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Reading literacy

Related literacies more or less overlap, and they do not exclude one another, rather they complement one another. Reading and understanding a text often requires using two or more aspects and different literacies. Multi-literacy can be seen as several continuums of literacy: in the broadest sense oral, print and electronic modes but also several continuums within those.

From another aspect, there are several continuums of knowledge, skills and strategies that individuals acquire in different contexts through interaction with their peers and community. Each reader has a separate position on every continuum, because hardly anyone is good at everything; a person may perform better in one subcategory than in another. (Barton 1994; ETS 2001; Tyner 1998.) That means that a multiliterate person, on the one hand, may easily cope with different media,

The relationship between ICT use and reading literacy

Focus on 15-year-old Finnish students
in PISA studies



UNIVERSITY OF JYVÄSKYLÄ

FINNISH INSTITUTE FOR
EDUCATIONAL RESEARCH

Finnish Institute for Educational Research
Studies 30

The relationship between ICT use and reading literacy

Focus on 15-year-old Finnish students in PISA studies

Kaisa Leino

Esitetään Jyväskylän yliopiston humanistisen tiedekunnan
suostumuksella julkisesti tarkastettavaksi yliopiston
Seminarium-rakennuksen juhlasalissa 212
lokakuun 11. päivänä 2014 kello 12.

Academic dissertation to be publicly discussed, by permission
of the Faculty of Humanities of the University of Jyväskylä,
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on October 11, 2014 at 12 o'clock noon.



UNIVERSITY OF JYVÄSKYLÄ
FINNISH INSTITUTE FOR
EDUCATIONAL RESEARCH

THIS PUBLICATION
CAN BE OBTAINED FROM:
Finnish Institute for Educational Research
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P.O. Box 35
FI-40014 University of Jyväskylä, Finland
Phone +358 40 805 4276
E-mail: ier-customerservices@jyu.fi
www.ier-publications.fi/

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Cover and graphic design: Martti Minkkinen
Layout: Kaija Mannström

ISSN-L 1455-447X
ISSN 1455-447X (printed version)
ISSN 2243-1381 (pdf)

ISBN 978-951-39-5827-5 (printed version)
ISBN 978-951-39-5828-2 (pdf)

Printed by Jyväskylä University Press
Jyväskylä 2014

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Abstract

This study examined the use of information and communication technology (ICT) among 15-year-old Finnish students and that use's relationship to reading literacy scores in the data from the OECD's Programme for International Student Assessment (PISA) survey. This study was executed with the help of six substudies, with each substudy taking a different view of ICT use and reading literacy. These substudies explored the purposes, frequencies and self-assessed skills of students' ICT use, as well as students' attitudes towards it. In addition, those ICT literacy activities and practices were studied in contrast to the reading literacy scores of the PISA surveys in 2000, 2003 and 2009. Gender differences were also studied. Moreover, students' perceptions about the advantages and disadvantages of the Internet were explored. Because the PISA survey assessed the reading literacy of traditional printed texts, the study also includes a discussion of the similarities and differences between electronic texts and printed ones and outlines the literacy needs of the mid-2010s in a multiliteracy frame.

The data of this study consisted of the PISA reading literacy scores and the PISA student questionnaire. In substudies I–IV, the data were based on PISA 2000, substudy V drew from PISA 2003 and substudy VI used PISA 2009. In 2000, two additional questions were added to the student questionnaire in order to obtain information for this study about the students' use and perceptions of ICT. In all the substudies, the data formed a representative sample of Finnish 15-year-olds, also in terms of gender differences.

Several methods of analysis were used. In substudy I, the responses were examined using the constant comparative method and with the help of the Atlas.ti application. The other substudies used quantitative methods: substudy II, descriptive statistics (means, percentages); substudy III, factor analysis; substudy IV, hierarchical cluster analysis; and substudies V and VI, multilevel regression analysis.

The results of this study showed that Finnish adolescents use computers and the Internet frequently and for varied purposes. Despite this frequent use, they are not very interested in computers and their comfort with their abilities to use computers was only near the mean of OECD countries. However, these affective propensities are important, because the results indicated that those students who had self-confidence in ICT tasks performed better in the reading literacy assessment than those who did not have self-confidence. Gender differences were significant: boys were more interested in computers and they were more confident about their skills than girls. Boys also engaged more in activities that require technical knowledge, whereas girls engaged more in social activities. Both genders considered finding information as the best advantage of the Internet.

Even though finding information was an advantage, the evaluation of that information was considered to be a challenge. According to the students, disadvantages also included the spreading of viruses and Internet addiction. However, only a few questioned issues such as online piracy or plagiarism. This emphasizes the need to support students' evaluative and ethical reading skills.

The results showed that moderate and versatile ICT use might support the reading literacy skills of traditional literacy, especially among boys. One explanation may be that because the Internet is very much text based, those computer users who seldom read printed texts encounter different kinds of texts online. Even though reading fiction seems to best support reading literacy skills, those who diversely used a range of media did almost as well as the active fiction-readers in the reading assessment. The lowest proficiency in reading literacy was among those who did not use computers at all or at least very seldom and among those who read printed materials the least, especially fiction.

There seem to be differences in how ICT is used. On the one hand, information retrieval has a positive relationship to traditional reading literacy. Those who actively searched for information did so despite the media, which means they were active readers of different kinds of texts and interested in reading. On the other hand, very active game playing, especially if it replaced other hobbies, had a negative relationship to reading literacy proficiency and on interest in reading. These two activities had a similar relationship to the use of reading strategies as well.

One limitation of the study was that the digital reading of Finnish students was not assessed. This lack is why the comparison between traditional print literacy and electronic literacy was presented. This comparison revealed that many of the skills and strategies needed with printed texts are needed with electronic ones as well, but practices such as evaluation of text reliability or ethical evaluation of the use of digital material are emphasized in the context of ICT. In addition, navigation skills are significant because without skills and knowledge for searching and navigation a reader may become frustrated and get lost by only following one hyperlink after another.

ICT literacy skills are essential in the knowledge society, and those skills have meaning for studying, working and participating in society and its policymaking. The need for these skills is why students should be guided to literacy practices in different media. They should be familiarized with the general principles of different kinds of tools and programs (tool literacies), helped to understand the advantages and disadvantages of different media and their suitability for various kinds of tasks (media literacy), and guided in learning to interpret and evaluate different text types and their content (information literacies). All these areas should also include critical, ethical, cultural and social evaluation of context, media and content.

Keywords: adolescents, information and communication technology (ICT), literacy, multiliteracy, reading, media education, OECD's Programme for International Student Assessment (PISA)

Tiivistelmä

Tämän tutkimuksen kohteena oli 15-vuotiaiden suomalaisnuorten tietokoneen käyttö sekä tietokoneen käytön yhteys lukutaitoon. Tutkimuksessa tarkasteltiin sitä, mihin nuoret tietokonetta ja Internetiä käyttävät, millaisiksi he arvioivat omat taitonsa ja ovatko he kiinnostuneita tietokoneen käytöstä. Lisäksi tutkimuksessa tuotiin esiin nuorten näkemyksiä siitä, mitkä ovat Internetin parhaimmat puolet ja suurimmat ongelmat. Tietokoneen käytön tapoja ja aktiivisuutta verrattiin OECD:n kansainvälisen PISA-tutkimuksen (Programme for International Student Assessment) perinteisen lukutaidon arvioinnin tuloksiin hyödyntäen PISAn aineistoa vuosilta 2000, 2003 ja 2009. Aiheen tarkastelussa huomioitiin myös keskeiset muuttujat, kuten sukupuoli ja sosioekonominen tausta. PISA-tutkimus kohdistui perinteisen eli painetun tekstin lukutaidon arviointiin, mutta tässä tutkimuksessa pohditaan myös niitä piirteitä, jotka tekevät verkkolukemisesta erilaista verrattuna printatun tekstin lukemiseen, ja näin on muodostettu laajempi kuva teknologian yhteydestä lukutaitoon.

Tutkimus toteutettiin kuuden osatutkimuksen avulla. Osatutkimuksissa I–IV käytettiin vuoden 2000 PISA-aineistoa, osatutkimuksessa V vuoden 2003 aineistoa ja osatutkimuksessa VI vuoden 2009 aineistoa. Aineistot koostuivat PISAn lukutaidon arvioinnin tuloksista ja oppilaskyselyn vastauksista. Vuonna 2000 oppilaskyselyn yhteydessä oppilaat vastasivat myös kahteen tätä tutkimusta varten lisättyyn kysymykseen, joista toinen kartoitti tietokoneen käytön tapoja ja yleisyyttä ja toinen oppilaiden näkemyksiä Internetistä. Kaikissa osatutkimuksissa aineisto oli kansallisesti kattava ja vertailukelpoinen sukupuolten välillä. Analyysimenetelmänä osatutkimuksessa I oli laadullinen lähiluvun menetelmä, jonka apuna käytettiin Atlas.ti-ohjelmistoa. Muut osatutkimukset hyödynsivät erilaisia määrällisiä menetelmiä: osatutkimuksessa II määrällinen kuvailu (keskiarvot ja prosent-

tijakaumat), osatutkimuksessa III faktorianalyysi, osatutkimuksessa IV klusterianalyysi ja osatutkimuksissa V ja VI monitasomallit.

Tutkimuksen tulokset osoittivat, että suomalaiset nuoret raportoivat käyttävänsä tietokonetta ja Internetiä monipuolisesti. Tästä huolimatta he eivät olleet kovin kiinnostuneita tietotekniikasta eivätkä luottaneet omiin kykyihinsä OECD:n keskiarvoa enempää. Näihin kiinnostuksen ja itseluottamuksen kysymyksiin kannattaisikin kiinnittää koulutuksessa huomiota, sillä tulokset osoittivat, että tietoteknisiin taitoihinsa luottavat oppilaat pärjäsivät paremmin lukutaidon arvioinnissa kuin ne, jotka eivät luota omiin taitoihinsa. Sukupuoliero tässä asiassa oli selvä: pojat olivat selvästi kiinnostuneempia tietotekniikasta, ja he myös luottivat itseensä tyttöjä enemmän. Poikien lukutaidon taso ei kuitenkaan yltänyt tyttöjen tasolle, joten itseluottamus selittää vain pienen osan lukutaitoon vaikuttavista tekijöistä. Pojat käyttivät enemmän toimintoja, jotka vaativat teknistä osaamista. Tytöt sen sijaan suosivat tietotekniikan sosiaalista käyttöä. Yhteistä molemmille sukupuolille oli, että he pitivät Internetin parhaana ominaisuutena sen tarjoamaa tiedonhakua ja -saantia.

Vaikka tiedonsaanti miellettiin Internetin parhaaksi puoleksi, oli toisaalta tiedon arviointi Internetin pahin ongelma. Lisäksi ongelmiksi nimettiin muun muassa virusten leviäminen ja nettiriippuvuus. Sen sijaan hyvin harva oppilas kyseenalaisti esimerkiksi laitoman lataamisen tai muiden tekstien plagioimisen. Tulos korostaakin sitä, että nuorten arvioivan ja eettisen lukemisen taitoja tulisi tukea ja ohjata.

Tietokoneen käytön vertailu lukutaidon arvioinnin tuloksiin osoitti, että kohtuullinen tietokoneen käyttö voi tukea perinteistä lukutaitoa, erityisesti siitä näyttäisi olevan hyötyä pojille. Tämä saattaakin liittyä siihen, että koska Internet kuitenkin on hyvin tekstivaltainen, kohtaavat muuten vähän lukevat pojat verkon kautta erilaisia tekstejä ja kehittävät näin omaa lukutaitoaan. Vaikka edelleen kaunokirjallisuuden lukeminen näyttää tukevan parhaiten perinteistä lukutaitoa, pärjäsivät eri medioita ja tekstejä monipuolisesti käyttävät nuoret lähes yhtä hyvin. Sen sijaan heikoiten pärjäsivät ne nuoret, jotka eivät käytä tietokonetta ollenkaan tai hyvin vähän, sekä ne, jotka vähiten lukivat painettuja tekstejä, etenkin kaunokirjallisuutta.

Jonkin verran vaikutusta näyttäisi olevan siis myös sillä, mihin tietokonetta käyttää. Tiedonhaku internetistä tuki myös perinteisen lukemisen tiedonhaun taitoja, ja aktiivisesti tietoa Internetistä etsivät olivat myös aktiivisia muiden medioiden, kuten sanomalehtien, lukijoita ja kiinnostuneita lukemisesta. Erittäin aktiivinen, muut harrastukset sivuun jätävä pelaaminen taas oli kielteisesti yhteydessä lukutaitoon ja kiinnostukseen lukemista kohtaan. Samansuuntainen yhteys näillä kahdella toiminnolla oli myös lukemisstrategioiden käyttöön.

Tutkimus osoitti, että monipuolisella tietotekniikan käytöllä voidaan tukea myös perinteisen lukemisen osaamista. Tutkimuksessa ei kuitenkaan tarkasteltu suomalaisten nuorten digitaalisen lukutaidon osaamista empiirisesti. Perinteisen, printatun tekstin

lukemisen ja uuden, elektronisessa muodossa olevan tekstin lukemisen erojen teoreettinen tarkastelu osoitti, että monet informaation arvioinnin taidot ovat samoja, mutta toisaalta esimerkiksi tekstin luotettavuuden ja käytön eettisyyden arviointi korostuvat verkkotekstejä luettaessa. Merkittävä tekijä verkkoteksteissä on myös navigoinnin hallitseminen, sillä ilman tiedonhaun ja navigoinnin taitoja lukija saattaa turhautua tiedon etsintään ja eksyä aiheesta hypertekstien linkkejä seuraamalla.

Verkkolukutaidon hallitseminen on yksi keskeinen tietoyhteiskunnan taito, jolla on suuri merkitys niin työelämässä kuin yksilön osallistumisessa yhteisöön ja yhteisön asioihin vaikuttamisessa. Tämän vuoksi koulutuksessa tulisi kiinnittää huomiota siihen, että lukutaitoa kehitetään monipuolisesti eri medioiden avulla: oppilaiden olisi tunnettava erilaisten välineiden ja ohjelmien yleisperiaatteet, pystyttävä arvioimaan median soveltuvuus eri tehtäviin ja ymmärrettävä eri medioiden vahvuudet ja heikkoudet sekä kyettävä tulkitsemaan ja arvioimaan monipuolisesti eri tekstityyppejä ja niiden sisältöjä. Kaikkeen tähän tulisi lukutilanteessa liittyä niin tilanteen, median kuin sisällönkin kriittinen, eettinen, kulttuurinen ja sosiaalinen tarkastelu.

Asiasanat: nuoret, tieto- ja viestintäteknologia (TVT), lukutaito, monilukutaito, lukeminen, mediakasvatus, OECD:n Programme for International Student Assessment (PISA)

List of original publications

- I Leino, K. 2006. Reading the Web – Students’ perceptions about the Internet. *Scandinavian Journal of Educational Research* 50 (5), 541–557. (Refereed.) <http://www.tandfonline.com/doi/full/10.1080/00313830600953618>
- II Leino, K. 2003. Computer usage and reading literacy. In S. Lie, P. Linnakylä & A. Roe (Eds.) *Northern Lights on PISA – Unity and diversity in the Nordic countries in PISA 2000*. University of Oslo. Department of teacher education and school development, 71–81. (Not refereed.) ISBN 82-90904-71-1. <http://www.oecd.org/dataoecd/31/16/33684855.pdf>
- III Leino, K. Exploring functions in network literacy practices of 15-year-old Finnish students. Submitted to publication for *Learning, Media & Technology*. (Not refereed.) <https://ktl.jyu.fi/henkilosto/leino-kaisa/articleIII.pdf>
- IV Leino, K., Linnakylä, P. & Malin, A. 2004. Finnish students’ multiliteracy profiles. *Scandinavian Journal of Educational Research* 48 (3), 251–270. (Refereed.) <http://www.tandfonline.com/doi/full/10.1080/00313830410001695727> <http://www.tandfonline.com/doi/full/10.1080/0031383042000252575>
- V Leino, K. & Malin, A. 2006. Could confidence in ICT boost boys’ reading performance? In J. Mejdning & A. Roe (Eds.) *Northern Lights on PISA 2003 – A reflection from the Nordic countries*. TemaNord 2006:523. Copenhagen: Nordic Council of Ministers, 175–188. (Refereed.) ISBN 92-893-1300-5. <http://www.norden.org/sv/publikationer/publikationer/2006-523>
- VI Leino, K. & Nissinen, K. 2012. Verkkolukutaito ja tietokoneen käyttö PISA 2009 -tutkimuksessa [ICT literacy and computer use in PISA 2009]. In S. Sulkunen & J. Välijärvi (Eds.) *PISA09. Kestääkö osaamisen pohja? [PISA09. Will the basis of competence hold?]* Publications of the Ministry of Education and Culture 2012:12, 62–76. (Not refereed.) ISBN 978-952-263-112-1. <http://www.minedu.fi/export/sites/default/OPM/Julkaisut/2012/liitteet/okm12.pdf?lang=fi>

The original publications and manuscripts are referred to as ‘substudies’ with Roman numerals I–VI. The work reported in the jointly authored articles was done to a great extent by the first author. In substudies V and VI, the co-author provided the methodological knowledge to perform the multi-level regression analysis. The first author was responsible for analysing the results and making the conclusions. In substudy IV, the third author performed the hierarchical cluster analysis, the second author wrote the international review and the first author was responsible for analysing the results of the cluster analysis and reporting the national data.

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Preface

My work at the Finnish Institute for Educational Research (FIER) started in 1999 when I was hired to give scores in the reading literacy assessment in a PISA field trial. Ten months after this first encounter with PISA (after working in other projects), I started as a research student working in the Finnish PISA team focusing on reading literacy and students' ICT questionnaire. I jumped in when the PISA team was dotting the i's and crossing the t's for the first round of PISA in 2000. With that team, I found a little researcher in me and I learned a great deal about large scale assessments. So my deepest gratitude is addressed to the Finnish PISA team that worked in PISA 2000 and PISA 2003, and especially to Professor Pirjo Linnakylä, who patiently guided me, a novice, until she retired in 2008. Most of the knowledge and research presented in this dissertation was born under her supervision. Another person from that team that I would like to mention is University Lecturer Sari Sulkunen, who is the reason I found my way to the Finnish Institute of Educational Research and who worked with me the most, sharing her knowledge of reading literacy.

I also want to thank my other supervisors. From Professor Minna-Riitta Luukka I have learned a lot and her impact was strong when finishing my dissertation. At the very end of the process, Adjunct Professor Mia Halonen was also signed as a supervisor. I thank Mia for encouraging me to continue when I had moments of despair with this dissertation.

My thanks also go to the reviewers of my dissertation, Professor Reijo Kupiainen and Professor Anne Pitkänen-Huhta. Your comments helped me to improve the final version and even gave me some new sights. I wish we could have had an opportunity to discuss this topic earlier.

In the Finnish Institute for Educational Research, I have had an opportunity to work with various people and on different duties. I am very grateful for Professor Antero Malin, Researcher Kari Nissinen and Data Manager Eija Puhakka for helping me to understand the sample design of PISA survey and quantitative methods, and analysing the data. When I started as a research student, I had had no studies in quantitative methods at all. Without your expertise and help I could not have done it. Thanks goes also to the Publication and Information Unit of FIER, which has been my base since 2006 when I changed from PISA team to another duties. The people working in the Publication and Information Unit have been important co-workers and have also helped me to put this book into its covers. Thank you also for all of you who have sat around a lunch or a coffee table with me and shared my sorrows and happiness.

For the last six years I have also worked at the Language Centre. I thank the staff of the Language Centre for taking me so warmly as a part of your community and also for believing in my expertise. I have enjoyed teaching and the discussions I have had. Thank you, also, for Matthew Wuethrich for proofreading my manuscript.

The warmest thanks go to my friends and family. You have given me joyful moments by letting me just be me. You have supported me when I have had hard times and celebrated with me on occasions. You have shared "the real life" with me, the life outside academia. Thank you to my dear father, Kauko, for the loving and support, and for taking care of your grandchildren when I was working. Finally my dearest: Toni, Sami and Peppi. There is nothing more important than you. Toni, you are to be blamed that I even became interested about ICT but you have also been my guide whenever I have needed to know anything about technology. You are my husband and my best friend, sharing the joys as well as the daily routines. Sami and Peppi, I am so proud of you. You are my best achievements.

I dedicate this dissertation to my mother, Kaarina. She always had faith in me and encouraged me whatever I planned or whenever I hesitated. Without her loving I would have never achieved the self-confidence that was needed to start and finish this dissertation. I hope I can give the same kind of support to my children in their lives. I wish she could have seen me finish this.

Jyväskylä, September 2014

Kaisa Leino

1

Introduction

Computers and the Internet – or more broadly information and communication technology (ICT) – are every day within reach of adolescents and adults. What is the relationship of ICT use to the literacy practices and skills they have? Since 2000, Finnish students have scored at the top of the countries in the Organization for Economic Co-operation and Development’s (OECD) Programme for International Student Assessment (PISA). What is the secret of Finland’s success? Has ICT use anything to do with it? The present study explores the reported ICT use of 15-year-old Finnish students and the relationship of that ICT use to reading literacy proficiency in the PISA studies. In this first chapter, I introduce the term ICT literacy and discuss the importance of ICT literacy in the information society. Then I introduce the background of this dissertation by taking a look at the premises of the OECD’s PISA survey and some results from it that form an important part of that background. In the last part of this chapter, I present the aims and structure of this dissertation.

