

-Kuvien jakamispalvelu (esim. Flickr, Webshots):

-Tekstinkäsittelyohjelmia (esim. Word, Writer):

-Jaettuja kirjanmerkkejä (esim. Delicious):

-Verkkoyhteisösovelluksia (esim. Facebook, MySpace, IRC):

-Taulukkolaskentaohjelmia (esim. Excel, Calc):

-Pikaviestimiä (esim. MSN Messenger, Skype, Google Talk):

-Sosiaalisia pelejä (esim. World of Warcraft, EverQuest):

-Virtuaalimaailmoja (esim. Second Life, Habbo hotel):

-Ammatillisen verkostoitumisen työkaluja (esim. LinkedIn):

-Kuvankäsittelyohjelmia (esim. Photoshop, PaintNet):

-Keskustelualueita (esim. www.suomi24.fi, www.peliplaneetta.net):

-Omien yhteisöjen rakennusohjelmistoja (esim. Ning):

-Tiedonhakukoneita (esim. Google):

-Tiedostojen jakamispalveluita (esim. BitTorrent, eMule):

-Videoiden jakamispalvelut (esim. Youtube, Google video):

-Mikroblogeja (esim. Twitter, Qaiku):

-Sähköposti (esim. Gmail, Live, Hotmail):

-Lukijaohjelmia (esim. Rss-syötteet):

-Katson päivittäin televisiota (alle tunnin) (1-2 tuntia) (3-4 tuntia) (4-5 tuntia) (yli 5):

-Vietän päivittäin aikaani Internetissä keskimäärin (alle tunnin) (1-2 tuntia) (3-4 tuntia) (4-5 tuntia) (yli 5):

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TEEMU VALTONEN

*An insight into collaborative
learning with ICT: Teachers'
and students' perspectives*

This dissertation consists of five studies providing insight into collaborative learning with ICT. Even though collaborative learning with ICT has been described almost as a mantra for knowledge age education, the results suggest that it continues to be challenging. Results also suggest that different ICT tools and today's students, the so called net generation, can be seen as change agents for developing teaching and learning practices to better meet the needs of the knowledge age society.



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