1.1 ICT as a part of everyday literacies

The rapid development and spread of technology, epitomized by the growth of the Internet, has made information and communication technology (ICT) very familiar to Finnish adolescents. For many, ICT has become part of their everyday lives. At the same time, the complexity and multidimensionality of literacies in the digital world have become appar-

ent (see Heinonen 2006). Donald Leu et al. (2007, 37) describe this world as a “digital, networked, multimodal, and multitasking world of information and communication”. Nowadays, it is common for adolescents to spend several hours a day with their computers or smart phones at school as well as at home (e.g. Suoninen 2013, 12–17; Uusitalo, Vehmas & Kupiainen 2011, 33–34) and even to use several media simultaneously in a form of multitasking (Herkman & Vainikka 2012b). The Internet has changed the way people communicate and act. It is easier than ever before to search and distribute information and publish one’s thoughts, opinions, skills and knowledge. Anyone can put anything – texts, images, videos – of any kind on the Internet, and it is very possible that nobody checks the validity of the information. People on the other side of the world can chat in real time and music can be bought and downloaded to your own computer or smart phone. Information and communication technology has transformed media, the contexts and purposes of literacy practices, texts and the literacy culture as a whole (Cope & Kalantzis 2000; Gilster 1997; Kaufmann 1993; Mike 1996; Reinking, McKenna, Labbo & Kieffer 1998).

It is expected that a person knows and can use, at a basic level, the most commonly used operating systems, word processing programs, spreadsheet applications, drawing and graphics software, and information networks, especially the Internet (e.g. Kapitzke 2001; Smith 2000). However, skills to use applications or devices are not enough. In fact, these so-called computer and network literacy skills are only one part of a set of skills and knowledge that is needed in the information society to be an efficient reader. Nowadays, literacy is emphasized especially when considering its meaning in searching for information, quality of life and active citizenship (see Linnakylä 2000, 108). Reading literacy is, at its best, something that a person can use to empower new dimensions in themselves and nurture independent thinking, knowledge and values. By reading, a person can access information that no one teaches or recommends (see Linnakylä 2000, 110). A good reader can, in different media, use varying strategies for a range of texts and purposes, including previewing the text, setting goals, making predictions, monitoring understanding, asking questions, making connections within and between texts, and integrating prior knowledge with new knowledge (Coiro & Dobler 2007, 218).

The literacies of the information age, often called new literacies (Leu, Kinzer, Coiro & Cammack 2004), have been conceptualized in various ways by different groups of scholars and approached from a range of perspectives. These include such as critical literacy (e.g. Bruce 2000; Luke 1997), which emphasizes the need to develop literacies to better understand the stance of authors writing, for example, under economic and political pressures; Multiliteracies (New London Group 1996, 2000), which emerged from the sociolinguistic tradition and emphasizes the multiple modalities and growing diversity of culture and language; media literacy (Tyner 1998), which is aligned with critical literacy and focuses on different medias; and the New Literacies Theory (Leu 2002a; Leu et al. 2004), which is psy-

cholinguistic in nature. Colin Lankshear and Michele Knobel (2013, 7) have distinguished two ways of applying new literacies. First is the paradigmatic sense, which sees new literacies as a sociocultural paradigm for literacy theory and research. Second is the ontological sense, which focuses on new emerging forms of literacy practices. All in all, new literacies have attempted to expand the cognitive-skill-oriented approach of the individual to consider the contextual, cultural and social dimensions in the literacy practices of a particular group (e.g. Pitkänen-Huhta 2003, 18). The framing definition for new literacies has been presented by, among others, Leu et al. (2004, 1572):

The new literacies of the Internet and other ICTs include the skills, strategies, and dispositions necessary to successfully use and adapt to the rapidly changing information and communication technologies and contexts that continuously emerge in our world and influence all areas of our personal and professional lives. These new literacies allow us to use the Internet and other ICTs to identify important questions, locate information, critically evaluate the usefulness of that information, synthesize information to answer those questions, and then communicate the answers to others.

One of the concepts used to refer to literacies of the 21st century is the term *ICT literacy*, which, for example, the OECD's international expert panel used in planning the PISA assessments. They defined the term as follows:

ICT literacy is the interest, attitude and ability of individuals to appropriately use digital technology and communication tools to access, manage, integrate and evaluate information, construct new knowledge, and communicate with others in order to participate effectively in society (OECD 2003/2005, 11).

According to the OECD's expert panel, ICT literacy is constructed of three elements: 1) technical proficiency; 2) cognitive proficiency, such as reading, information gathering, knowledge construction, critical thinking and communication; and 3) affective propensities: interest and attitudes (OECD 2003/2005). This definition of ICT literacy covers multiple skills, different types of knowledge and several related concepts of literacy (see section 4.2). In some ways, this definition resembles the definition of literacy practices proposed by Sylvia Scribner and Michael Cole (1981), two pioneers of literacy practice studies. They stated that literacy practices develop in social interaction and have three essential components: knowledge, skills and appropriate technologies. The OECD definition given above also highlights that the goal of literacy is "to participate effectively in society". However, it does not say that practices are also born through past and present social activities, as Scribner and Cole (1981) emphasize. In this way, the OECD definition is more function oriented.

Changing literacy needs have also been addressed in school curricula. In the most recent national Finnish curriculum (Perusopetuksen opetussuunnitelman perusteet 2004),

literacy is considered in formal and informal contexts and the approach taken is cognitive as well as functional and sociocultural (Kauppinen 2007, 2010; see chapter 2). Unfortunately, in practice the main focus is still on school literacies (Kauppinen 2010; Luukka 2003; Luukka, Pöyhönen, Huhta, Taalas, Tarnanen & Keränen 2008, 58–60; Peruskoulun opetussuunnitelman perusteet 2004). The quantity and quality of media education are still dependent on teachers' own actions, especially when it comes to reading literacy skills for media texts (Kupiainen 2013; Luukka et al. 2008; Noppari, Uusitalo, Kupiainen & Luostarinen 2008, 160–161; Taalas 2008). However, some new schoolbooks have included reading electronic texts, such as websites, as part of their instruction. In addition, many interesting and innovative pedagogical practices have been developed to combine reading literacy and ICT, such as Netlibris (see IEA 2009), which arose from a need to get boys involved in reading but which has also inspired girls to use the Internet.

In Finland, the new national curriculum is currently under development, and it is planned to be implemented in 2016. In the new curriculum, the concept of multiliteracy (*monilukutaito*) has been included for the first time in the Finnish curriculum. The emphasis on multiliteracy skills is evident. The curriculum's definition of multiliteracy is in line with the one presented in this study (see Halinen, Holappa & Jääskeläinen 2013; OPH 2012, 13–14).

The Finnish government also recognized the importance of ICT early on. In Finland, education focusing on computers and the Internet was ramped up at the beginning of the 21st century, the same time at which this study began. Accordingly, the Finnish government established the Information Society Programme, the target of which was to provide not only functioning connections and electronic services but also the readiness and skills to use the services. This readiness was assumed to be made possible by strengthening media education, providing tools for strengthening information technology skills (i.e. basic information technology skills), information management, media literacy and the use of electronic services, and improving the content of Internet teaching (Information Society Programme 2004). The programme was a good start in bringing ICT to schools, but the process has been slow. The change is first and foremost in the hands of teachers and the school budgets often cannot support it. However, as Leu, O'Byrne, Zawilinski, McVerry and Everett-Cacopardo (2009) point out, functional affordances define the Internet more than its technological affordances. As ICT use becomes a common activity for the majority of people, the Internet should be framed as a literacy issue more than as a technical issue (Leu et al. 2009).

As technology has developed, so has interest in different media. In the 1960s, the focus was on television, movies and newspapers. In the 1970s, it was on television and mass media. In the 1980s, the focus shifted to video, audiovisual culture, movies and music videos. It was in the 1990s that information technology, the Internet and digital technology

were introduced. Now in the 2000s, the focus has been on digital technology and multimodality. (Kupiainen, Sintonen & Suoranta 2007, 23.) Along with this change, the challenges of multiple literacies have become of interest in recent years (e.g. Alvermann 2002; Leu 2002a, b; Kalantzis, Cope & Harvey 2003). In Finland, the focus has been on media literacy and the use of different media (e.g. Herkman & Vainikka 2012a, 2012b; Kupiainen 2013; Luukka, Hujanen, Lokka, Modinos, Pietikäinen & Suoninen 2001; Noppari et al. 2008; Tarnanen, Luukka, Pöyhönen & Huhta 2010; Uusitalo et al. 2011), promoting ICT in education (e.g. Atjonen 2005; Kankaanranta 2004; Kankaanranta & Puhakka 2008), studies examining ICT culture and its relationship to school achievements and grades (e.g. Kumpulainen 2004), and recently critical literacy skills for the Internet (e.g. Kiili 2012; Kiili, Laurinen & Marttunen 2008) as well as literacy practices at school (Kupiainen 2013; Luukka et al. 2008; Taalas 2008).

These areas of literacy studies are of current interest and importance because the rapid development of technology has changed life, learning and work, and continues to stimulate further changes. Information and communication technologies are used every day by adolescents. They direct and influence, among other areas, adolescents' choices, how they spend their free time, their interests, their groups of friends, and their views of their skills as well as the knowledge needed for managing information and communication. ICT literacy skills are connected to the cultural and social success of adolescents among their peers. For example, students who cannot join the online chat after school may easily feel themselves to be outsiders and become outcasts.

In other words, this kind of study is important to understand the literacy practices connected to the textual and social practices of popular culture. Without an understanding of the literacy practices of adolescents, the gap between adults and adolescents may grow (Kupiainen & Sintonen 2009, 47). In addition, huge investments in hardware are useless without ICT literacy skills. Those skills are necessary to function effectively in society and in a global world increasingly dependent on ICT (ETS 2001). The skills and knowledge that adolescents possess influence their lives not only now, but also later when they move on to academic studies or to working life. Organizations in the information society are often organized horizontally, which means that teams at lower levels also make decisions related to their functioning and therefore employees with information and ICT literacy skills are valued (Leu et al. 2004, 1576). Many authorities realize that ICT literacy skills are key tools for lifelong learning, democratic empowerment and civic activism (Wills 1999) because these skills aid information retrieval, marketing and communications, and because research indicates that literacy proficiencies are associated with social, educational and economic outcomes (ETS 2001; Sweet & Meates 2004). There are also other important questions: How does technology and the Internet affect students' reading literacy habits and skills? Is the Internet a threat or an aid to reading literacy? Do active computer users

abandon printed texts and what does it mean for reading literacy? What kinds of reading literacy skills do we need in the information age? However, current research on the uses of ICT and its impact on education, achievements and changing requirements is inadequate.

Because the Internet is part of young people's everyday life, it, not surprisingly, has raised questions about its advantages and disadvantages from educational, ethical and social viewpoints. What kinds of literacy practices do adolescents use and learn at school and during their leisure time and should formal education change (see Luukka et al. 2008; Taalas 2008)? Are the literacy practices, and especially ICT literacy practices, used during leisure time of any benefit to school literacies? There are many beliefs and prejudices about the Internet, but there are few studies about, for example, the relationship between Internet use and reading literacy, especially considering the large amount of data available. However, some studies were published only after this study had been started. For example, there are studies with the PISA 2000 data that concern computer use (Fuchs & Woessmann 2004) and the impact of computer use on reading achievement (Bussière & Gluszynski 2004) as well as one regarding low achievers' access to computers at school (Sweet & Meates 2004). There is also a larger study with PISA 2009 (OECD 2011), in which the focus was not on Finland but on comparing the participating countries. Some of the questions within the scope of this study, such as the purposes of Internet use during leisure time and interest in computer use, have been asked in Finland as well (see Kaarakainen, Kivinen & Tervahartiala 2013), and those will be discussed.

In this study, I have adopted the OECD definition of ICT literacy presented above, but ICT literacy has more sociocultural perspectives as well, and I will define these later. In this study, the concept of ICT literacy is used to make a distinction from traditional literacy conveyed by printed texts. Terms such as digital literacy or electronic literacy – or in some parts Internet or network literacy – are synonyms. The concept of ICT literacy was chosen for several reasons. First, its definition includes not only technical skills and knowledge but also cognitive skills and affective propensities. Second, the concept covers computer and Internet use as well as the wide frame studied here. Third, in my view, it follows the socio-cultural view of literacy that is utilized in this study (see section 2.3). Fourth, the concept was used by the experts of the Educational Testing Service (ETS) and the OECD (e.g. in PISA 2000 and 2003), as well as by many teachers and researchers in Finland (using in Finnish *tieto- ja viestintätekniikka*, TVT; see Atjonen 2005). This study is strongly connected to the OECD's use of the term, because the data were collected from the OECD's PISA studies (see sections 1.2 and 6.1). However, it says something about the conceptual chaos surrounding the concept that in its international assessment in 2009 (PISA 2009), the OECD changed the concept and the term digital literacy was adopted instead of ICT literacy: in PISA 2009, digital literacy refers to the texts and tasks in the assessment, and the reported computer use of students is referred to as ICT tasks and activities.

In this study, the concepts of ICT literacy and traditional (printed) literacy are juxtaposed. The difference is in how the texts are mediated. These two literacies are essential parts of the literacy world of adolescents, which consist of interwoven texts and products of these two. This study takes the view that reading literacy consists of some common elements regardless of media. That is why all literacies, new and traditional, are placed under the umbrella of multiliteracy. In this study, the concept of multiliteracy is not understood as it is presented by the New London Group (1996, 2000), but instead a synthesis of different theories is presented in order to achieve a comprehensive way to approach texts and to help to conceive of literacy needs from an educational point of view. I use the concept of *multiliteracy* instead of the term 'Multiliteracies' that is used by the New London Group. Multiliteracy is understood as a comprehensive approach to literacy considering the technology and media used as well as information management. The concept of multiliteracy is presented in chapter 4.

In the 21st century, technological development has been rapid, and this change obviously has an impact on the development of concepts. Some concepts used earlier are now out of date, but they need to be clarified because they were in active use at the beginning of the 21st century when the first substudies were published. In this study, ICT literacy was studied as the reported use of computers and the Internet. However, tablets and smart phones with access to the Internet can now be used in the same way as computers.

Even though the PISA assessments are based on the functional literacy approach (see section 2.2.2), the approach in this study is more sociocultural. The premises of this study are not only in studying activities and aspects of literacy, but also in bringing out students' self-reported attitudes and perceptions. In addition, the theories presented here that form the concept of multiliteracy are built on the sociocultural view. For the purposes of this study, the sociocultural approach is also more useful when discussing ICT literacy from an educational perspective. The definition of ICT literacy also reflects the social approach, because its one goal is "to communicate with others in order to participate effectively in society". In addition, the concepts of *activities* and *practices* used in this study are also based on the sociocultural theory presented by Mary Hamilton (2000), although I use the concept of activities instead of events. An activity is a visible, performed action, such as using an email application. A practice, however, is something people do with literacy when all the other resources, such as values, skills and knowledge, are brought to the context. These concepts are defined in section 2.3.

When talking about assessment of student abilities, one cannot avoid the concept of *skill*. The use of the terms skills and strategies seems to be inconsistent and overlapping (Afflerbach, Pearson & Paris 2008). Skill can sometimes be understood as merely a mechanical or cognitive action or performance (Afflerbach et al. 2008; Kupiainen & Sintonen 2009, 32), but in this study the concept of skills, in connection with literacy skills

and ICT skills, is understood more widely. A skill is the learned ability to carry out a task or activity. The concept of skill often refers to how well one does something. Dole, Duffy, Roehler and Pearson (1991, 242) have divided skills and strategies so that skills can be defined as “routinized, almost automatic behaviors” but strategies are understood to be more “conscious, instantiated, and flexible plans readers apply and adapt to a variety of texts and tasks”. The same kind of definition is made by Afflerbach et al. (2008). They emphasize that skills are automatic, whereas strategies involve deliberate control. A reading strategy may become a reading skill if the activity becomes effortless and automatic (Afflerbach et al. 2008, 368). In other words, when defined in this way, the activity of finding information on the Internet with a search engine may at first be a goal-directed reading strategy, but it may later turn into an unconscious skill. This action then becomes a literacy practice where the user not only engages in an activity but also uses his or her prior knowledge to identify good search engines and search words and to select the most relevant link from the search results. Some people do it more skilfully than others. With this definition in mind, in this study the term skill, in the context of ICT literacy practices, usually means skills and strategies, because some practices may be both and consist of several skills and strategies when considering the reader’s experience and expertise. ICT literacy skills consist of mechanical and cognitive processes as well as information processing.

1.2 Basis of the OECD’s PISA survey

The data of this study are based on the national data collection of the OECD’s Programme for International Student Assessment (PISA; for more about the data, see section 6.1). The PISA assessments were set up to measure how well adolescents (from 15 years 3 months to 16 years 2 months) near the end of compulsory schooling are prepared to meet the challenges of today’s information society. The assessments are conducted in three-year cycles, with each cycle focusing on one of three domains: reading literacy (excluding writing skills), mathematical literacy and scientific literacy. (OECD 2002b.) The PISA assessment has represented the know-how of one-third of the world population: in 2000, 32 countries participated; in 2003 the number of countries was 49; in 2006 it was 57; and in 2009, 65 countries and special economic zones (such as Macao in China) participated in the paper-based assessment. In 2000 and 2009, reading literacy was the major domain, accounting for over two-thirds of the testing content. In 2003, mathematical literacy was the major domain, as scientific literacy was in 2006, but there was still a subset of reading literacy tasks that were also used in PISA 2000. In 2009, 19 countries participated in a digital reading assessment as well. Finland, however, did not

participate. (OECD 2004, 2011.) Because of its global reach and continuity, OECD's PISA assessments have achieved an important role in educational policy nationally and internationally (see Rautalin 2013).

The PISA assessment consisted of two parts for students: the assessment and the background questionnaire. First each student completed a two-hour pencil-and-paper assessment. The assessment consisted of multiple-choice items and questions requiring students to construct their own answers by writing. Then they answered a background questionnaire that took about 30 minutes to complete. The background questionnaire is important, because PISA is policy driven, and the results of the assessment only would not give enough information and capacity to discuss the factors that correlate with the assessed skills, such as reading literacy performance. In examining students' literacy practices, PISA asked students about their motivations, their beliefs about themselves and their learning strategies, and also about the amount of time they spend on reading, the diversity of reading materials and their attitudes toward reading. In addition, several background questions were asked, such as the students' gender, their parents' occupation and education, the language of their school, and some family possessions. (See e.g. OECD 2002b.) The variables that were used in this study are defined in Appendix 1.

Some of the background questions were obligatory for all participating countries. There were also international options, such as questions about learning and study practices as well as regarding familiarity with computers. (OECD 2001, 2004, 2009.) International options were set for questions that "countries could elect to have administered to enrich the information base for their schools and students" (OECD 2009, 162). Most countries, Finland included, used most of them. In addition, there were also national options that were presented only in the country in question. Some data in this study were collected as a national option (see section 6.1). These options were restricted by time because of the need to avoid assessment sessions that were too long. Two straight hours was considered to be enough time for concentrating on the assessment and so completing the background questionnaire needed to be simple and quick.

In addition to the student questionnaire, there were different kinds of questionnaires for schools, teachers and parents (the last one in 2009 only). Those questionnaires are not used in this dissertation, and therefore I will not describe them.

Finnish students scored at the top of the participating countries in reading literacy both in 2000 and 2003 and they were second in 2009. In Finland, the difference between the best and the worst readers was rather small, but gender differences were wide, although they reflected the excellent performance of the girls rather than the poor performance of the boys, since the Finnish boys were the best readers compared to boys in other countries. Finnish students were especially good at retrieving information and interpreting texts. (Linakylä & Sulkunen 2002.) These aspects were also the ones that seem to have had a posi-

tive relationship with moderate ICT use (Leino 2002). These aspects are also considered in substudies II and VI.

Finnish students were very interested in reading and this had a positive relationship with the assessment scores. However, girls' interest in reading was the highest of all the participating countries, but boys' interest was clearly below the OECD average. In addition, 78% of Finnish students said that they read some at least every day for their own pleasure. However, 22% said that they did not read every day. Gender differences in time spent on reading were evident: almost two-thirds of the girls read every day for more than half-an-hour, but only one-third of the boys did the same. In addition, Finnish students actively read different kinds of materials, including newspapers, magazines, comic books, emails and websites. Boys, in particular, favoured digital materials but girls were more interested in fiction and magazines. (OECD 2001; Linnakylä 2002b; see also Kaarakainen et al. 2013, 28.)

This study examines reading literacy through the Finnish data of OECD's PISA 2000, 2003 and 2009 surveys. The results of the reading literacy assessment have been widely published elsewhere in several publications both internationally (e.g. OECD 2001, 2002b, 2004, 2011) and nationally (e.g. Kupari & Välijärvi 2005; Sulkunen & Välijärvi 2012; Välijärvi & Linnakylä 2002). However, the focus of this study is not on the reading literacy proficiency of Finnish students but on the factors behind those results, especially their reported ICT use and attitudes towards it. The aim of this study is described in the next section.

1.3 Aims and organization of the study

The primary aim of the empirical studies was to explore, with the data provided by OECD's PISA surveys in 2000, 2003 and 2009, the reported ICT use, especially the use of the Internet, of 15-year-old Finnish students and the relationship of that use to reading literacy. This opportunity to exploit a large set of national data focused this study on the background variables of the reading literacy assessment of PISA. The reading literacy assessment was based on reading traditional printed texts, but a background questionnaire provided self-reported information about students' reading habits and materials, their use of computers and the Internet, their perceptions about reading and computers, and perceptions about their abilities to perform some ICT tasks. In the quantitative approach, students' ICT use was formed from their self-reported responses to questions concerning the frequency of ICT use, so that those who engaged in some activity, such as downloading music, at least once a week, were considered to be actively participating in that activity. The empirical studies aimed to examine some of those background variables, especially related to the

Internet, and also their relationship to reading literacy scores in the PISA assessment when reading printed texts was concerned.

Reading literacy was defined broadly to mean reading literacy proficiency measured by scores on PISA's reading literacy assessment as well as to refer to reading literacy practices, activities and even affective propensities. The relationship between ICT use and reading literacy was approached from several perspectives and with qualitative and quantitative methods. The multifaceted approach of this study provides information about the relationship between ICT use and reading proficiency of printed texts as well as about ICT literacy practices. The empirical studies are limited to the self-reported usage and attitudes of the students, but these uses and attitudes reflect larger social dimensions because such issues as appreciation or perceptions of good and bad, or of skilful and unskilful are constructed when individuals act in social interaction with others and as part of society (see e.g. Scribner & Cole 1981). To bring out the voice of adolescents and also to strengthen the socio-cultural approach, a study on students' perceptions of the advantages and disadvantages of the Internet was included in this dissertation. From that view, the students' self-reported use, attitudes and perceptions indicate, for example, how they view ICT and what kind of textual world they encounter.

In summary, the empirical studies explore *how adolescents use and perceive ICT and what its relationship to reading literacy is* by answering the following questions:

1. *What kinds of purposes and functions of use did young people encounter in ICT tasks at the beginning of the 2000s?*
2. *What is the relationship between ICT use and reading literacy proficiency?*
3. *What kind of subcultural differences, such as gender, exist in ICT literacy practices as well as among reading traditional texts and what is their relationship to reading performance?*
4. *What is the relationship of such affective propensities, such as students' confidence in ICT tasks and interest in computers, to reading literacy proficiency?*
5. *How do students evaluate the use of the Internet: What are the advantages and the disadvantages of Internet literacy practices?*

These questions are examined in six empirical substudies, which all have their specific aims as follows:

Substudy I explored the perceptions of Finnish 15-year-olds regarding the advantages and disadvantages of the Internet. The results indicate two aspects of their perceptions: what features of the Internet students feel are important or beneficial, and what they feel are the thresholds for exploiting the Internet. The study includes discussion of what literacy skills adolescents need to practice.

Substudy II compared the Internet use of Nordic students and examined it in relation to the reading literacy scores from PISA 2000. The guiding questions were as follows: Which of the given activities were used most often? Are there gender or national differences in interest in computers? What is the students' self-reported comfort with and perceived ability to use computers? What is the relationship of reported ICT use and reading literacy mean scores in the four Nordic countries? Gender differences were also considered. This study focused on comparing The Nordic countries using basic statistical analysis.

Substudy III explored the purposes and functions of Internet use among the same 15-year-old Finnish students. This substudy focused on the following questions: How common are certain network literacy activities for 15-year-old students? What are the functions of these uses? Are there any gender differences in terms of functions and usage? The findings were discussed by determining whether the functions of network literacy resemble the functions of traditional literacy or if the functions of network literacy have distinct features.

Substudy IV examined the reader profiles of Finnish students from the perspective of both traditional print literacy and Internet activities. This substudy explored the following questions: What kinds of groups and types of readers can we find among Finnish students? Are all young people keen users of electronic texts who only rarely touch a book in their free time, or are there also groups that favour traditional printed books? And are there also those who have altogether missed the opportunities offered by information networks? The different groups were described and their reading literacy performance in the PISA assessment was examined considering several background factors, such as socioeconomic background.

Substudy V disentangled the relationship between reported ICT use and reading literacy by studying whether students' confidence in ICT tasks affects reading literacy performance when gender differences were concerned. The study aimed to answer these related questions: Are different categories of confidence in ICT tasks associated with students' reading literacy performance? Are there gender differences in this association? Several background variables were controlled for in this substudy.

Substudy VI examined the relationship between reported ICT use and reported literacy practices (i.e. diversity of reading material, interest in reading and reading strategies) using data from PISA 2009. In this assessment, reading literacy was, for the second time, the main domain of assessment. There was also a digital literacy assessment executed in 19 countries. Even though Finland did not participate in the digital literacy assessment, it offered interesting information about students' digital literacy skills and some results are therefore reported on. This substudy aimed to answer these questions: What is the relationship among Finnish students between reported ICT use and diversity of reading print material, interest in reading and reading strategies? What is the relationship of digital

literacy and traditional literacy and reading proficiency in both according to the results of the international PISA 2009 assessment?

Substudies II, IV, V and VI are concerned with the association of ICT use to PISA reading literacy scores, and they can be considered more as an evaluation of reading literacy skills. Substudies I and III explore ICT literacy in general. Substudies III, IV, V and VI examine gender differences. The compilation of research questions, data and methods of the substudies are presented in section 6.2 and in Table 5.

In addition to these empirical questions, the topic and approach of this study raised the question of how traditional reading of printed texts is different from reading computer-mediated, electronic texts. This question is especially valid because in empirical studies one variable is students' reading literacy scores, which are based on reading printed texts. Would the results have been different if the variable had been based on reading digital literacy? This study cannot answer that, although the international results of the digital literacy assessment in substudy VI touch on this subject. However, the similarities and differences between ICT literacy and traditional literacy have a significant role in the theoretical part of this dissertation. This question, then, leads to a consideration of what kinds of literacy needs adolescents have and what kinds of skills they should possess in the information age. From this consideration emerges the secondary aim of this dissertation: to discuss the literacy practices and needs of adolescents from an educational point of view. To participate in that discussion, on a theoretical level, ICT literacy and traditional literacy are brought together by using the concept of multiliteracy, which is presented in chapter 4.

At the time of the first PISA assessment in 2000, ICT literacy practices were virtually unexamined and so an explorative approach to the topic was decided upon. Kamil, Intrator and Kim (2000) had proposed research on the effects that simply using technologies have on literacy, as well as the urgent need to study questions of engagement, self-efficacy and cognitive strategies when reading electronic texts. In addition, Leu (2000) hoped that research into computer use would focus on adolescents, not only on adults. These suggestions also inspired this study. Later, after more research on electronic texts and reading them had been published, the importance of this study for better understanding the factors that correlate to reading literacy skills and attitudes became clear. Because the development of information technology has been rapid and the interest in it has increased since PISA 2000, I have acknowledged in the theoretical summary recent research that was not available at the time when the substudies were carried out. However, these kinds of gaps are common in longitudinal and repetitive studies.

Literacy studies are a broad area of research because they emerge from different perspectives and disciplines. This broad scope is also why different approaches are used to study the subject. In this dissertation, reading literacy is the focus, excluding writing practices. However, in the sociocultural view of reading literacy, reading and writing are seen as inter-

twined. Reading and writing work together in many literacy practices, such as when one is chatting online or writing a thesis. So when I say that only reading literacy is concerned, it means that only reading literacy assessments are used in the empirical studies.

From a linguistic perspective, reading literacy studies can be roughly separated into three kinds of studies. First are those studies that examine an individual's actions in the reading process, such as how a reader scans a text, chooses a path in hypertext or critically evaluates the text (see e.g. Kiili 2012). Those studies are usually executed with a small amount of participants and they use, for example, interviews or observation. Second are those studies that evaluate the reading proficiency of individuals or groups compared to others, such as a comparison of reading proficiency between countries participating in PISA. Third are those that attempt to identify relationships within reading literacy practices, such as reading habits and attitudes (Schatschneider & Petscher 2011). This third type can be executed on a small or large scale, using qualitative or quantitative approaches.

This study focuses on the latter two types. That is because of the chosen explorative approach, because of the characteristics of the data, and because of the opportunities given to publish my substudies, which directed the phrasing of questions. The data used are based on student questionnaires and on reading literacy proficiency scores. The scores are derived from points that students scored on the PISA assessment (see section 2.2.3). Other data, however, are based on students' self-reported responses to several questions concerning their use, habits and attitudes regarding ICT and print literacy. In the substudies, this information about reported ICT use has been associated with data about students' backgrounds and scores in reading literacy test to better understand the ways that different groups use literacy and to explore ICT literacy activities and even practices. Using the PISA data provided nationally representative data and allowed for a large-scale comparison. In PISA studies, no interviews were considered necessary, because the focus was on large-scale assessment and the data itself was extensive. Therefore no interviews were performed for the substudies of this dissertation. The characteristics of the data are discussed in section 6.1.

Even though the focus of this study is limited, it highlights the relationship of technology and literacy: how literacy is part of technology and everyday life and, at the same time, how literacy influences and is influenced by technology. This view has been called deictic (see Leu 2000; Leu et al. 2004) and transactional (Leu et al. 2004). Moreover, this study could also be seen as a sociology of reading which, according to the Literacy Dictionary (Harris & Hodges 1995), is a study interested in the interaction between people and texts and also in how social forces, such as socioeconomic status or social institutions, affect reading behaviour. In this study, several background factors of students are examined, and ICT literacy use at school and during leisure time is discussed. From one perspective, we could also interpret that the constructionist view is present. It emphasizes the sociocultural

view of literacy and examines literacy and language used in communities or subgroups, not the literacy of individuals (see Luukka 2000, 151–153). In this approach, the focus is not the ICT literacy of an individual but the aim is to compose different kinds of user groups.

This study is organized as follows: *In chapter 2*, I describe the theoretical view of literacy on which this dissertation is based. First, there is a short introduction to present approaches to literacy. Next, a functional view of literacy is introduced. In this context, I also introduce the framework of the PISA studies, because it is considered to be mainly functional. The process of PISA's reading literacy assessment is presented. Then the functional approach to literacy is broadened to include the sociocultural approach, because it is present in some of the substudies and also in the theoretical approach of multiliteracy presented in chapter 4. Finally, I sum up how functional and sociocultural literacy are present in this study.

To better understand the similarities and differences between traditional print literacy, and new digital ICT literacy, *in chapter 3* I describe characteristics that distinguish the two. In this study, the ICT use reported by adolescents is compared to the reading literacy scores of PISA. Computer and Internet use demand literacy skills that are, in some respects, similar to those skills needed when reading traditional printed texts but which are also, in other respects, different. Therefore it is important to look at some characteristics of ICT literacy and reading strategies to better understand why it is important to study the relationship between ICT use and traditional reading literacy along with the same issues for digital literacy. The focus here is on the reading process and strategies, textual differences, the participatory nature of ICT and the information that the Internet provides. In addition, I present two theories about different kinds of readers: First, Bertram C. Bruce's (2000) four profiles of critical readers, and second, five types of readers by Juha Herkman and Eliisa Vainikka (2012a; 2012b). Different kinds of readers have different kind of attitudes towards information and media.

The characteristics of ICT literacy form the basis for *chapter 4*. First, I present some theories of the new literacies that concentrate on literacy used with new technology. Then I describe related concepts that define approaches to literacies in different contexts, some of which are still actively used and some of which were in use at the time when the substudies were published. There are many kinds of literacies, and understanding them is important to this study. Next I sum up the challenges that ICT poses to literacy, based on the information presented in chapter 3 and sections 4.1 and 4.2. Those challenges are the challenges one must face on the way to becoming a multiliterate reader. Finally, I link the characteristics of ICT literacy to a theoretical frame and form my own view of ICT literacy and traditional literacy in the multiliteracy frame. This framework follows the sociocultural approach to literacy. It is an attempt to better understand the special needs of multiliteracy and it supports one of the goals of this dissertation: to provide new information for teach-

ing multiliteracy. The hope is that this theoretical discussion will help, for example, teachers to understand the demands of multiliteracy. It also gives a basis for understanding the ICT literacy practices described in the empirical studies.

In chapter 5, I present some earlier studies. First, I look at information about ICT use collected between 2000 and 2012. Then I take a closer look at some variables examined in the substudies and in reading studies in general. I present studies concerning the relationship of reading literacy and ICT, the correlation of reading literacy to students' self-confidence, motivation and engagement, and findings about gender differences. These studies form part of the background of the substudies presented later.

After the theoretical review, *in chapter 6*, I give an overview of the data of the six substudies as well as of the methods of analysis used for them. At the end of this chapter the research questions, the data and the methods of each substudy are presented in a summation table. In this study, the data are mainly analysed by quantitative methods, a natural choice for the quantitative data of the PISA studies. Some of the methods are more or less descriptive while others, such as statistical modelling, use "mathematical equations that generate predictions about the observed phenomena" (Schatschneider & Petscher 2011, 54).

In chapter 7, the main results of each substudy are presented. After that, the results and execution of this study are discussed *in chapter 8*. I also compare some answers of substudy I to the categorization presented by Bruce (2000). This comparison is not presented in the related substudies but it complements the discussion about adolescents' attitudes and also the discussion of critical reading that ICT literacy requires. The execution of this study is discussed with a critical eye, because the large-scale studies using statistical methods have advantages as well as limitations. At the end of chapter 8, I also discuss the educational challenges that changes in literacy are creating. Because this study focuses on 15-year-olds who are at school and the focus of PISA's reading literacy assessment is on the skills and knowledge that are needed at school as well as in working life, it is necessary to look at some of the educational issues that arise from the results. The information this study provides can help policy makers, educators and parents in their attempt to understand and support adolescents' access to, fluency with and the effect of ICT literacy practices.

2

Different paradigms of literacy

The notions of literacy, as well as literacy practices, have changed along with globalization and technical development. As Kristen Perry (2012, 65) points out, to understand the whole process of becoming literate, we need to understand the different approaches to and paradigms of literacy. In this chapter, I first describe the change in the paradigm of literacy. Then I focus more closely on functional literacy and the framework of the PISA studies, which are considered to present functional literacy. After that I take a look at literacy as a social practice, because some of the substudies clearly present a wider perspective on sociocultural literacy than the framework of the PISA studies does. Section 2.4 includes a summary of how the substudies emphasize functional and sociocultural literacy. This chapter lays the theoretical foundation needed to understand the socioculturally defined concept of multiliteracy, which is discussed in more detail in chapter 4.

2.1 Changing paradigm of literacy

In the last few decades, the definition of literacy has changed considerably, as new perspectives have been added and the old views supplemented. Five decades ago, reading literacy was defined as a basic skill and the ability to understand what meanings an author wanted to convey. The context of reading and readers' purposes as well as their positions were not considered (e.g. Pitkänen-Huhta 1999) and literacy was "considered as a technical skill

which belongs to an individual reader or writer” (Pitkänen-Huhta 2003, 15–16). This notion of information transfer became an interactive view implying a linear interaction between the text and the reader. This view contained an idea of predetermined meaning, and soon it gave way to a transactional view, which highlighted the reader’s active role and reading became to be seen as a process of constructing meaning. (E.g. Linnakylä 2000, 113; Rosenblatt 2004.) The fundamental ideas of a transactional theory have been related to the work of John Dewey, Louise Rosenblatt and Kenneth Goodman as well as to L. S. Vygotsky’s learning theories (e.g. Rosenblatt 2004; Whitmore, Martens, Goodman & Owochi 2005).

Based on this view, reading literacy can be divided into four approaches to reading literacy: *cognitive*, *sociocognitive*, *functional* and *sociocultural*. These approaches build on one another (see Figure 1 for an illustration).

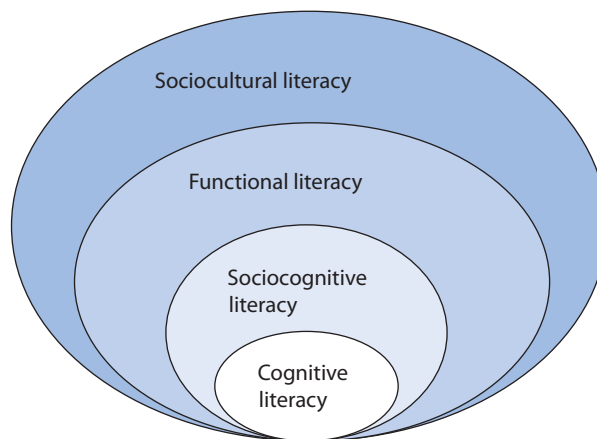


Figure 1. Changes in the literacy paradigm

The cognitive approach sees literacy as a thinking skill and emphasizes reading literacy as understanding the content of a text. In this approach, literacy is seen to consist of different universal skills and levels of reading. (Street 1995; also Alvermann 2011, 543.) Wesley Hoover and Philip Gough (1990) have presented the so-called simple view of reading, in which reading consists of two components: decoding and linguistic comprehension. Without the latter, they state, it is not reading. The different skills can be divided into five categories: literal, interpreting, evaluating, critical and applying reading. Reading literacy skills accumulate as an individual matures and reaches another level. (Harris & Sipay 1990, 552.) The role of contextual effects differs from view to view. Some have seen reading to

be a strictly bottom-up or stimulus-driven process, but others have expressed views that information from the word is combined with the information from semantic and syntactic sources (Daneman 1991, 514). The basis for this approach is in psychology, where the individual is seen to master one skill at a time. The evolution is biological, and the individual does not have to do much to help the process. This view is also known as the autonomous view of literacy (Street 1995). Charles Alderson (2000, 8), for example, has criticized putting these skills in order. He sees that reading is such a complex operation that we cannot be sure how meaning is made. Shirley Brice Heath (1983, in Alvermann 2011, 543) has pointed out that it is not only the cognitive skill that matters, but also how children are socialized into different literacies.

The *sociocognitive approach* to reading literacy has the same basis as the cognitive approach, but it also acknowledges the context of reading: the process of reading consists of the reader, the text and the context. Reading is led by the reader's activeness and purpose for reading, but the reader also needs to know different kinds of reading strategies to be able to construct meaning. (Afflerbach et al. 2008; Dole et al. 1991.) Meaning-making can be seen as a negotiation between the text and a reader's metaknowledge and skills (Alderson 2000, 6).

To compare, in the cognitive approach the reader tries to find the meaning the author has given, but in the sociocognitive approach, the meaning is created by negotiating with the context and with a reader's skills, knowledge and purposes. In that way, the same text can have different meanings in different situations. (Gee 2009, 3.) As I have stated, the sociocognitive approach has emerged from the cognitive approach, but it is also close to the social approach, in which it is seen that people grow into literacy by encountering a range of texts in various contexts. This view has been extended and the process of meaning-making is seen as socioconstructivist or sociocultural, which stresses readers' interpretations along with their sociocultural positions, their knowledge, experiences, purposes and needs in meaning-making. (E.g. Barton 1994; Reder 1994; Vygotsky 1978; also Linnakylä 2000, 113.)

Functional and sociocultural literacy have much common ground. Because these two paradigms are important for understanding the theoretical background of the PISA assessments and also to understand what this study is trying to achieve, I define them more extensively in the following sections.

2.2 The functional approach and the framework of the PISA survey

2.2.1 Functional literacy

In Unesco's literacy studies of the 1950s, functional literacy was "defined in terms of the skills and abilities required to use print to function in everyday life" (Venezky 1995). This paradigm of literacy has also been called pragmatic (see Nikula 2000, 338) or conventional literacy (Venezky 1995). Nowadays, the use of print has expanded to the use of electronic texts and images. John Ryan (1995, 90) also sees functional literacy as part of lifelong learning and says that "it [functional literacy] is, in effect, a measure of one's capacity to cope with the educational challenges of a given environment".

Functional literacy can be studied within the paradigm of cultural practices or one of individual skills (Luukka 2000; Reder 1994). These two paradigms of the social approach have the same basis but they reach in different directions. The individual approach looks for "the mental processes underlying reading and writing". The cultural approach highlights the meaning of socialization. By no means are they contrary to one another, but they are useful for different practical and explanatory purposes. (Reder 1994, 33–34.) Stephen Reder (1994, 34) explains the different purposes as follows: "The cultural practices paradigm better addresses issues of how the characteristics of literacy behaviors vary with and are closely fitted to the features of the contexts in which they occur. The individual skills paradigm overlooks the ways in which the details of reading, writing, and communicative activities are systematically fitted to the characteristics of the social situations in which such activities occur." In other words, the cultural paradigm is used when we compare, for example, adolescents' literacy practices at school and outside of school. The individual approach, alternatively, looks for the reading processes on an individual level.

With more focus on individual skills, Verhoeven, Elbro and Reitsma (2002, 4) point to Ludo Verhoeven's categorization (1994, 1997), in which functional literacy is defined within the framework of communicative competence and divides functional literacy into five types of competencies: grammatical competence, discourse competence, (de) coding competence, strategic competence and sociolinguistic competence. Grammatical competence includes phonological and morphological rules as well as rules of sentence formation. Discourse competence refers to understanding the characteristics, the cohesion and coherence of different types of texts and communication. (De)coding competence refers to technical abilities, such as word comprehension. Strategic competence means that an individual can plan, execute and evaluate the functions to reach a communicative goal. Sociolinguistic competence consists of knowledge of different literacy conventions, an understanding of what is appropriate in a given culture or situation. It also includes

cultural background knowledge. (Verhoeven et al. 2002.) This definition reflects the socio-cognitive approach to literacy in how it is focused on different types of skills, but it also acknowledges understanding the context of a text.

At its most basic, functional literacy can be defined as literacy “for practical purposes, as to get information” or “the level of reading [or literacy] skills to get along in the society” (Harris & Hodges 1995, 89; see also Linnakylä 2000). At its broadest, functional literacy can be understood as applying the skills and knowledge of reading and writing and even as engagement in cultural and group activities, including individual and social functions, economics of the workplace, and personal fulfilment, social progress and economic development (Harris & Hodges 1995, 89), as well as the ability to produce new literate materials and understanding (Cook-Gumperz 2006, 24). Functional literacy focuses on what, why and how we use literacy and it emphasizes the purpose of using texts and how individuals can cope with different communicative opportunities. In functional literacy, the social dimension means that an individual can function in a target-oriented way in a given situation and context. The individual, in other words, takes into consideration the purpose and the goal. (Kucer 2005, 197–198.) This approach includes the notion that the integral function of language is communication and meaning-making in different situations or communities (see Luukka 2000, 137–139, 151). This brings functional literacy close to the sociocultural approach of literacy¹ and to the thoughts of Freire (e.g. 1983; Freire & Macedo 1987), who coined the well-known phrase “Reading the word is reading the world”. This means that an evocation of literacy is not only describing the structure of language but also the different uses and choices of life that people make with language. The relationship between language and context and differences among individuals, subgroups and communities are emphasized in the functional approach to literacy and language. (Luukka 2000, 138–139.)

The purpose of using literacy is not only to understand or produce words, but that every situation has a different, functional purpose. Skilled readers, for example, choose the right strategy based on what kind of text (including the text type, media and length of the text) they are reading, why they are reading (purpose) and the context and domain of reading. For some texts, scanning may be an appropriate strategy, but for others, more close reading is needed. Sometimes readers need to form an understanding of a chapter and sometimes they need to select one detail. (See also Kauppinen 2010, 133–134.) This idea is evident in the reading tasks of PISA assessments. In functional literacy, there is no dichotomy between literate and illiterate. Instead, there are several continuums. This same view appears in the definition of multiliteracy and is discussed in more detail in section 4.1.

¹ For example, Perry (2012) defines functional literacy as social approach to literacy.

Reading literacy proficiency does not grow step by step but rather expands as readers face new texts and domains and contexts and compare the new situations to old ones (Barton 1994; Tyner 1998).

Texts – in a broad sense – are the central part of literacy practices and they serve different functions. Those functions are not always predetermined in the sense that a text would serve only the particular purpose it is originally made for (imposed uses of literacy), but people may use texts for their own purposes as they find appropriate (self-generated uses of literacy). One text can thus serve many functions, and the functions of reading may vary according to particular situations and between individuals. (Barton 1994, 38–40; Barton & Hamilton 2000, 12; Linnakylä 1995, 14–20.) What seems to be the same text or multimedia genre on paper and onscreen is not always functionally the same. It may follow different meaning conventions and require a range of skills to be read, because it may work in various social environments for different purposes (Lemke 1998, 284).

Reading studies present different functional categorizations. Judit Kádár-Fülop (1985) has presented four categories: reading that supports other activities (e.g. everyday tasks), reading that fills a void of communication (e.g. reading newspapers), reading to learn, and reflective reading. Pirjo Linnakylä (1995, 18) has given an even more detailed categorization of functional literacy, which includes the following seven categories: reading that is connected to one's surroundings and everyday tasks, reading that supports social and communal intercourse, occupational reading, reading to gain information to learn, entertaining and recreational reading, ritual reading, and reading to expand thinking and critical reflection. Merja Kauppinen (2007, 28) found that the functional approach to literacy is also stressed in the Finnish national curriculum, because literacy is seen as something that an individual needs to cope with everyday situations, education and the challenges set by society. According to the curriculum, literacy is used to search for and use information, for self-expression, for fun and entertainment, and also to interact and to exercise power (Kauppinen 2007, 28). The purposes of ICT literacy use and gender issues are further discussed in sections 5.1 and 5.5.

2.2.2 Reading literacy in PISA survey

Reading literacy is reflected by the culture of the reader, the context of reading and the purposes of reading (Bruner 1996; Linnakylä 2000, 114). In reading assessments the context often includes the purpose of reading, social relations and media, text type and subject (Linnakylä 2000, 115; also OECD 1999). In recent international reading literacy studies, such as the OECD's PISA, literacy has been seen as functional from the perspectives of the individual and society (see OECD 1999; Sulkunen 2004).

The original reading literacy framework for PISA was developed through a process involving literacy experts selected by participating countries and the PISA 2000 advisory groups. One of the premises was the IEA's Reading Literacy Study (1992) and the International Adult Literacy Survey (IALS, 1994, 1997 and 1998). In particular, IALS's emphasis on reading skills for active participation in society was adopted. The development also took into account the contemporary – and still current – theories of reading, which considered reading's interactive nature, models of discourse comprehension, and theories of performance in solving reading tasks. (OECD 2009, 20.)

In OECD's PISA survey, reading literacy is seen as an expanding set of knowledge, skills and strategies which individuals build on throughout their lives in various situations, through interactions with their peers and with the larger communities in which they participate. The emphasis is on reflective thinking and critical evaluation of texts. (OECD 1999; also Linnakylä 2000, 112.) The concept of reading literacy is used instead of plain *reading* because reading literacy is seen as a functional ability in which the context and the purpose of reading is acknowledged. This view has been reinforced in PISA by the careful selection of concepts and definitions used on the theoretical level as well as in the actual tests. It is acknowledged that a person's background and the culture from which a text emerges reflect the evaluation and interpretation of the text. In the PISA survey, this issue is taken into account in, for example, coding, when (in some tasks) an alternative answer is considered to be as good as the more common answer. (See Sulkunen 2007, 23.) For the PISA survey, reading literacy is considered to be a key ability to achieve one's goals, especially in one's education and as an active member of society (Linnakylä & Sulkunen 2002, 10; OECD 1999). The idea of lifelong learning can be recognized in the PISA framework.

The following definition of reading literacy was adopted for the PISA survey for the first cycle (OECD 1999, 20): "*Reading literacy is understanding, using and reflecting on written texts, in order to achieve one's goals, to develop one's knowledge and potential, and to participate in society.*" The definition clearly sees reading literacy as a set of practices rather than as the mere act of reading (see also Sulkunen 2007, 23). It emphasizes the individual's goals and active role as a member of society, including the reading literacy skills needed in this role.

In the PISA studies, texts are understood and used broadly – from classical novels to diagrams and graphs and maps. Electronic texts are also considered to be included in the definition of reading literacy, even though they were not used until PISA 2009. (OECD 1999, 2002b, 2003; Sulkunen 2004.) However, the first rounds of PISA assessed aspects related to information literacy that are also needed when navigating the Internet.

The general framework of PISA reflects a sociocultural approach by emphasizing meaning-making as part of society's practices. However, the assessment itself can be seen to represent the functional view. For example, the framework recognizes, although this is not visible in the definition above, the full scope of purposes (domains) for young people

to use reading: reading for private use, reading for public use, reading for work, and reading for education. This categorization is also used within assessment texts.

The definition of reading literacy in the PISA framework emphasizes that reading is not only understanding the meaning of a text but also evaluating and the proper use of texts and information. Meaning-making as well as understanding and evaluating texts are seen as contextual microprocesses, as strategies or, as in OECD's PISA, aspects which include cognitive processes, metacognition (knowledge about process and strategies of meaning-making) and processes specified by context and purposes (Linnakylä 2000, 114; OECD 1999). Different aspects associated with achieving a full understanding of the text were measured, and can be defined as key competences as follows:

- retrieving information
- forming a broad general understanding
- developing an interpretation
- reflecting on and evaluating the content of the text
- reflecting on and evaluating the form of a text. (OECD 1999.)

The processes listed above formed three aspects that were reported as follows: retrieving information, interpreting texts, and reflecting and evaluating texts (Figure 2). *Retrieving information* was defined as something a reader does when he or she needs to find a particular piece of information, such as the departure time for a bus. To do so, the reader must scan, search for, locate and select relevant information. In tasks, students must match information given in the question with either identically worded or synonymous information in the text and in that way find the information called for. Retrieving information is based on the text itself and on explicit information included in it. (OECD 2002b, 31–32.)

Interpreting texts combined the processes of “forming a broad general understanding” and “developing an interpretation”. When interpreting a text, the reader must construct meaning and draw inferences from written information. Tasks in this category call for the reader to see the text or part of the text as a whole and also to process the organization of information. This aspect includes tasks such as identifying the main topic or general purpose or use of the text, or making inferences based on two or more pieces of information from the text, such as finding cause and effect. The reader must be able to compare and contrast information, draw inferences and find supporting evidence. (OECD 2002b, 32.)

Reflecting and evaluating texts combined the processes of “reflecting on and evaluating the content of the text” and “reflecting on and evaluating the form of a text”. To reflect on and evaluate the text, the reader must connect written information to their prior knowledge, ideas, values and experiences or to other texts or information provided in the situation. Tasks related to that may, for example, require students to articulate and defend their

own points of view by finding evidence – in favour or against – from the given text. This aspect also includes evaluating the form of the text, its quality and its appropriateness. The reader must have prior knowledge or be able to evaluate aspects such as text structure, genre and register. The task may call upon the reader to comment on the author’s style or attitude in the text or on the appropriateness of a specific part of the text compared to the whole text. (OECD 2002b, 32–33.)

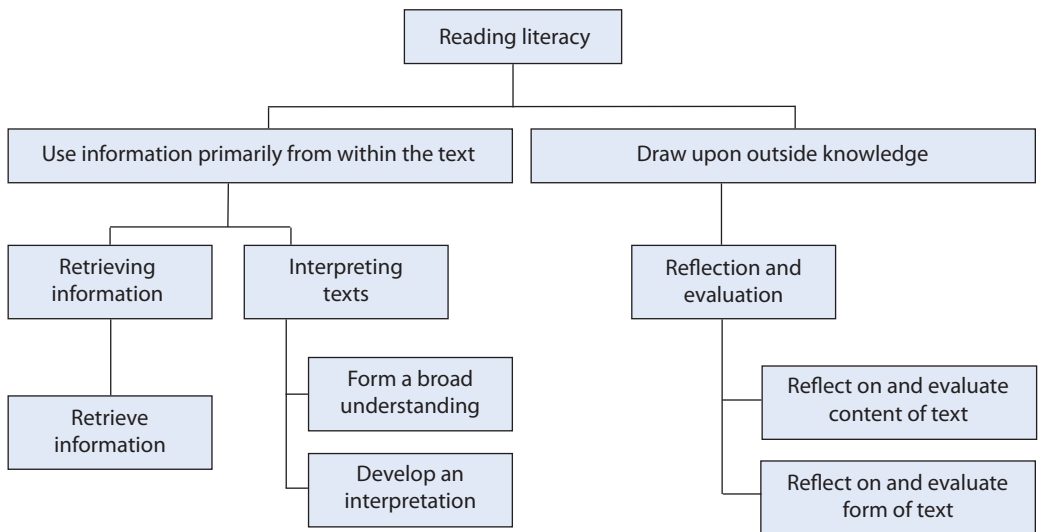


Figure 2. Aspects of reading literacy (OECD 2002b, 36)

2.2.3 Assessing reading literacy in PISA assessments

In 2000, reading literacy was assessed using several texts (continuous and non-continuous) including different text types (argumentation, description, exposition, instruction, narration and transaction), and several tasks were given to each text. In the reading literacy test of PISA 2000, almost half the items were open-ended tasks in which students constructed their own responses by relating the text to their own experience and knowledge. For this first round of reading literacy assessment, 141 reading literacy tasks were constructed and administered to nationally representative samples of 15-year-olds. Reading literacy tasks can be divided into aspects of reading literacy as follows: retrieving information, 42 tasks; interpreting texts, 70 tasks; and reflecting and evaluating texts, 29 tasks. However, because one student could not be expected to complete all these tasks, the survey was designed to

give each student a subset of tasks they could be expected to answer in two hours. Item response theory (IRT) was used to capture the continuum of difficulty and ability, referred to as a “scale”. (OECD 2002b, 33–34.)

In 2003, reading literacy proficiency was assessed in the framework established in 2000 using a subset of tasks (28 reading items). The results were reported on the same scale as in 2000 so that the results would be comparable. (OECD 2005.)

It should be noted that PISA’s assessment was never designed to follow the curricula of any particular country or countries. The focus was to assess skills and knowledge that students need after basic education, especially in further studies. (OECD 1999; Sulkunen 2004.) Even though the focus is not on curricula, there are some confluences between the PISA framework and the Finnish national curriculum of 1994, which was valid at the time of PISA 2000. In the 1994 curriculum, the literacy needs of an individual to become a functional member of society were in focus. In addition, the curriculum identified narrative, expository and descriptive texts, which are present in the PISA assessment. However, the national curriculum did not specifically mention non-continuous texts, such as charts and graphs, maps and advertisements, which were a part of many PISA items. (Sulkunen 2004; also Kauppinen 2010.) Moreover, Sari Sulkunen (2004, 37–38) observed that reflecting on and evaluating the form of a text was missing in the national curriculum from 1994, and evaluating the form of a text was in fact one of the areas that Finnish students found difficult. Instead, the national curriculum refers to reading strategies, which were not included in the PISA assessment’s student questionnaire until 2009. The current Finnish curriculum, implemented in 2004, is more specific and has more confluences with the PISA assessment framework. (See Sulkunen 2004.)

In the 2009 assessment, the framework was basically the same (e.g. in its purposes) as the framework presented in 1999 (for PISA 2000). However, one of the aims of the PISA domain is to develop new theories and practices over time. Therefore some changes were made. A phrase pointing out that reading literacy is also “engaging with written texts” was added to the definition of reading literacy (OECD 2009, 23). Second, motivational and behavioural characteristics of reading – reading engagement and metacognition – were emphasized in the students’ questionnaire more than in 2000. Third, the framework “acknowledges the fact that any definition of reading in the 21st century needs to encompass both printed and digital texts”. Therefore, a digital reading assessment was implemented as an international option. (OECD 2009, 20.) For that reason also the classification by medium was created: print-medium texts and electronic-medium texts (OECD 2009, 27).

In 2009, a total of 130 reading literacy tasks were used. Of those, 41 originated from the assessment of PISA 2000. (Sulkunen et al. 2010, 23.) Partly the same tasks were used in order to enable comparison between the data from 2000 and from 2009.

In 2009, electronic texts were included, and 19 countries, with at least 1,500 students, participated in the PISA digital reading assessment (OECD 2011). Finland did not participate, and so the results of the digital assessment are not a part of the main focus of this study. However, its results are unique, because it is the first large-scale assessment of digital reading, and therefore some international results will be presented and discussed in this study.

Although the OECD's expert panel used the term ICT literacy when planning the assessments at the beginning of 2000, in the assessment of 2009 the term digital literacy was adopted. The definition of reading literacy presented in the PISA framework (see above in this chapter) was adopted also to apply to digital literacy. (OECD 2011, 19.) In this context, any definitions about the special characters of digital literacy compared to traditional literacy were not made. However, some differences were acknowledged and discussed, as I will bring out next (see OECD 2011; see also chapter 3).

In the digital reading assessment, three sets of aspects were named *access and retrieve*, *integrate and interpret*, and *reflect and evaluate*. Access includes navigation, which was considered as part of the cognitive process, not only the physical functions such as clicking on links or scrolling the webpage (see chapter 3). The other aspects were defined as presented above. In addition, the fourth aspect was included and named *complex*, which brought out the fact that some tasks required different kinds of processes and they could not be pointed to as only one of the three aspects. (OECD 2011.)

There were 29 tasks organized into three 20-minute clusters, and each participating student was administered two of the clusters. Tasks were based on the written texts (including graphic elements, excluding audio), which represented the digital medium as closely as possible (e.g. including hyperlinks). The texts were specified in terms of environment (authored and message-based), format (continuous, non-continuous, mixed, and multiple), text type (argumentation, description, exposition, and transaction) and navigation tools and features (see chapter 3). (OECD 2011, 40–41.)

All the tasks were evaluated by the characteristics of the text (e.g. length, familiarity), the complexity of navigation (e.g. number and place of hyperlinks), the explicitness of task demands (e.g. familiarity of terminology, form of the answer needed), and nature of the response (e.g. does it need a series of inferences or simple identification). The digital reading scale was set in a way that comparison to the traditional reading literacy proficiency was possible. (OECD 2011, 45–47.) Some comparisons of international results are presented in substudy VI.

The results of reading literacy were reported in levels, based on a set of statistical principles, using the scores of students. This so-called PISA scale was adopted for all reading literacy assessments to be able to compare the results. For example, in the digital reading assessment the scale was set in a way that the mean and standard deviation for 16 equally weighted OECD countries were the same as for reading the printed text assessment (OECD

2011, 46). This PISA scale is also used in the substudies and the scores are visible, for example, in tables in the substudies. The PISA scale was set in 2000 as presented in Table 1 (OECD 2002b, 40; 2009, 79):

Table 1. Reading literacy levels in PISA 2000 (OECD 2002b, 40; 2009, 79)

Level	Score points	Characteristics of level: Students can
5	more than 625	<p>Continuous texts: Negotiate texts whose discourse structure is not obvious or clearly marked, in order to discern the relationship of specific parts of the text to its implicit theme or intention.</p> <p>Non-continuous texts: Identify patterns among many pieces of information presented in a display which may be long and detailed, sometimes by referring to information external to the display. The reader may need to realise independently that a full understanding of the section of text requires reference to a separate part of the same document, such as a footnote.</p>
4	553–625	<p>Continuous texts: Follow linguistic or thematic links over several paragraphs, often in the absence of clear discourse markers, in order to locate, interpret or evaluate embedded information or to infer psychological or metaphysical meaning.</p> <p>Non-continuous texts: Scan a long, detailed text in order to find relevant information, often with little or no assistance from organisers such as labels or special formatting, to locate several pieces of information to be compared or combined.</p>
3	481–552	<p>Continuous texts: Use conventions of text organisation, where present, and follow implicit or explicit logical links such as cause and effect relationships across sentences or paragraphs in order to locate, interpret or evaluate information.</p> <p>Non-continuous texts: Consider one display in the light of a second, separate document or display, possibly in a different format, or combine several pieces of spatial, verbal and numeric information in a graph or map to draw conclusions about the information represented.</p>
2	408–480	<p>Continuous texts: Follow logical and linguistic connections within a paragraph in order to locate or interpret information; or synthesise information across texts or parts of a text in order to infer the author's purpose.</p> <p>Non-continuous texts: Demonstrate a grasp of the underlying structure of a visual display such as a simple tree diagram or table, or combine two pieces of information from a graph or table.</p>
1	335–407	<p>Continuous texts: Use redundancy, paragraph headings or common print conventions to form an impression of the main idea of the text, or to locate information stated explicitly within a short section of text.</p> <p>Non-continuous texts: Focus on discrete pieces of information, usually within a single display such as a simple map, a line graph or a bar graph that presents only a small amount of information in a straightforward way, and in which most of the verbal text is limited to a small number of words or phrases.</p>
below 1	less than 335	[No description.]

2.3 Literacy as a social practice

In the sociocultural view, literacy is seen as “a set of social and cultural *practices* and its participants as a *community of practice*” (Reder 1994, 33–34). Reading and writing are seen as one entity of literacy, and they are used to act, to get involved and to be a part of a community. An individual is socialized with the literacy practices of the community he or she is involved with. (Barton 1994; Gee 2009; Kucer 2005, 197–198; Säljö 2001.) For example, to be able to write a strategy guide for a video game (game FAQ), one must know “how game faqs [FAQs] are used in social practices of gamers” (Gee 2009, 5). Reading and writing are not considered to be skills or actions but rather to be social practices in which people act in ways that are learned as part of and accepted by a community or society. They require understanding the differences and implications of using the literacy conventions of different groups and societies. Literacy is a way to participate in society and to empower an individual. It is also a way to build a person’s identity. (Barton 1994; Säljö 2001; also Kauppinen 2010, 74–75.) Whereas the cognitive approach to literacy sees that a learned skill can be used anytime, in the sociocultural approach the context is always unique and literacy needs must be considered case by case (Barton 1994; Kauppinen 2010, 164).

Needs and reasons to use literacy are sometimes determined by society, as it is often with literacy practices at school. Different practices are associated with different domains of life, such as home or school or social life with peers. Different domains, then, demand appropriate language, and even further, appropriate behaviour in appropriate settings. (Barton 1994.) Because learning literacy is seen to happen everywhere, not only at school or at home, this sets a challenging task also for education. The literacy practices students use in their leisure time are an important part of their socialization to different kinds of texts. (See also Kauppinen 2010, 12–13.)

In the sociocultural approach to literacy, there are two important terms: literacy events and literacy practices. *Literacy events* are observable activities in everyday life that involve texts. (Barton & Hamilton 2000; Reder 1994.) An obvious example of a literacy event would be an adolescent using an email application. Mary Hamilton (2000, 17) likens the literacy event to a photograph taken of a situation (see Table 2). The literacy event is something where elements can be captured in a picture: a participant interacting with a text, the physical circumstances of an activity, the tools and accessories involved, and the visible actions performed, such as typing.

Literacy practices consist of three components: technology, knowledge and skills. They are patterns in using reading and writing in a particular situation and they involve bringing cultural knowledge to an activity. (Barton 1994, 36–37, 165; Barton & Hamilton 2000; Scribner & Cole 1981, 236.) Literacy practices are acts that are situated in specific social, cultural, historical and institutional contexts. The meanings people create out of them are

contextualized. As, for example, when an adolescent interprets an email message from a friend and creates a perception about the value of that email for him- or herself and also about the email’s value in general in his or her life when contacting people. When people perform different literacy practices, they use particular ways of reading, writing, speaking and performing. (Barton 1994; Kaufmann 1993; Luke 1996, 1997; Moje, Dillon & O'Brien 2000; Tyner 1998.) Literacy practices are more abstract than literacy events. They relate to customs, beliefs and attitudes, and power relations. (Barton 1994, 37; Lewis & Fabos 2005.) However, the connection between literacy events and literacy practices has been seen as vague (Perry 2012). Table 2 presents the basic elements of literacy events and practices as introduced by Hamilton (2000, 17). In this study, the concept of practice is used as it is defined in Table 2. However, because events are often regular everyday activities (Barton & Hamilton 2000, 9), the concept of activity was used in this study instead of events. Activity was also the concept used by the OECD’s experts in the PISA survey when concerning computer use.

Table 2. *The basic elements of literacy events and practices (Hamilton 2000, 17)*

	Elements visible within literacy events (These may be captured in photograph)	Non-visible elements of literacy practices (These may only be inferred from photographs)
Participants	The people who can be seen to be interacting with the written text	The hidden participants – other people, or groups of people involved in the social relationship of producing, interpreting, circulating and otherwise regulating written texts
Settings	The immediate physical circumstances in which the interaction takes place	The domain of practice within which the event takes place and takes its sense and social purpose
Artefacts	The material tools and accessories that are involved in the interaction (including the texts)	All the other resources brought to the literacy practice including non-material values, understandings, ways of thinking, feeling, skills and knowledge
Activities	The actions performed by participants in the literacy event	Structured routines and pathways that facilitate or regulate actions; rules of appropriacy and eligibility – who does/doesn’t, can/can’t engage in particular activities

Literacy practices are a way to share and develop the attitudes, values and norms that emerge from our social and cultural background (Bruner 1996). For example, we all have perceptions about literacy: is reading valued, is it appropriate to read at the dinner table, or is reading a novel better than reading a magazine or a website. What we learn from our

community or society has a great importance in meaning-making. This importance is visible also in questions about literacy (such as who wrote the text, who is the target audience and what is the purpose), because they are all about the social patterning of literacy. In addition, as a society – at the individual level or more broadly – changes, literacy needs, practices and definitions also change. (Barton 1994; Gee 2000, 2003; Lemke 1998; Nurminen 2000, 104.)

As mentioned above, one component of literacy practices is technology, which refers to the products and tools used to produce and distribute information or to access information. For this reason, the consideration of technology is justified in reading studies as well. Tool literacy skills (see section 4.4) are essential in the information age, because technologies shape and direct literacy practices. For example, to produce and use hypertext, certain types of hardware and software are needed. (Lemke 1998, 283–287.) The mental and the material components are united in new literacy practices, about which Jay Lemke (1998, 283) writes:

Literacies are legion. Each one consists of a set of interdependent social practices that link people, media objects, and strategies for meaning making. Each is an integral part of a culture and its subcultures. Each plays a role in maintaining and transforming a society because literacies provide essential links between meanings and doings. Literacies are themselves technologies, and they give us the keys to using broader technologies. They also provide a key link between self and society: the means through which we act, participate in and become shaped by larger "ecosocial" systems and networks.

Literacy practices and events are important subjects for understanding the variety as well as the acquisition and development of literacy. In this view, the cross-cutting issues have been in what kinds of contexts people use the texts in their day-to-day interactions, how these interactions influence or are influenced by texts and how participants give meaning to the texts and actions involved (Reder 1994, 35–36). The theory of literacy as a social practice can help to describe what types of knowledge are needed to be able to engage in different literacy practices.

When considering the teaching of literacy at school, Kauppinen (2010, 156) identifies three factors that in the curriculum reflect the sociocultural approach to literacy. The factors are reading as a social practice, reading for teaching cultural participation, and ideology and power related to reading. Kauppinen (2010, 156–164) also finds evidence for this approach in the Finnish curriculum from, for example, phrases pointing to reading engagement, to texts as sources of cultural information and to critical reading and its capability to empower people.

2.4 Functional and sociocultural literacy in this study

This study taps both the sociocultural and functional paradigms in an attempt to explore the ICT use of adolescents and its relationship to reading literacy. As presented in section 2.2.2, PISA's framework for reading literacy assessment is considered to represent functional literacy (see also Kauppinen 2010, 135; Sulkunen 2007, 23), but the general framework reflects the sociocultural view as well (also Sulkunen 2007, 23). This means that only competences are assessed, but in the background questionnaire there are several questions regarding students' attitudes and beliefs about themselves and their learning strategies.

Because separating these two paradigms is like drawing a line in water, I do not try to make clear distinctions on whether the substudies follow the paradigm of functional literacy or sociocultural literacy. In some of the substudies, both views can be found, but in some can one view or another can be placed more clearly. Based on the above descriptions, it can be said that the *functional approach* is present in this study in the framework and reading literacy assessment of PISA as well as in studying the ICT tasks that students exploit. In those, reading literacy is seen as target oriented and as consisting of functional activities which vary based on environment, domain, genre, purposes and so on. The reader acknowledges and develops individual strategies and skills, and the goal is to succeed in tasks and situations that require reading.

However, I have also taken the *sociocultural approach* by viewing ICT use and the perceptions and interest of young people as they themselves report them. The sociocultural approach is present when studying perceptions about the Internet, attitudes toward reading and ICT as well as self-confidence. Those are based on the interpretation that attitudes and perceptions are adopted through interaction with others. This approach is especially clear in substudy I, because adolescents' perceptions about the Internet are considered to reflect not only their attitudes and values and knowledge but also those of the community they live in and how the use of ICT is intertwined in their lives by offering media and a chance to belong to a community. The sociocultural approach is also present when studying students' attitudes and confidence regarding ICT use (substudy II and V), because an understanding of one's own skills cannot be formed without mirroring them to peers and to the expectations that society has. As James Paul Gee (2009, 10) says, "what determines what experiences a person has and how they pay attention to the elements of these experiences is their participation in the practices of various social and cultural groups". In substudy I, I also consider critical reading: critical reading always reflects the values, power and control of society. In addition, the term *practices* is used in this study in a sociocultural sense, and not to refer to mere activities. The concept of multiliteracy is used in this study to intertwine different literacies and also to highlight the literacy needs of the information society. This concept is built on the sociocultural view, and it is presented in chapter 4.

3

Comparison of ICT literacy and traditional literacy

Julia Coiro and Elizabeth Dobler (2007) found that online reading and offline reading had similarities as well as differences. According to their review, readers on the Internet face several challenges that are associated with ineffective and inefficient search processes, cognitive overload and disorientation, a tendency to drift from one search question to another, and an inability to know how to use the information once it has been located (Coiro & Dobler 2007, 220–221). In this chapter, I present some comparisons of reading printed texts and electronic ones. This chapter establishes the basis for students' perceptions in substudy I, in which they ponder the advantages and disadvantages of the Internet. In addition, in some substudies the correlations between ICT use and reading traditional literacy have been studied, and to fully understand their relationship a discussion is needed of the similarities and differences between reading printed texts and electronic texts. This discussion is especially important in substudy VI, when I present the international results of a reading literacy assessment that focuses on both traditional and electronic texts.

3.1 Reading processes and strategies

The relationship between reading traditional texts and electronic ones is puzzling. Although Geoffrey Nunberg (1996, 117) argued that “information does not change its nature according either to the medium it is stored in or the way it is presented”, there are several research-

ers who claim that we do need different kinds of reading strategies to find and understand that information. Access and presentation influence meaning-making, as do readers' own experiences, values and attitudes. (Barton 1994; Coiro 2003; Cope & Kalantzis 2000; Gilster 1997; Linnakylä 2000; Tyner 1998.)

Strategies for coping with texts are often called reading strategies, but the concept is defined in various ways. In fact the concept of strategy can be problematic, because the difference between skill and strategy is not well defined (see section 1.1; also e.g. Alderson 2000). Briefly defined, reading strategies are often understood as processes of understanding and evaluating a text. These processes can be understood to be the same as the ones used in the PISA survey (see section 2.2.3).

One of the earliest definitions of this view, which focused on processes of media literacy (which in this view includes also ICT literacy) was Renee Hobbs' (1997, 1998) categorization into four processes: access, analyse, evaluate and communicate. *Accessing* includes decoding symbols, building broad vocabularies, skills related to locating, organizing and retaining information, and the ability to use the tools of technology. *Analysing* includes interpretive comprehension skills: the ability to make use of categories, concepts or ideas, such as determining the genre of a work, making inferences about cause and effect, and identifying the author's purpose and point of view. On a secondary level, recognition of the historical, political, economic and aesthetic contexts are included. *Evaluating* includes judgements about the relevance and value of messages for the reader. That requires use of prior knowledge, predicting a further outcome or a logical conclusion, identifying values and appreciating the aesthetic qualities. Finally, *communicating* includes the ability to understand the audience to whom one is communicating, the effective use of symbols, the ability to organize a sequence of ideas, and the ability to capture as well as to hold the attention and interest of the message receiver. Communication skills are to some extent media specific, such as when producing a video or communicating via a text-based message board. (Hobbs 1997, 166–167; 1998.) Especially the ability to use the tools of technology and the assessment of communication in a more media-specific way were dimensions that had received less attention previously.

In a broader definition, the processes of decoding, evaluating and understanding are only a part of reading strategies, as reading strategies cover almost everything related to using the text: beginning from planning to read the text to underlining important parts and to afterwards reflecting on whether the ways you acted and processed were functional and fertile. For example, Coiro and Dobler (2007, 218–219) state that key elements for the comprehension process of informal texts are 1) prior knowledge of the topic and text structure, 2) inferential reasoning to make connections not explicitly stated in the text, 3) self-regulation to adopt alternative strategies when others do not work, and 4) affective

variables related to efficacy and motivation towards reading and the text. Especially the latter two may point to strategies that are wider than those about concentrating only on the text on the hand.

The concept of reading strategy is used in this study, but as Alderson (2000, 308–209) points out in reference to Joan Rubin (1987), other concepts could also be used. Rubin (1987, 19–20) classifies strategies as “any set of operations, steps, plans, routines used by the learner to facilitate the obtaining, storage, retrieval and use of information”. She also makes a distinction between cognitive learning strategies, metacognitive learning strategies, communication strategies and social strategies.

In PISA 2009, reading strategies are seen as actions an individual makes to achieve, for example, understanding of a text. In PISA 2009, two metacognition strategies were defined: strategies for understanding and remembering, and strategies for summarizing (OECD 2011, 226; see Appendix 1). These definitions represent the broader definition of reading strategies, but in another respect the PISA survey can only access the narrower definition. Mastering strategies for understanding and remembering as well as strategies for summarizing had a positive relationship with reading literacy proficiency. Strategies for understanding and remembering explained 16% of the score for traditional literacy and 13% of the digital literacy score. Strategies for summarizing explained 22% of the score for traditional literacy and 19% of the digital literacy score. Clearly those students who had mastered these strategies scored better than those who had not. (OECD 2011, 138.) However, those reading strategies did not explain the same amount of proficiency in traditional and digital reading, which suggests that the strategies needed are not exactly the same.

A comparing categorization is made by Elizabeth Schmar-Dobler (2003), who, employing the comprehension model of Pearson, Roehler, Dole and Duffy (1992), has compared the reading strategies for books and the Internet (Table 3). She sees that when it comes to activating prior knowledge, determining important ideas, synthesizing and drawing inferences, the strategies used are similar. However, new dimensions are included in “monitoring and repairing comprehension”, “asking questions” and “navigating”. In monitoring and repairing comprehension, skimming and scanning become crucial on the Internet. However, it could be argued that adjusting the reading rate depending on the purpose of reading is also common on the Internet. (Schmar-Dobler 2003.) According to some studies, four out of five online readers scan text and only one of five read word by word (Nielsen 1997). Kiilakoski and af Ursin (2014) note that reading online is often more surfing, skimming or browsing than reading word by word.

Missing in Schmar-Dobler’s comparison table are the strategies needed before accessing the text as well as both critical and ethical reading. In the framework of PISA 2009, the

Table 3. Comparison of reading strategies for books and the Internet (Schmar-Dobler 2003, see section 'Connections between literacy and technology')

Reading strategy	Book	Internet
Activate prior knowledge	Reader recalls experiences and information relating to the topic.	Similar strategies used.
Monitor and repair comprehension	Reader adjust reading rate depending on the purpose of reading.	Skimming and scanning becomes crucial for reading sheer volume of text.
Determine important ideas	Reader analyzes text to determine which parts are important for developing an understanding of text.	Similar strategies used.
Synthesize	Reader sifts important from unimportant details to determine the kernel of an idea.	Similar strategies used.
Draw inferences	Reader reads between the lines, using background knowledge and text to help fill in the gaps.	Similar strategies used.
Ask questions	Questions give purpose to reading by motivating the reader to continue.	Guiding question must be in forefront of reader's mind or getting lost or sidetracked is likely.
Navigate	Reader uses the feature of print text to search for information (e.g. table of contents, glossary, headings).	Reader figures out features of the Internet in order to search for information (e.g., pop-up ads, downloading).

difference between print and electronic texts is presented as in Figure 3. Compared to how printed texts are read, the reading of electronic texts emphasizes the navigational skills before entering the text, hyperlinks in text as well as hyperlinks between texts, that makes it difficult to comprehend the boundaries of a single text and that also enables the creation of multiple paths.

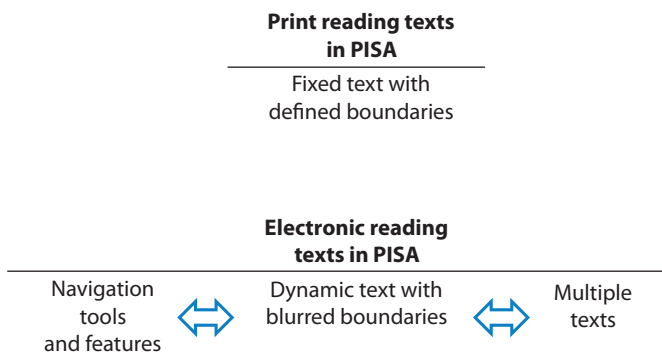


Figure 3. Differences between print and electronic texts and reading (OECD 2009, 28)

In PISA 2009, navigation was considered to be one of the most distinguishing features of electronic texts. Some navigation tools and features are parallel in print texts (e.g. table of contents, headings, page numbers), but some are more unique to the digital environment. Those are features that allow the reader to move on, over and from the page. In addition, there are global organizers – search engines – which help orient the reader to what is available. (OECD 2011, 41–42.) When the reader finds an interesting website, he or she can locate information on the page by using a search. The table of contents may be visible all the time in the sidebar, which makes searching easier than with books. Reading hypertexts and multilinear texts requires the ability to navigate and use search engines and keywords.

So when comparing the printed and electronic text, the biggest difference seems to be before and after interpreting the chosen text. This is represented in Figure 4. The strategies that Schmar-Dobler (2003) describes are mainly situated in the square in the middle and those strategies relate to information literacy skills. Finding the relevant information has its own challenges, but the digital form extends the variety of possibilities for using, editing and sharing information. However, there is no clear dividing line, because all the texts are different based on their genre, manner of representation and so on.

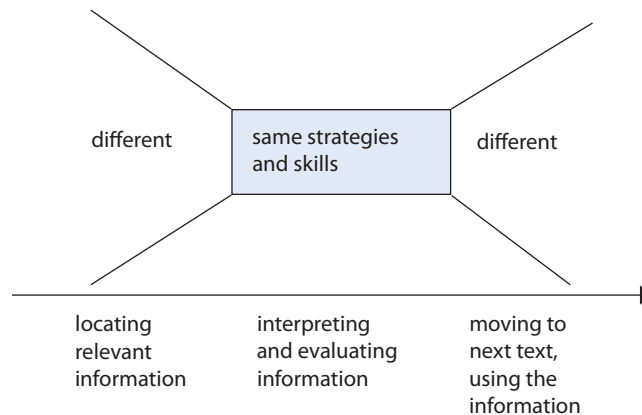


Figure 4. Comparison of literacy needs for printed and electronic texts

3.2 Textual differences

The Internet has offered technical possibilities that have created a need to broaden the understanding of a text. Coiro (2003) points out that electronic texts can be nonlinear hypertexts, multimedia texts and interactive texts. On the Internet, text is more often expository and narrative texts are in the minority (Kamil & Lane 1998; Schmar-Dobler

2003), or it is a combination of different kinds of text types. This puts strains on reading comprehension as well, because people – children as well as adults – seem to have more difficulties in reading informational than narrative texts (Coiro & Dobler 2007, 218). The development of technology influences texts in other ways as well: texts from the Internet are increasingly read from small mobile devices, such as tablet computers or smart phones. The physical size of the page defines the amount and disposition of information that can be easily read. (OECD 2011, 33.) On well-designed websites, these restrictions have been taken into account. But we do have to remember that printed literacy is much more than books. For example, newspapers and single documents are much closer to reading hypertext than reading a novel. Moreover, texts on the Internet vary from complex hypertext to traditionally organized and written books that are only stored in an electronic format.

Another textual feature is linking. Intertextuality, connection and cross-reference to other media and genres are fundamental to Internet navigation and searching for information. But it also obscures the document as a coherent, integrated whole. (Järvinen 1999, 64; Luke 2000, 72–73; Unsworth 2001.) Links can be made from one document to another or within the same page and there may also be non-linked references in the content (Sugimoto & Levin 2000, 146–147; Säljö 2001). These references make texts multilinear (Bolter 1998) and multidirectional (Purves 1998). These features mean that all the relevant text does not have to be on the same webpage. In fact, it enables less text per page than readers are used to in print form. However, the reader must be able to follow the path that he or she is creating and not lose track of what is being searched for. (See OECD 2011, 34–37, 90–91.)

Some aspects distinguishing literacy in the information age are not that new. Images, for example, have been added to texts for centuries. However, the number of images has increased (Bazin 1996; Kress 2000). In addition, ICT enables representational systems, combinations of characters and textual genres that are different from or even non-existent in print texts (Bazin 1996; Kress 2000), such as the use of smileys or abbreviations to the extent that they are used on the Internet. Several different modes – linguistic, visual, audio, gestural, spatial and multimodal – “represent the patterns of interconnection among the other modes” (New London Group 2000, 25). In this multimodal textuality, the reading of texts and images has converged: texts are not read linearly, and images are becoming part of the discourse and more temporal (Bazin 1996, 165). Images are also used more often without any text.

3.3 Participation and communication

This variety of texts, images, sounds, films, data sources and network systems changes the way we read and produce information for others to read. Patrick Bazin (1996, 161) observed, soon after the Internet became commonly accessible, that electronic texts require more “extensive reading, the comparison of diverse texts and viewpoints, multidisciplinary transversality, the ‘conversation’ between readers”. The impact is on the individual mechanism of texts (e.g. reading, producing) as well as on the sociology of reading (transmitting learning and knowledge; Bazin 1996, 161–163). Such an impact has resulted in what may be called participatory culture (Kupiainen & Sintonen 2009, 14). Indeed, knowledge is often negotiated and collaboratively constructed via electronic communication (e.g. Arvaja 2005; Leu et al. 2004; Mäkitalo 2006), and the knowledge may not be in the form of an encyclopaedia, but may instead comprise the feelings and values of another party. Such a process is possible because computers and networks enable easy access to information but also provide easy tools to revise that information. User-friendly software programs and their properties make it easy to edit, rewrite or create materials, texts and images in collaboration with others.

Yet another characteristic of ICT literacy concerns what it has to offer to communication. Herkman and Vainikka (2012a, 97) point out that, very often on the Internet, viewing turns into reading and then into communication. Compared with more traditional forms of reading printed texts, which also seek to communicate in one way or another, modern electronic communication is much more complex. It is easy to connect, and maintain connection, with people, even if they are on the other side of the world. Messages reach their receivers instantly. It is not necessary to know the person you are discussing with, as long as you have joint interests. As suddenly as a conversation starts, it can also end, and it is possible that you will never know the person you just discussed with a moment ago. Among the factors that make electronic conversations unique in comparison to any other means of communication are, for example, their interactivity, synchronous appearance, text that can be described as “written talk”, abbreviations, cryptic jargon and anonymity (Laihanen 1999). It is different to write for the formal discourses of print than it is to write as an author to an anonymous public (Nunberg 1996, 132). Anonymity and freedom of place can be both facilitating and scary (e.g. Beach & Lundell 1998). With ICT, members of different subgroups can reach one another, but also wider groups if they wish to make their lives public with blogs (public diaries), videos or other ways that ICT enables. For example, some feel that they can express themselves more freely when their true identity is hidden, but at the same time it creates a channel for misuse, and even abuse, of those individuals who are not critical and careful enough. (Luke 2000; New London Group 2000.)

The new media and hypermedia channels and various text types can, and sometimes obviously do, provide members of subcultures with an opportunity to come into contact

with their interest groups and to find their own voices and communities. New technology has the potential to bring greater autonomy to different groups of people. As life spheres, or communities, become more divergent, boundaries become more complex and obscure. Also, young people often belong to multiple groups and subcultures simultaneously, by way of their interests and affiliations as well as their gender, ethnicity, and so on. (Cope & Kalantzis 2000.) The new technologies likewise allow and require a constant crossing of borders, be it with respect to neighbourhood living, niche marketing or the processes of citizen participation (Kalantzis et al. 2003). Subcultural differences also challenge the pedagogy of today (see Luke 2000; New London Group 2000). A reader must understand how and why people in different social groups are in a different position concerning literacy, knowledge and information, and what this means for the contents, intentions and purposes of texts and their writers (Luke 2000, 72). Understanding the foundation of this new social community and its possibilities – good and bad – helps the reader to evaluate the content and to take a position on it.

3.4 Information and evaluation

One of the major benefits of the Internet is that it offers alternatives. And those alternatives start as soon as you enter the Internet. Whereas traditional media, including television and radio, offer content that changes in an order that is agreed beforehand – or the medium may even serve as a kind of background wallpaper – on the Internet the path is created by navigating through pages chosen by an individual's own interest and needs. (Gilster 1997, 38–41; Järvinen 1999; also Herkman & Vainikka 2012b.) In fact, nothing happens without clicking links or entering new URLs (Uniform Resource Locator, the global address of documents and other resources on the World Wide Web). An individual can upload new content to the Internet, but can also create new content by navigating through existing materials. (Ebersole 1999; Gilster 1997, 38–41.)

The paradox of the Internet is created by the availability of information. People are fascinated by its communicative possibilities, multimodality and benefits for convertibility, but at the same time it fails to fully support the semantic properties that the informational mode of reading requires, because people are used to explicitly structured information which is often received from someone, not collected by themselves. Impressions of objectivity and autonomy may fool the reader, and alternatives may be experienced more as overwhelming chaos than as a feature enabling wider possibilities, since the reader must select what is relevant and reliable from among dozens or hundreds of sources, not to mention malinformation, that is, inappropriate or even dangerous information. (Coiro 2003, 462; Järvinen 1999, 25–26; Nunberg 1996, 124.)

That is why all the information on the Internet has to be evaluated using different kinds of reading strategies. As pointed out in the framework of PISA 2009, although there are similarities in comparing the different pieces of texts, hyperlinks make it much easier to jump across different texts and therefore get lost in an accumulation of information (OECD 2011, 36–37). Elina Noppari et al. (2008, 141) have pointed out that one of the ways young people search for information is through so-called everyday information seeking (see Harris 2008, 162), which is more a social process than a cognitive one. Information is not evaluated very much but rather it is picked up quickly to find information that is “good enough”. Coiro (2007) has noted that the reader should engage in at least five different types of evaluation during online reading:

1. Evaluating understanding: Does it make sense to me?
2. Evaluating relevancy: Does it meet my needs?
3. Evaluating accuracy: Can I verify it with another reliable source?
4. Evaluating reliability: Can I trust it?
5. Evaluating bias: How does the author shape it?

Openness, broadness and lack of control promote diversity of information, but they also require a critical stance from the reader. Navigation on the Internet strongly involves predicting, evaluating and integrating information. Critical reading is an important skill with regard to printed texts as well, but in electronic media it is even more valuable, because in online networks text and action are more closely connected than ever. A misplaced phrase can have repercussions on many other texts and even on network connections, not to mention on more general reliability and validity issues concerning data security. The absence of referees and complex connections between computers create a whole new context. Paul Gilster (1997, 38–39) sees that whereas television is “exclusive” by censoring offensive material, the Internet is an “inclusive” medium where everything goes because there are no referees. The Internet offers choices for everyone and for every need – good and bad.

Children, adolescents and even adults cannot always identify problematic websites. Niina Uusitalo et al. (2011, 130) found that children were unable to describe how they recognize inappropriate or safe websites. Inappropriate websites included violence, horror, cruelty to animals or nudity. Children said they navigated to these websites by accident or through pop-up windows. (Uusitalo et al. 2011, 130.) Some children do not even seem to be aware of the dangers, or they see them as something they can avoid and they separate the online world from real life (Noppari et al. 2008, 101–103).

With the Internet we have to change the expectations and experiences we gain from more traditional media. Missing references or the lack of a writer’s name are problems that hardly ever appear in books. On websites, the writer’s identity or purpose or reliability is often not that evident. The reader can even enter a website from a link or a search engine

in a way that he or she misses the main page, which might contain important information for evaluating the text. But then, the threshold to contacting the writer or administrator of a website has been lowered. In addition, context, appearance, layout, the location of the website and other external factors affect the reader's attitude towards the content. However, Carita Kiili et al. (2008, 84–86) found that students evaluate the relevance of a website much more often than its credibility. Credibility is also often evaluated based on the context the website appears in. In the same way as we usually take a tip from a trade journal differently from the same piece of information on a supermarket billboard or on a flier, the previous page you entered from usually contextualizes the page on the web: Each page is read differently if you have come to it through an educational website or a fun website. (Gilster 1997; Herkman & Vainikka 2012b, 64–67; Säljö 2001.) A similar situation is if the address of the website comes from a friend or a teacher. In this secondary traffic (Nunberg 1996, 128), it is the informer's identity that may contextualize the page (also Herkman & Vainikka 2012b, 65). Those recommendations that come from friends are an important way for children to find different kinds of websites (Uusitalo et al. 2011, 45; also Herkman & Vainikka 2012a, 95–96).

URLs themselves also often contextualize the website. In national World Wide Web domains (e.g. *.fi*, *.se*) that aspect is less visible, but internationally a reader can instantly see, for example, the commercial purpose of a website if the address ends with *.com*. In addition, the address may tell you whether the information on the website is reliable or even that the reader should at least consider the reliability, such as when comparing the addresses <http://en.wikipedia.org/wiki/> and <http://uncyclopedia.org/wiki/>. Visually, these websites are almost identical. The latter address, however, immediately indicates that information should be read with extreme suspicion. However, a closer look at Wikipedia reveals that it is an encyclopaedia that anyone can edit. Although it aims at the truth and several editors also may increase the reliability, critical reading is still recommended. Uusitalo et al. (2011, 133), however, observed that many 14-year-olds refer to Wikipedia because of its assumed reliability (cf. Herkman & Vainikka 2012b, 54). On the Internet, the form does not necessarily tell anything about the content, and making valid, moral and ethical choices is the responsibility of the user.

3.5 Different kind of readers

A comparison of printed and electronic texts is also present in the taxonomy of Bertram C. Bruce (2000) who, employing Walter Kaufmann's (1977) taxonomy of the modes of reading, approaches critical reading on the World Wide Web with four profiles dividing web users into exegetical, dogmatic, agnostic, and dialectical readers. These profiles

represent various attitudes towards print and electronic texts as well as different reading strategies. These differences are why I present the taxonomy in this context. The taxonomy is especially interesting here because its basis was developed before the Internet became accessible to a large majority of the population. It also supports the hypothesis that reading online is not that different from reading traditional printed texts, although there are some new dimensions. *Exegetical readers* see the web as superior to print because of its multimedia and hypertext capacity, which gives the content a feel of freshness and authenticity that print cannot produce. *Dogmatic readers*, on the contrary, see print as superior to the web. They point to such negative online features as ready access to pornography, commercialization and the uncontrollable chaos of self-created websites with questionable content. These two reader types do not critically evaluate media. Instead, they select cases that support their prior beliefs.

The third type of reader, *the agnostic reader*, sees the advantages and disadvantages of the web, and tries to learn techniques and tools to distinguish what is good. They evaluate contents, tools and services, trawling through websites for three kinds of issues: 1) syntactic issues, such as "ease of navigation, accessibility to users with physical impairments or slow network connections, copy-editing, or readability of the layout"; 2) semantic or content-level issues, such as "understandability and relevance of images, acknowledgement of biases, or indications of the source of information", and 3) pragmatic issues, such as "judgement about the reputation of the author, the website's primary purpose, or the time of its writing" (Bruce 2000, 104). However, agnostic readers see the web as an archive, not as a platform for social activity such as conversation. (Bruce 2000, 103–104.)

Finally, the fourth mode of reading is what Kaufmann calls *dialectical*, but Bruce sees it as being synonymous with transactional reading, a term used by Dewey and Bentley (1949). These views adopt a constructivist theory of meaning, where "knowing is then a process in which the individual learns through reflection on ordinary experience and through communication with others" (Bruce 2000, 107). Dialectical readers evaluate the web by thinking and doing. But they go further than agnostic readers, as they critically evaluate documents as well as the social practices of the web and open themselves "to different ways of interpreting the world" as they seek "to understand the political, social, and historical dimensions of web discourse". (Bruce 2000, 107–108.) What is not clearly mentioned in Bruce's taxonomy is ethical consideration, which can be added as a quality of excellent reader. Bruce's reader profiles are clearly visible in the answers of students represented in substudy I, and they will be discussed more in section 8.1.

Another comparison of reader types is made by Juha Herkman and Eliisa Vainikka (2012a; 2012b). They have identified five different types of readers: printers, producers, book-hi-fis, communicators, and mixers [transl. KL]. *Printers* are old-fashioned, who need the "feel of paper". The use of the computer is limited to communication and searching

for information. *Producers* like to read things that relate to their own production. They are familiar with digital culture and printed materials have no special meaning. Putting information on the Internet has ethical, experiential and instrumental value. *Book-hi-fis* appreciate books as objects of reading, especially with longer texts, but they are also versatile users of the Internet. Internet use is part of their everyday routines by reading news, electronic books or participating in communities. *Communicators* are social and interactive. They are active users of social media in their goal to be in touch with other people. *Mixers* combine features of other types. Especially participatory activities, such as communication, content production and sharing of links, are typical for them. Task requirements and personal desires direct whether they use digital or printed materials. (Herkman & Vainikka 2012a, 136–139; 2012b, 105–107.)

4

Defining multiliteracy

Due to technological development the definitions of literacy and skilled reader have changed. These changes were evident in the previous chapter as well. Literacy is no longer defined as the ability to read and write traditional texts but also as a competence to speak and listen, to switch codes, to recognize numbers, signs, animations and various types of symbols, including visual and audio ones. Literacy also includes the ability to retrieve information, to develop interpretation and to reflect critically on various kinds of texts and symbols when printed as well as electronic texts are concerned. It even includes ethical evaluation of information and information technology. (AASL 1998; OECD 1999; Quéau 1993/1995.) Next, I introduce some theories that are focused on studying these new needs of literacy. I also present some definitions of different literacies, focusing on special contexts and media. These related literacies reflect technological change, and some of them are outdated while some are still actively in use. Presenting these definitions is valid because most of these concepts were used in the substudies at the time of they were published. The presented theories of new literacies and definitions form a basis for the framework of multiliteracy I present in section 4.3.

4.1 Basis for the concept of multiliteracy

In the middle of the 1990s, New Literacy Studies (NLS) emerged, exemplified in the work of Street, Gee, Barton and others. Gee (2009, 11) suggests that “the NLS was about studying literacy in a new way”. The approach was soon connected to studies concerning new technologies and the several literacies comprising New Literacies Studies. It was sociolinguistic and sociocultural by nature though it had scholars from many disciplines and was therefore defined differently in different contexts (Gee 2009). Gee (2009, 11) also explains that “the New Literacies Studies is about studying new types of literacy beyond print literacy, especially ‘digital literacies’ and literacy practices embedded in popular culture”. Hereby, in studying new literacies the focus is often on technology, but not always (also Lankshear & Knobel 2013, 7).

One representative of the new approach was an interdisciplinary group of scholars named the New London Group, which emphasized the sociolinguistic view and settled into the sociocultural approach to literacy. Their perceptions gave birth to new terms, such as Multiliteracies (New London Group 1996) and situated literacies (Barton, Hamilton & Ivanic 2000). (See also Alvermann 2011, 543.) The conceptual view introduced by the New London Group (1996) and later supplemented by Bill Cope and Mary Kalantzis (2000), defines *Multiliteracies* as something in which information is represented in a multiplicity of communication channels, both printed and electronic, and where the textual is often related to the visual, the audio, the spatial and so on. Information is thus considered to be increasingly multimodal. This multimodality is particularly typical of websites, which may contain various types of texts, images, graphical presentations, audiovisual symbols, music, codes and animations (Cope & Kalantzis 2000).

Donald Leu et al. (2004, 1588) have criticized the Multiliteracies perspective of the New London Group for failing to make the Internet and other ICT central to their perspective. Rather, the theory has been applied to the landscape of ICT from other contexts. In addition, Leu et al. see that sociolinguistic grounding limits the ability to predict more cognitive and ontological aspects needed in ICT literacies. However, they admit that the Multiliteracies theory is the most useful among those that have arisen from New Literacy Studies. (Leu et al. 2004, 1588.)

Leu et al. have presented another theory under the rubric of New Literacy Studies. In a 2009 article, they made a distinction between New Literacies (capitalized) and new literacies (lower case). New Literacies describe the common findings of work in many new and expanding areas of research, whereas new literacies concentrate on specific types of changes in separate areas, such as the new literacies of online reading comprehension, the new literacies of social networking or the new literacies of online communication. From that position, they have developed the New Literacies Theory, which focuses on examin-

ing the cognitive and social processes involved in comprehending online or digital texts in general (see Leu et al. 2004). They state that their framework is grounded “in technologies themselves, taking advantage of the sights that a variety of different perspectives might bring to understanding the complete picture of the new literacies” (Leu et al. 2004, 1588).

Leu et al. (2004, 1589–1599) have determined ten principles for a New Literacies Perspective:

1. The Internet and other ICTs are central technologies for literacy within a global community in an information age.
2. The Internet and other ICTs require new literacies to fully access their potential.
3. New literacies are deictic.
4. The relationship between literacy and technology is transactional.
5. New literacies are multiple in nature.
6. Critical literacies are central to the new literacies.
7. New forms of strategic knowledge are central to the new literacies.
8. Speed counts in important ways within the new literacies.
9. Learning often is socially constructed within new literacies.
10. Teachers become more important, though their role changes, within new literacy classrooms.

Later, Leu et al. (2007, 42–43; also Coiro, Knobel, Lankshear & Leu 2008, 41–42; Leu et al. 2004) summarized these principles into four defining characteristics for new literacies. First, effective use of ICT requires new skills and strategies. Second, skills of new literacies are key competences for “civic, economic and personal participation”. Third, literacies change all the time, that is, they are deictic, so instead of learning some specific set of literacy, students should learn to learn new emerging skills and literacies. And fourth, “literacies are multiple, multimodal and multifaceted”.

Another view, in which we can find many similarities to the other views presented here, is provided by Jenkins, Purushotma, Weigel, Clinton and Robison (2009, xviii–xiv). They emphasize the value of cultural competences and social skills among new literacies. The foundation of new literacies is built on “traditional literacy, research skills, technical skills, and critical analysis skills learned in the classroom”. Their wider list of skills needed in today’s society includes the following (Jenkins et al. 2009, xiv):

1. Play – the capacity to experiment with one’s surroundings as a form of problem-solving
2. Performance – the ability to adopt alternative identities for the purpose of improvisation and discovery
3. Simulation – the ability to interpret and construct dynamic models of real-world processes

4. Appropriation – the ability to meaningfully sample and remix media content
5. Multitasking – the ability to scan one’s environment and shift focus as needed to salient details
6. Distributed Cognition – the ability to interact meaningfully with tools that expand mental capacities
7. Collective Intelligence – the ability to pool knowledge and compare notes with others toward a common goal
8. Judgment – the ability to evaluate the reliability and credibility of different information sources
9. Transmedia Navigation – the ability to follow the flow of stories and information across multiple modalities
10. Networking – the ability to search for, synthesize, and disseminate information
11. Negotiation – the ability to travel across diverse communities, discerning and respecting multiple perspectives, and grasping and following alternative norms.

Kathleen Tyner (1998) has also analysed the theory of Multiliteracies. She has found many usable ideas in it, especially for media education, though she feels that some of the ideas are not that new and are only presented in a new way. She also sees that one problem in the use of the concept of Multiliteracies is oversimplification. It suggests “that one literacy is as good as the next, when the operant question should instead be ‘good for what?’” (Tyner 1998, 65). Tyner (1998) uses the term *multiliteracy* to indicate multiple literacies in distinction to New London Group’s theory of Multiliteracies. In this former meaning she has presented a comparative definition of multiliteracies, where she makes a distinction between two literacies: tool literacies, which include computer, network and technology literacies; and literacies of presentation, which include information, media and visual literacies. Tool literacies represent the new technological tools in society whereas literacies of presentation are “relevant to the uses of technologies within the context of schooling”. (Tyner 1998, 92.)

In this study and its substudies, the term multiliteracy, coined by Tyner (1998), is used as an umbrella term to encapsulate a wide range of literacy skills and practices needed in the 21st century². Multiliteracy here is a combination of different theoretical orientations presented in this study. Those different theories overlap to some extent, and therefore separating one from the other with strict categories is not relevant in this context.

The concept of multiliteracy is also chosen here, because in one word it indicates that there are multiple literacies concerned and that those can be examined at the same time

² In the Handbook of New Literacies Research, Coiro et al. (2008, 10) note that all these terms “are used to refer to phenomena we would see as falling broadly under a new literacies umbrella”.

with a frame that is wider than single skills. The concept of media literacy – or media education – has been used quite widely, for example in school curricula. However, in a draft of the new Finnish curriculum of elementary education the term *monilukutaito*, that is multiliteracy, has been adopted (OPH 2012). One reason for that change is probably the widespread perception that we should no longer separate traditional literacy, meaning basically printed fiction and non-fiction, from media literacy, that is, texts that appear in different media, such as on television and the World Wide Web or in magazines. Today all these are converging: you can read poetry from the Internet and read about the Internet in a novel published as a book. The deeply rooted meaning of the concept of media literacy delimits conventional literacy, which today appears also on the Internet and in other unconventional surroundings, from the perspective of traditional literacy.

Multiliteracy includes dealing with different media and their related tools, as well as information processing skills, problem solving and knowledge management (Cope & Kalantzis 2000; Kaufmann 1993; Luke 1997; Tyner 1998). In the multiliteracy view, literacy is not only about being able to understand, produce and display information but also about social skills and individual capacities, that is, connection to other people and their ideas, attitudes, perceptions and desires (Kellner 2002, 56–67). It is also an awareness of the way new contexts are created by blending older forms of communication (Gilster 1997). One might say that multiliteracy is a synonym for extensive and flexible literacy.

The term multiliteracy indicates different kinds of literacies linked and interrelated to it and to each other, and those related literacies all have their own focus and they are needed for different purposes and contexts (e.g. Luke 1997; Labbo & Reinking 1999; Tyner 1998). As the variety of texts has grown, the range of approaches to texts has expanded. Texts can be approached, for example, by these aspects:

- 1) the media where texts appear (newspapers, books, television, the Internet);
- 2) the modality of text, that is, written, visual and audio texts or the combination of these;
- 3) information management, that is, how these texts are approached in order to understand the meaning and purpose of text; how people search, develop interpretations, evaluate and use these texts and the information they consist of;
- 4) affective propensities and knowledge needed, that is, what kind of knowledge and values we need to understand and use these texts, how we consider the context or purpose where a text is presented, how we critically, ethically and morally evaluate texts, and what we need to know about the society concerned to be able to do that; and
- 5) the technical skills employed or required (Luke 1997; McClure 1997; Tyner 1998; Labbo & Reinking 1999).

Several different literacies concern these aspects, but the point of view and definitions vary based on the field of research. The first aspect involves, in addition to traditional literacy, related terms such as media literacy (e.g. Considine 1990; Kubey 1997), Internet literacy, web literacy, network literacy (e.g. Tyner 1998; McClure 1997), digital literacy (e.g. Gilster 1997) or technological literacy (e.g. Thomas & Knezek 1993; Luke 1997). The second aspect involves terms such as visual literacy, audiovisual literacy or multimedia literacy (e.g. Kress 1998; Lemke 1998). To the third aspect we could add information literacy (Farmer & Mech 1992). Related to the fourth are critical (e.g. Freire 1983; Luke 1996), cultural (e.g. Barton & Hamilton 2000) and ethical literacy (e.g. Quéau 1993/1995), and to the fifth computer literacy (e.g. Tyner 1998) and parts of, for example, network literacy (e.g. McClure 1997; Tyner 1998).

In addition, literacies that concern the reader's age or place or time of reading can be specified, such as adult and adolescent literacies, or school literacies versus out-of-school literacies, workplace literacies and formal versus informal literacies. The list is almost endless and only a few are mentioned here. Those literacies have characteristic features and focuses, because these concepts have all originated from the different domains and branches of science. However, technological development has brought these concepts closer to each other and now some of them are clearly synonyms. Together they form the basic elements of multiliteracy.

All these related literacies more or less overlap, and they do not exclude one another, rather they complement one another. Reading and understanding a text often requires using two or more aspects and different literacies. Multiliteracy can be seen as several continuums of literacy: in the broadest sense oral, print and electronic modes but also several continuums within those. From another aspect, there are several continuums of knowledge, skills and strategies that individuals acquire in different contexts through interaction with their peers and community. Each reader has a separate position on every continuum, because hardly anyone is good at everything; a person may perform better in one subcategory than in another. (Barton 1994; ETS 2001; Tyner 1998.) That means that a multiliterate person, on the one hand, may easily cope with different media, but he or she is also able to understand, analyse, reflect on and evaluate traditional printed books as well as various types of documents, both linear and nonlinear, used in diverse contexts (Bruce & Hogan 1998; Tyner 1998). On the other hand, a person who skilfully interprets poems may have difficulties in evaluating the truthfulness and reliability of a text on the Internet. One way to communicate does not replace another. On the contrary, different forms of communication offer more possibilities to our textual world. (Barton 1994; Kaufmann 1993; Tyner 1998.)

In the next section, I define some of the related literacies concerning the concept of multiliteracy and this study. A summary of these definitions can also be found in Appendix 2. These, considered to be the most important ones, are ICT literacy (defined in section

1.1), digital literacy, computer literacy, network literacy, game literacy, information literacy, visual literacy, media literacy and critical literacy.

4.2 Related concepts of literacy

Digital literacy may be used as a synonym for ICT literacy. It delimits literacies to the use of digital technologies, excluding analogue technologies such as traditional radio (which in the future will also be digital, and on the Internet it already is) and the fax. However, this difference is almost insignificant nowadays as almost all the previously analogue media (such as television) have become digital technologies. Paul Gilster (1997, 1) has defined the concept of digital literacy as not only “the ability to access networked computer resources and use them” but also as “the ability to understand and use information in multiple formats from a wide range of sources when it is presented via computers”. This definition is nearly the same as the one presented with ICT literacy. Gilster (1997) proposed that key aspects of digital literacy are content evaluation, hypertext navigation, searching and knowledge assembly, which means applying information for one’s own purposes. When Gilster wrote about digital literacy in 1997, the reference to computers was obvious. However, today digital television, for example, is a reality, and the concept of digital literacy is not so specific any more. However, I originally chose ICT literacy instead of digital literacy because changes from analogue to digital are so recent and still continuing and this can present misunderstandings. Furthermore, ICT is more common among educators. For a similar reason, the synonym electronic literacy was not chosen because it was too broad and vague. However, electronic literacy is used in some substudies to refer to all electronically mediated text – in a broad sense – in contrast to printed texts, and the term digital literacy is used in the context of the PISA 2009 digital reading study, as OECD adopted the term then.

Computer literacy is widely understood as a general understanding of the way computers work and the ability to use them. It can be seen mostly as a technical skill. Basic knowledge of operating systems, word processing programs, spreadsheet applications, graphic tools and using the Internet are essential parts of computer literacy. A fluent user also knows keyboard combinations (such as ctrl/apple + c, ctrl/apple + v to copy and paste) that help everyday use. Computer literacy generally refers to the ability to use applications rather than to program. To achieve good computer literacy skills, a user must understand the basic principles and functions of the software so he or she can apply that knowledge when using another program. (Tyner 1998; ACRL 2000/2005; Smith 2000.) That way after using, for example, one word processing program, a user can perform all the basic functions with other word processing programs.

Network literacy can be defined as knowledge about networked information and the uses and skills needed to find and combine information and use it to cope with school- or work-related and personal situations (McClure 1997; Tyner 1998, 75–77). Network literacy is essential when navigating on the Internet, which means that the reader can fluently navigate through websites, transfer files from FTP servers, exploit services of online stores and have conversations with other Internet users. Network literacy also implies understanding of how networked information is organized and how it works, what it can be used for, and how it should, or should not, be used (netiquette, netethics). (Gilster 1997; Kapitzke 2001; McClure 1997; Tyner 1998; Smith 2000.) In its broadest sense, the concept of network literacy includes various computer, telecommunication, cable TV, and other technologies (McClure 1997). In addition, network literacy is sometimes seen as a rather broad concept, the definition of which is clearly approaching the definitions of ICT literacy or media literacy – especially when speaking in Finnish with the equivalent term *verkkolukutaito* – because it may include computer literacy, visual literacy, information literacy and, perhaps, multimedia literacy (e.g. Ministry of Education 2000; see the concepts below).

As one of the most popular activities on the Internet and computers is playing games (e.g. Suoninen 2013, 37), the term *game literacy* has also become common. According to Alvermann (2011, 544), game literacy includes much more than knowing a game's multimodal properties. It also refers to writing scripts, researching the history behind the game's plot, making directions for playing the game, or participating in a game's themed chatrooms or discussion boards or the communities of amateur game developers.

Technology literacy is another rather broad concept used, which could be seen as a synonym for ICT literacy. It is defined as an integrated process that includes people, procedures, ideas, devices and organizations for analysing problems and devising, evaluating, and managing solutions for those problems (Tyner 1998). Computer literacy and technology literacy are combined when *technological fluency* is discussed. Technological fluency demands understanding concepts, exploiting technology in various situations and also taking a critical stance toward technology. It may demand more versatile thinking than the mastery of hardware and software included in computer literacy, but the primary focus is on technology itself. Technological fluency is on the same level as information literacy, which is, however, more focused on analysing, searching for and assessing content. (ACRL 2000/2005.)

The definition of *information literacy* originated among librarians and library studies. The skills and knowledge related to information management are as important in traditional literacy as they are among electronic texts. Essential in the definition of information literacy is an ability to recognize a need for information, and to search, retrieve, evaluate and use that information in everyday life. An information literate person is

able to determine the amount of information needed, find information effectively, evaluate information and its source critically (a skill that is included in critical literacy) and accommodate new information to prior knowledge. Finding information requires, for example, knowing information structures, such as the basis for classification and understanding hierarchical structure of the files, and the ability to use search tools. An information literate person can exploit information that he or she has found in everyday tasks. The person also understands the economic, legal, ethical and social effects of using that information, and because of that understanding, he or she also searches and uses information ethically and legally. Information literacy is, furthermore, seen as a key to lifelong learning. (ACRL 2000/2005; Kapitzke 2001; Smith 2000; Tyner 1998.) In the broadest sense, information literacy is understood to include library literacy, computer literacy, media literacy, technological literacy, ethics, critical thinking or critical literacy, and communication skills (Academic network skills project 2000–2005). This formulation approaches the definition of multiliteracy presented in this study. In addition, the pedagogy for Multiliteracies formed by the New London Group (2000, 30–36) is rather close to the broad definition of information literacy. This similarity exists because, roughly simplified, the pedagogy encompasses activities of interpreting texts using knowledge from the text and the reader's prior knowledge, evaluating text critically and exploiting the new knowledge in other contexts, all the while considering multimodality and media, which are also included in this pedagogical frame.

An important part of information literacy is *information technology skills*. They ease information searches by making possible the use of computer and its software and databases, and other technologies. (ACRL 2000/2005.) One such information technology skill is knowledge of where and how you can easily find help when using new software, or not to be afraid to use the instruction or help menu. However, the term information technology (IT) has spread to mean almost everything that concerns technology and networks, although for many it also carries strong historical associations with data processing and storage, and computer services (ETS 2001; OECD 2003/2005).

To understand and evaluate visual images, *visual literacy* is needed. Visual here means not only pictures, but also graphic design, because typography, layout, signs, images and videos are visual as well. For example, many navigation buttons are visual rather than textual. Communication has always been multimodal (Kress 1998; Unsworth 2001), but the increase of imagery can clearly be seen in different media. To written text itself, computer technology brings not only wide typographic variation, but also the use of dynamic text that can flash, rotate, move across the screen, and so on (Unsworth 2001, 9). Text may gain new meaning when it is combined with images, video or sound (e.g. Cope & Kalantzis 2000; Gilster 1997; Myers, Hammett & McKillop 1998). In addition, *audio literacy* is sometimes attached to visual literacy to form *audiovisual literacy*, which is needed, for example,

when interpreting music videos. Because sounds and images can be used in so many ways, some prefer the term *multimedia literacy* (e.g. Lemke 1998, 284).

Media literacy – also called media education – has been defined by many researchers and educators. It is often defined as an upper-level concept for all those literacies defined above that handle media and media texts (see Kupiainen et al. 2007, 4–5). Sirkku Kotilainen (1999, 36) says that “media literacy is needed in media texts that are verbal, graphical and audio and in multimodal combinations of those. It is needed in reading a newspaper as well as in carrying out or interpreting a homepage”. She sees those literacies associated with different media as parallel to those that are part of the media literacy concept. The concept of multimedia literacy, suggested by Lemke (1998), suits this view well.

The content of media literacy is defined more accurately by Outi Nurminen (2000, 104). According to her, media literacy consists of practical skills (using hardware and software, producing media acts), cognitive skills (data management, receiving and processing media acts, language skills) and cultural knowledge (understanding the rules of the media environment). Jody McBrien (1999) also stresses how important it is to learn to interpret and understand media texts, voices and images, and to be able to make responsible decisions with media choices. In addition to interpreting, producing, analysing and evaluating text (McBrien 1999; Tyner 1998), one task for media literacy is also to help enjoy communication as an individual as well as a social experience (McClure 1997). It can be emancipatory or empowering (Alvermann, interviewed in Alsop 2001; Kupiainen & Sintonen 2009, 41, 95). Reijo Kupiainen and Sara Sintonen (2009, 32) stress that use of media has a strong sociocultural meaning.

Although the definition of media literacy above seems clear and extensive, the view of media literacy that is taken can often be very different: some emphasize the use and meaning of ICT at school, some focus on protecting children and adolescents from the bad influence of the media, some find it interesting as an area of cultural and sociological research and some see the media as manipulating people (Kotilainen & Sintonen 2005; Luukka et al. 2008, 62). Whatever view is taken, the consensus is that more research and knowledge about meaning and influence in different media is needed.

In this study, however, media literacy is defined by closely following Tyner’s (1998) definition that media literacy helps us to understand how media work and construct reality and how these influence the viewer. In addition, it refers to the way of reading and understanding information that differs from what we do when we read a book or a website (Gilster 1997, 28–29). Of course, all literacies mentioned above are a part of a process that happens when we use different media. Common to all the views of media literacy presented here is that media literacy is more than simply using media; it is the study of media.

The critical approach to literacy has been developed especially in the work of Freire (e.g. 1983; Freire & Macedo 1987). The Freirean approach has some essential views that

have been preserved. Being investigative, inquiring and questioning, critical literacy aims to progressively deepen and extend the reader's understanding of social reality – reading the word is also reading the world. He saw that there should be a critical approach not only to text, but also to society as a whole. Literacy can empower people and help them to change their cultural context. (Freire & Macedo 1987.)

Since Freire, the concept of *critical literacy* has been redefined by many researchers (e.g. Bruce 2000; Kellner 2002; Luke 1996). Some researchers incorporate the critical aspect into the concept of media literacy (see Kubey 1997), but some prefer a more specific concept of critical media literacy (see Alvermann & Hagood 2000). The difference between these two concepts is, according to Douglas Kellner (2002, 49–50), that media literacy is focused on reading, analysing and decoding media texts, but critical media literacy builds on these and goes even further by emphasizing the sociocultural perspective that Freire already had by “analysing media culture as products of social production and struggle” with a critical approach. Critical media literacy should motivate people to use media for self-expression and social activism as well as help them see how media culture can advance different forms of prejudice, misinformation or questionable ideas. Kellner (2002, 51) explains that critical media literacy not only “teaches students to learn from media, to resist media manipulation, and to use media materials in constructive ways”, but also it develops skills that help to create “motivated and competent participants in social life” and “good citizens”. (Kellner 2002, 49–53.) It should also be noted that critical literacy, or critical reading or critical thinking – whatever concept is used – is not about judging, but more about considering options.

Critical literacy is an important part of multiliteracy. According to Carmen Luke (2000, 72), critical literacy in a frame of multiliteracy entails three aspects. One, it involves meta-knowledge, which means that a reader should understand the structures of information in different media and genres, and how these structures influence the ways in which texts and information are used and read. Two, it demands technical and analytic skills to be able to use information in different contexts. And three, a reader must understand how and why people in different social groups are in different positions concerning literacy and knowledge, and what this means to the contents, intentions and purposes of texts and their writers. She also adds that, “Critical Multiliteracies, then, require student debate and understanding of the political and material consequences of technological change. How will IT change our lives? Who will benefit? Who will be disadvantaged?” (Luke 2000, 74.) These questions are also touched on in substudy I and in the discussion of this study.

What distinguishes multiliteracy from the concepts presented above is that it includes all the forms of literacy mentioned above and also traditional literacy. From many perspectives, the terms ICT literacy and media literacy can be seen as synonyms of multiliteracy, but it should be noted that it is so only in the context of ICT use or in the use of other

media, such as television. Electronic texts may include similar texts and demand similar reading strategies as printed texts, but if we include, for example, the printed novel in the definition of ICT literacy, then we are talking about multiliteracy, not ICT literacy. However, when we discuss the literacy needs of the information age, neither ICT nor traditional literacy can be ignored. Therefore the challenges that technology brings to ICT literacy are also challenges for multiliteracy.

In the next section, I first describe the compilation of special characteristics for multiliteracy. Then I propose a new view of ICT literacy and traditional literacy in the frame of multiliteracy.

4.3 ICT literacy and traditional literacy in the frame of multiliteracy

All the aspects of the operational environment as well as the skills and knowledge needed for ICT literacy, described in chapter 3 and sections 4.1 and 4.2, set new challenges for reading and even more broadly for learning. When considering the different aspects and factors discussed above, the characteristics of new literacy – here called multiliteracy – can be encapsulated as follows (see also Leu et al. 2004; Linnakylä 2000, 125–130):

- 1) The new literacies complement and widen traditional literacies; they do not replace them (Leu 2002a; Tyner 1998).
- 2) Assessing texts requires skills with and knowledge of navigation tools (Hobbs 1998; OECD 2011).
- 3) The ways to make meaning are multimodal; they involve understanding the complex relationship between written texts, the visual, aural, gestural and spatial (Cope & Kalantzis 2000; Gilster 1997; Jenkins et al. 2009; Kalantzis et al. 2003; Kress 1998, 2000; Lankshear & Knobel 2012; Lewis & Fabos 2005).
- 4) Intertextuality prevails; the ability of hypertexts to link documents may help the reader to understand references, and interactivity may help to create intertextuality; at the same time the line between intertextuality and plagiarism or commercialism becomes fuzzy (Parr-Davies 2003).
- 5) Continuous searching, evaluating and reflecting while accessing and using websites, executing programmes, and retrieving and analysing information are emphasized; an understanding of how texts work helps a reader to cope with unfamiliar texts in different media (Kalantzis et al. 2003; Leu 2002a).
- 6) Critical literacy skills are increasingly important; visual appearance does not say anything about how accurate, reliable or relevant the information on the Internet is or what the purpose of the site or message is, because the Internet is often

used by various political, religious and ideological groups to spread their message (Kalantzis et al. 2003; Leu 2000, 2002a). A pleasant and secure environment can be achieved only if both netics and ethics are taken into consideration (Quéau 1993/1995).

- 7) Literacies are more social than ever; knowledge and opinions are negotiated in various networks (e.g. Arvaja 2005; Herkman & Vainikka 2012b; Lankhear & Knobel 2012; Mäkitalo 2006) rather than through books; technologies provide new ways to collaborate; the audience is easily reached globally (Beach & Lundell 1998; Leu 2002a).
- 8) Knowledge is situated and contextualized; different technologies, different community groups and different subcultures have their own experts, habits, and registers as well as dialects; linguistic diversity is growing even though English is becoming a lingua mundi (Barton, Hamilton & Ivanič 2000; Cope & Kalantzis 2000; Gee 2003).
- 9) The absence of distance promotes multiculturalism (Cope & Kalantzis 2000; Leu 2002a); insight into other cultures may strengthen or confuse a person's own identity and ideologies.

Based on the description of literacy change and definitions above, I introduce one interpretation of multiliteracy. The web of concepts, however, needs some clarification³. Using only one concept may sometimes be too vague to be useful, such as when referring specifically to visual literacy (see Lewis & Fabos 2005). I agree with Kotilainen (1999, 36) that hierarchical order is unnecessary and redundant, because in media texts, images and sounds mingle with each other in a way that cannot be compared with other forms of text. Because different media will increasingly blend in the future, the separation by type of medium is not functional. Categorizing literacies according to their focus on the meaning-making process is more valid when thinking of the literacies of the 21st century.

An attempt to simplify the jungle of concepts was made by media educator Kathleen Tyner (1998, 92–97). She divided multiliteracy into two literacies: tool literacies (including computer, network and technology literacies) and literacies of presentation (including information, media and visual literacies). However I argue that the division is inadequate because it seems to be too competence oriented and leaves out the sociocultural elements of literacy use. I have divided the latter category of literacies into two, forming media literacies and information literacies, because information literacies themselves form an important and large domain that is closely related to information

³ In the Finnish language the variation of concepts is even greater, because the term *lukutaito*, which is often the translation of the term literacy, points strongly to reading. Nowadays the well-established concept *tekstitalidot* is a good translation for literacy.

management on a textual level and should therefore be stressed as a separate category. Texts are primarily visual, so images are included in the definition of texts and therefore they do not need their own category.

My proposal for the elements of multiliteracy is presented in Figure 5. Multiliteracy includes both traditional and ICT literacy, and views texts multimodally. Processing and meaning-making in texts is composed of three functional aspects: tool literacies, media literacies and information literacies. *Tool literacies* deal with the activities and practices related to the use itself: How to use this medium? What software or program should I use? How do I use them? What can this software or program do? How in a technical sense can I participate in this activity? When is it time to upgrade? Tool literacies include computer literacy and technical skills sometimes related to network literacy, technical literacy and media literacy. From this perspective, the definition of tool literacies is somewhat broader than simple computer literacy. (C.f. Tyner 1998.)

Media literacies process text from the media aspect including, for example, understanding how different media work and produce meanings, what are the characteristics and general rules of each medium, and for what purpose a certain medium is the best. An individual must understand the potential of a technology and medium and then make strategic choices about whether or not to use them, and how best to use them (OECD 2003/2005). Media literacies include skills and knowledge from multimedia literacy, technological literacy and network literacy.

And the third category, *information literacies*, deals more directly with the content of texts (with the term texts being understood in a broad sense). It requires even greater cognitive proficiency than media literacies or tool literacies, and includes finding, interpreting and evaluating text, and using it for its own purposes. Briefly, it can be said that these three aspects of literacies include knowledge and skills at the technical, media and text level.

It is important to note that all these aspects include or should include some amount of critical, ethical, social, and cultural literacy (or sociocultural). The presence of these literacies means, for example, considering in tool literacies the legitimacy of downloading certain software. In media literacies, it means considering, for example, the familiarity and interest of a certain medium among a focus group. And in information literacies it could mean considering words in a multicultural conversation or a writer's position and how it affects the way in which the writer's words should be interpreted. These literacies also include a consideration of the validity of the information and issues related to plagiarism.

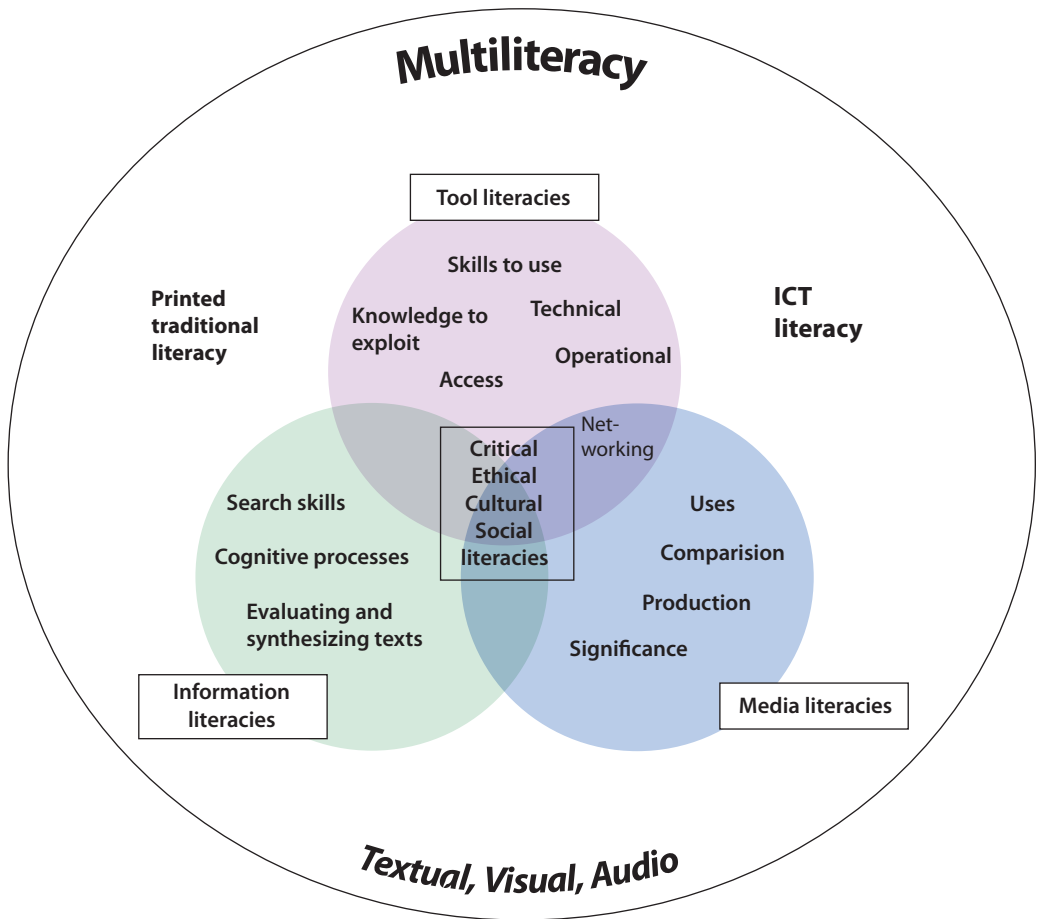


Figure 5. ICT literacy in a multiliteracy frame

Table 4 presents how the substudies of this study are placed in the frame of multiliteracy presented above. All the substudies focused on two areas in that tri-literacy view. Tool literacies were emphasized in substudies II, IV and VI, which focused on ICT literacy activities. Those activities relate to skills and knowledge of actual use. In substudy V, these uses were examined through students' self-reported confidence, that is, their affective perspective, on these activities.

Media literacies were the focus of substudies I, III and IV. In substudy I, students considered the functional use of the Internet and evaluated this media from their own perspective. In substudy III, students' reported activities on the Internet were considered from a functional view and the results were discussed by comparing functions of new electronic

and traditional printed media. In substudy IV, students were grouped by their connection to different media, such as newspapers, magazines, fiction and Internet activities.

Furthermore, information literacies were examined in substudies I, II, IV, V and VI. In substudy I, students' perceptions were considered not only from the view of how they evaluated the media, but also in terms of whether their responses indicated any evaluation and interpretation of texts and information on that media. In substudies II, IV, V and VI, information literacy was emphasized, because the results of these studies were compared to reading literacy performance on PISA, the main focus of which is on information literacy skills, such as retrieving information and evaluating the text, in traditional printed literacy.

Table 4. *How substudies explore the field of multiliteracy*

	Tool literacies	Media literacies	Information literacies
Substudy I		X	X
Substudy II	X		X
Substudy III		X	
Substudy IV	X	X	X
Substudy V	X		X
Substudy VI	X		X

5

ICT use, affective propensities and gender differences in other related studies

There are several factors that earlier research has pointed out as being important for reading literacy skills. ICT literacy is here studied in the light of PISA reading literacy proficiency, which makes it important to determine what these influential factors are. In this chapter, first some information about computer and Internet use at the time of this study is presented. Second, some studies considering the relationship between ICT use and reading literacy proficiency are introduced. After that, issues of self-confidence in ICT, and motivation, engagement and interest in reading are described. Finally, gender issues are discussed.

5.1 ICT use at the beginning of the 21st century

How and to what extent do adolescents use computers and the Internet? In the context of the Programme for International Student Assessment (PISA) in 2000, 20 countries asked their 15-year-old students about their ICT use. In 2009, all the participating countries had an ICT questionnaire for students. Students were asked about their interest in computers, their self-assessment of their computer literacy skills and their reasons for and frequency of using ICT. According to the first results of PISA 2000 (OECD 2001), in the Nordic countries, the Swedish and Norwegian teenagers were the most active users of computers at home. More than 70% of them used computers at home at least a few times a week. To compare,

the Danish students used computers most actively at school. Finnish students were – a bit surprisingly – the least active users of these four Nordic countries. On a broader scale, all the Nordic countries were very active: 65% to 77% of Nordic students used the Internet at least a few times per week, as the average in all the participating countries was 23%. Also, an overall average of 16% said they never used the Internet, but in the Nordic countries only a few percent replied this way. (OECD 2001.) In 2009, only 0.8% of students (the average of 29 OECD countries) said they had never used a computer. In the Nordic countries, over 99% of homes had a computer and almost all of them had an Internet connection. (OECD 2011; see also Livingstone, Haddon, Görzig & Ólafsson 2011, 12–13.) In 2008, Noppari et al. (2008, 42) reported that, on a daily basis, the 14-year-olds in their study used the Internet more than they watched television.

Several studies have pointed out that the purposes of using new media and technologies are similar to the uses of print (see Ebersole 1999; Suoninen 2004) described in section 2.2.1. On the Internet, young people search for companionship, knowledge and fun. The Internet is a source of texts and hypertexts, images and sounds, providing a huge, virtual agora, and it is also a place where individuals can publish their own writing and other presentations, which can be inspired by public discussion as well as by enthusiasm for a particular book or television series or genre (see fan fiction in Chandler-Olcott & Mahar 2003a; see also Kaarakainen et al. 2013, 23). It also provides a meeting point for social interaction (e.g. Noppari et al. 2008, 54; Uusitalo et al. 2011, 41), whether it happens privately over email, in a small group of friends in, for example, Internet relay chat, subject-oriented chat rooms or message boards, or even in worldwide interactive arenas where participants can chat and also buy products to decorate their own rooms and to improve their avatar, that is, their guise in the virtual world. On the Internet the adolescents find information, meet friends, play games, fall in love, stretch their own boundaries and become acquainted with the world in good as well as in bad ways. Suoninen (2004, 62) divides children's media use into three categories: use related to content (e.g. information, entertainment or enjoyment), use related to context (e.g. rituals, relaxation, the need to socialize or escapism), and use related to social environment (e.g. current events or belonging to the group).

Samuel Ebersole (1999) has reported similar findings. He specified seven functional statements in his study concerning Internet use by adolescents: for research and learning, to communicate with other people, for access to material otherwise unavailable, to find something fun or exciting, for something to do when bored, for sports and game information, and for shopping and consumer information. Obviously, there is some age-related emphasis: the use of adolescents is more focused on fun and searching for information than on commercial purposes. (See also Kaarakainen et al. 2013; Uusitalo et al. 2011.)

In 2000, 66% of Finnish 15-year-olds reported using a computer at home at least a few times a week. The first results of PISA 2000 (Leino 2002) revealed that students used computers and the Internet to play games, communicate with email and other discussion possibilities and to have fun by browsing the Internet. In 2000, Finnish students were, in fact, more keen than those in other OECD countries on average, to use digital communication. Computers were also used for word processing. However, the activity of using a computer to help with learning, drawing and programming was engaged in by a minority of students. (Leino 2002, 171–173.)

At school, the use seemed to be much less: in 2000 in Finland almost half (46%) of students reported using a computer at school at least a few times a week (Leino 2002, 171). Results from the international Second Information Technology in Education Study (SITES) show that one reason for lesser computer use at school was that, for example, in 2006 only slightly more than 20% of schools in Finland had a computer for less than five students. Most of the schools in Finland had one computer for every 5 to 9 students. Schools participating in SITES 2006 also evaluated the active use of computers in different subjects: approximately 35% of Finnish schools said that computers were used often in lessons for civics, foreign languages and mother tongue. In other subjects the use was lower. (Kankaanranta & Puhakka 2008.)

The study called ToLP (Towards Future Literacy Pedagogies – Finnish 9th graders' and teachers' literacy practices in school and out-of-school contexts), which studied, among other things, the media use of 9th graders and media education and teaching methods in mother tongue and foreign language lessons through the eyes of students and teachers, found that the 12% of participating foreign language teachers and 5% of mother tongue teachers thought that the Internet is a good place for learning. In addition, 40% of mother tongue teachers and 45% of foreign language teachers had never used any digital learning platforms. Students were also asked about their use of the Internet: 42% responded that they never used the Internet in mother tongue lessons and 47% said that was the case in foreign languages. (Luukka et al. 2008, 78–80.) The study also showed a need to improve teachers' skills in using computers and the Internet (Luukka et al. 2008, 84–85; also Kankaanranta & Puhakka 2008).

Minna-Riitta Luukka et al. (2008, 175) found that the most common activities for adolescents were chatting (72% used often), surfing websites (66%) and using email (51%); blogs and individual homepages were less frequently used, as only 6% of students used both of them often. The results also showed that students mostly used computers at home, especially for email, chatting and playing games (Luukka et al. 2008, 163).

Noppari et al. (2008, 90) had similar findings. In their study of 14-year-olds, 92% reported that they used search engines as well as email (92%), and 58% used social spaces (such as Finnish IRC-gallery or Myspace), messenger and discussion boards. However, they

noticed that only a few 11- and 14-year-olds read or wrote emails every day, even though they had an email address. They suggested that the popularity of email had decreased among students, because alternative options, such as Messenger or Facebook, had replaced them. (Noppari et al. 2008, 86; also Herkman & Vainikka 2012b, 17; Luukka et al. 2008, 169.) This observation is supported by the results of Meri-Tuulia Kaarakainen et al. (2013, 25). In the data they collected in 2012, the most frequently used activities were surfing on the Internet, social media (e.g. Facebook, Google+, Twitter), listening to music, watching videos (on YouTube or Vimeo) and contacting others with messenger or IRC (also Herkman & Vainikka 2012b, 23). In addition, Uusitalo et al. (2011) compared the change of media use from 2007 to 2011. The sample consisted of only 60 children, but it was a longitudinal study, so change among the same children could be seen. They found that in four years, the offerings of digital games as well as the popularity of Facebook and other social media had increased. The use of media was linked to their real life: the same friends, hobbies and interests existed online as well as offline. (Uusitalo et al. 2011, 3, 41.)

The popularity of social media was evident also in a study by EU Kids Online (Livingstone, Ólafsson & Staksrud 2011, 1, 3), which reported that 84% of Finnish 13–16-year-olds used some social networking site, most often Facebook. The average among all participating countries was 77%. In comparison to other Nordic countries that participated in that study, in Sweden it was 81%, in Denmark 89% and in Norway 92%. The number of underage users (according to Facebook's age restriction; in the EU Kids Online study 9–12-year-olds) was highest in Denmark (58%). In addition, writing blogs had also become more common among adolescents. According to EU Kids Online study, 27% of Finnish 13–16-year-old girls wrote blogs and 9% of boys did so (Kupiainen et al. 2011, 54). However, the most common activities seemed to have changed little in ten years, as the data of the EU Kids Online study, gathered in 2010, reported that the most common activities were playing games (83% of Finnish 9–16-year-olds), watching video clips online (79%; cf. having fun by browsing) and social networking (62%; cf. discussion possibilities). However, in this international study, using the Internet for schoolwork was one of the most common activities, even in Finland, where 85% of adolescents used the Internet for school. (Kupiainen 2010; Livingstone, Haddon et al. 2011, 14.)

The existence of different possibilities direct the ICT use of adolescents. For example, in 2000 the possibilities for social media were very different than they were, for example, in 2013. Facebook, which in 2013 had approximately 1.1 billion active users (Yle 2013), became available worldwide as late as 2005, and since then its increasing popularity among adolescents can be seen in the growing number of users as well as in their widening age range (Uusitalo et al. 2011, 93). The attraction of Facebook is that it combines different aspects in one location. Among other things, it is a social meeting point and a place for sharing with many people at the same time, a personal chatroom, a game and contest platform and a

place for advertisements (also Uusitalo et al. 2011, 93). The growth of social media has encouraged adolescents to publish content on the Internet. According to Uusitalo et al. (2011, 4–5; see also Kangas & Cavén 2011, 12), most of the children that participated in their study posted on or downloaded something from the Internet, such as updating their Facebook status or commenting on a friend’s post, or even made their own funny versions of games or television programmes, and shared those with their friends. Sonja Kangas and Outi Cavén-Pöysä (2011, 12) make an apt remark and call this purpose “see and be seen”. The decision to post depends on many factors: the need to protect one’s privacy, the individual’s skill level, feedback on previous posts and more (Uusitalo et al. 2011, 5).

Satisfaction with the content of the Internet seems to vary based on age and the country where adolescent lives. To compare, almost 60% of adolescents in Belgium think that “there are lots of things on the Internet that are good for children of my [his/her] age” and only 40% think that “there are things on the Internet that people about your [his/her] age will be bothered by in any way”; in Norway just over 20% find good things and almost 90% find some content to be upsetting. In Finland, the answers were almost at the average of all countries (approximately 40% and 50%, respectively). (Livingstone, Haddon et al. 2011, 15.) In the EU Kids Online study, Finland was categorized as a country of “higher use, some risks”. All in all, it seems that the higher the use is, the more risks there are. However, more ICT skills does not mean fewer risks, because the more skilful are likely to experiment more and encounter a greater range of Internet content. However, having good ICT skills, especially ICT literacy skills one might say, may reduce the harm experienced from the risks of the Internet. (Livingstone, Haddon et al. 2011, 3, 43.)

5.2 ICT use and reading literacy proficiency

The increasing popularity of home computers has raised many questions about, for example, the relationship between ICT use and reading literacy. Using ICT seems to motivate students (e.g. Chandler-Olcott & Mahar 2003b; Mohammed 2002), and some research has shown a positive relationship between ICT use and achievements. Based on previous studies, the quality of the relationship varies (see Bruce & Hogan 1998). Some have seen the destruction of traditional literacy (e.g. Birkerts 1996), but many also see the stability and new possibilities of texts even though the media change (e.g. Cope & Kalantzis 2000; Nunberg 1996; Reinking et al. 1998). For example, Herkman and Vainikka (2012a, 29) stress that the digital revolution is not the end of reading literacy, but that it means more variety in reading materials and environments.

The bottom line in this debate is what we consider to be educationally worthy. Donna Alvermann (2011, 547) points to Shelley Xu’s (2004) research and notes that “popular cul-

ture and literacy materials (whether print-based, multimodal, digital, or hypermediated) that can be integrated into meaningful hybrid curricula appear to stand a better chance of being considered educational worthy than materials that lack this integrative element". Several studies show that so-called transfer of learning can be bi-directional in flow or even blurred. A gamer may start reading the printed books behind the game plot and the development of a website may turn into an e-zine, an Internet-based fan-magazine (Alvermann 2011; Uusitalo et al. 2011, 74). Leu et al. (2009) found in their study no significant correlation between a measure of offline reading and online reading. In that study, there were children with a high level of literacy in both online and offline reading, and then there were children which succeeded in one but did poorly in another (see also Leu et al. 2007).

The results of the Second International Adult Literacy Survey (SIALS) in Finland showed that active and versatile users of computers are not only the best but also the most active readers (Linnakylä, Malin, Blomqvist & Sulkunen 2000, 96–100). Additionally, Luukka et al. (2001) observed that traditional media and new media can work side by side. This interaction was evident especially with boys between the ages of 17 and 19: at those ages the most active gamers were also active readers of books (Luukka et al. 2001, 264). Respectively, those who own lots of books also produce more content on the Internet than those who have fewer books (Herkman & Vainikka 2012b, 33). In addition, research has shown that emphasized media literacy instruction can improve reading comprehension, especially in the ability to identify main ideas, purposes and target audiences (Hobbs & Frost 2003; see also Leu et al. 2009, 266).

Various studies have reported that the perceived ability to use computers correlates with the PISA reading scores, but the effect of computers on student achievement depends on the specific ways in which the computers are used (Bussière & Gluszynski 2004; Fuchs & Woessmann 2004; Leino 2002; OECD 2006). Performance increased especially with the frequency of the use of the Internet and electronic communication (Fuchs & Woessmann 2004; Leino 2002; Sweet & Meates 2004), but programming, along with using educational software and spreadsheets, seemed to have a negative relationship to reading (Leino 2002; Sweet & Meates 2004). An international digital reading assessment in PISA 2009 showed that the students with the lowest scores were those who did not use computers at home for school tasks, but those who actively did so scored almost as low. In addition, reported computer use at school had a negative relationship to digital reading literacy scores. However, the difference was not so wide when students' traditional reading literacy proficiency was taken into account. (OECD 2011, 20, 185–187, 190.)

In Harold Wenglinsky's study (1998), the use of computers to teach lower-order thinking skills for eighth graders was negatively related and correspondingly the use of computers to teach high-order thinking skills was positively related to academic achievement in a study. However, the study took only mathematics into account. It did not examine teachers' tenden-

cies to use other media to teach high-order thinking skills nor did it distinguish between the effectiveness of different types of software. Studies also show that levels of computer use do not seem to matter much, but that extremely high levels of use may be counterproductive in mathematics (Fuchs & Woessmann 2004; Leino 2005; Wenglinsky 1998) as well as in reading (Leino 2002). This issue is further studied in substudies II, IV and V.

5.3 Self-confidence in reading and in ICT use

When the relationship between ICT use and reading literacy is studied, some important factors should be considered. A social perspective on literacy accounts for the substantial differences between individuals regarding, for example, their motivations, beliefs, values and goals, and the wider social context. Contextual factors clearly affecting literacy proficiency include an individual's affective propensities and their sociocultural background. In addition, the materials used and everyday experiences may have effects. (Barton 2006; Li 2011.) Of the affective propensities that influence reading literacy, the essentials are self-confidence and engagement in reading (e.g. OECD 2001). These attributes form learners' identities, which define how learners see themselves and are seen by others (Li 2011). Motivational and affective propensities are intertwined and must be considered together, even though in this study I deal with them in two chapters.

Self-confidence and self-concept beliefs are related to academic achievements: A high degree of confidence is associated with better results. In a study by the Software and Information Association (Solomon 2002, 19), it was observed that educational technologies "improve self-esteem and attitudes toward learning, especially when used in the context of collaborative learning activities". In PISA 2000, students' belief in themselves as learners in the subject of their mother tongue did not seem to have a relationship with reading test scores on an international level, which compared countries, but on the national level a strong belief in one's abilities as a learner correlated strongly with good performance on the reading literacy test. In addition, the OECD report (2006) indicated that confidence in ICT and performance in mathematics tend to go together. Indeed, Bandura (1986a) has even claimed that people's behaviour can be better predicted by their beliefs about their capabilities than by their actual accomplishments, because competent functioning requires harmony between self-belief and the skills and knowledge they possess. Self-perceptions of capability help determine what individuals do with the knowledge and skills they have (Bandura 1986a; Pajares 2002).

Confidence is the subject of substudy V and it is understood as self-efficacy, which as a concept builds on social learning theory. According to Bandura (1986b), "self-efficacy is the belief in one's capabilities to organize and execute the sources of action required to

manage prospective situations – an individual’s judgement of his or her capabilities to perform given actions”. These beliefs influence the choices people make, how they approach new tasks and what kind of outcomes they expect. Self-efficacy differs from self-concept in a way that self-efficacy is a judgement of confidence revolving around questions of *can*, such as “Can I open a file?” and “Can I build a website?”. Self-concept, on the other hand, is a cognitive appraisal, an evaluation of self-worth that reflects questions of being and feeling, such as “Do I feel that working with computers is important to me?”. (Bandura 1986b; Pajares & Schunk 2001.) Self-concept is considered in substudy II, in the index of interest in computers.

Even though self-confidence is an essential factor in motivation and is related to achievements, researchers are troubled by the chicken-and-egg question of causality (see Pajares & Schunk 2001). For example, when computer use is concerned, confident ICT users usually use computers often, and frequent use amplifies skills and confidence. In addition, even if individuals believe they are competent and efficacious in a literacy event, they may not engage in it if they have no reason or incentive for doing so. How an individual subjectively values a task, relates to that decision, and every task has a different amount of interest value, utility value, and attainment value for the individual. Subjective task values predict intentions and future engagement with literacy events. Competence beliefs, achievement values and intrinsic motivation relate positively to one another. (Wigfield 1997, 17, 20.) This view leads to a challenging situation for the teaching of ICT literacy skills, because according to Luukka et al. (2008, 84–90) students’ confidence in their ICT skills is clearly higher than teachers’ confidence in their own skills.

The self-confidence of Finnish students in computer use is discussed in substudies II, V and VI. In substudy II, it is called the index of comfort with and perceived ability to use computers. In PISA 2009, the index of self-confidence in ICT high-level tasks was formed internationally. It showed that the confidence of Finnish students in those tasks was clearly below the OECD average (index value -0.31). However, the gender difference was huge. The index of self-confidence in ICT high-level tasks for Finnish girls was -0.58 below OECD average and -0.03 for boys. The trend was similar in Sweden as well. The index of Finnish girls was the second lowest of all 45 countries that had students self-report this issue. Only girls in Japan had less faith in their abilities. (OECD 2011, 328.) Interestingly, the EU Kids Online study (Livingstone, Haddon et al. 2011, 17) reported opposite results indicating that, among the 25 European countries studied, Finnish students were the most confident in their ICT skills.

Reijo Kupiainen (2013, 131–132) reported on a study in which adolescents were asked what kind of skills they had concerning computer use. Adolescents were quite confident about their skills. They felt that with a computer they can (in order of most confident) protect personal information and online passwords, search for information online for school tasks, use word processing software, evaluate the reliability of information, edit graphics,

download pictures and videos from a website, edit web or profile pages (also Uusitalo et al. 2011, 123). The EU Kids Online study showed that as much as boys were more confident than girls in general, girls were more confident in tasks such as changing their privacy settings in social media and in preventing messages from unwanted persons (Livingstone, Haddon et al. 2011, 17).

Kangas and Cavén-Pöysä (2011) reported on data gathered in 2006–2007 from 15–29-year-olds. They found that the majority of men felt that search engines were easy to use, but a minority of women felt the same. When it came to performing more demanding tasks, such as downloading a file from the Internet, one-fifth of women felt confident doing so compared with over half of the men who expressed confidence in carrying out such tasks. Kangas and Cavén have suggested that one explanation for the difference may be that “even though a computer is an everyday tool for many, it still carries historical weight as a masculine technology, with men being the developers of machines and having a better knowledge of machines in general”. (Kangas & Cavén 2011, 11.) Luukka et al. (2008, 87) showed that boys are more confident in computer use than girls. In their study, both groups felt their skills were good in using search engines as well as in playing and using the Internet for fun. However, again the confidence was lower for demanding tasks such as creating graphics or websites.

Karakainen et al. (2013) have also studied the computer use of Finnish students. All the ninth graders in their study had a positive attitude toward learning more about ICT skills (see also Luukka et al. 2008, 87–89). The most active users (intensive users) were the most confident in their skills, whereas the most passive users had the lowest confidence in their ICT skills. There were no gender differences in students’ self-reported evaluations of their skills, but boys were keener than girls to study ICT skills and to use computers at school. (Karakainen et al. 2013, 27.)

5.4 Motivation, engagement and interest

Students like to use computers in learning (e.g. Mohammed 2002), because for them real-world experiences and hands-on tasks are extremely motivating. An integrated curriculum including reading and hands-on tasks *motivates* students to achieve better results. Patricia Alexander and Emily Fox (2011, 171) suggest, based on their literacy review, that “the keys to reading motivation for adolescents might be found in non-traditional or alternative texts processed in out-of-school settings”. In addition, there is research suggesting that the rich content of a technology environment can encourage at-risk students to participate in literacy experiences and increase their motivation to become independent readers and writers and their sense of competency (see Coiro 2007; Kamil et al. 2000).

Several studies show (e.g. Luukka et al. 2001; Noppari et al. 2008) that approximately half of the Finnish students reported reading books at least once a week. The level of student *engagement* is, according to John Guthrie and Allan Wigfield (2000), the mediating factor when factors effecting reading and performance in reading assessments are concerned. They argue that reading engagement calls for instruction that fosters student motivation (including self-efficacy), strategy use, growth of conceptual knowledge and social interaction (e.g. discussions with a teacher about Internet searches). According to Guthrie and Wigfield (2000), engagement in reading can also mean intrinsic reading motivation, which is characterized by an individual's enjoyment of reading activities and intention to participate in the literacy event when possible for its own sake. This type of motivation can be observed, for example, as losing track of time when involved in a literacy event. Engagement in reading can also be motivated by parents' support for reading (Noppari et al. 2008, 48). Opposite to intrinsic motivation is extrinsic motivation, when an individual is motivated for external reasons, such as a reward or by someone's order. Motivation and engagement can be seen as the "energy base" of learning (OECD 2001, 99). They are essential factors when lifelong learning is considered.

In the PISA framework, the concept of engagement is seen as covering two areas: reading practices and reading attitudes. These areas were examined by three sets of questions concerning time spent on reading, diversity and content of reading, and reading interest and attitudes. (OECD 2002b, 108; Sulkunen et al. 2010, 53.) The latter two are also considered in this dissertation (see Appendix 1). Engaged readers typically use many kinds of texts and they have a positive attitude towards reading. They value reading as something that offers them pleasure and knowledge. (OECD 2002b, 108.) Furthermore, reading engagement that is initially learned in one content domain can be applied to a new situation (Guthrie, Anderson, Aloa & Rinehart 1999; Guthrie & Wigfield 2000, 411). In PISA 2000, the correlation of 0.48 between engagement in reading and reading literacy scores in the assessment of Finnish students indicated that engaged readers achieve higher scores (OECD 2002b, 128).

Two important factors that can influence reading engagement are attitudes towards reading and *interest in reading*. Attitudes influence how much individuals involve themselves. In discussing interest, a distinction between individual interest (stable feelings about different activity areas) and situational interest (activity specific and less stable) can be made. According to different studies, students' interest seems to relate to the use of effective learning strategies, to the level of attention and to the comprehension of reading materials. (Wigfield 1997, 21–22.)

The results of PISA 2000 showed that about half of all 15-year-olds surveyed were generally positive about reading. In Finland the interest in reading was more positive than in OECD countries on average. In fact, the highest interest in reading was reported in Den-

mark, Finland and Portugal, whereas the lowest was in Belgium (Flemish Community) and in Korea. (Linnakylä 2002a, b; OECD 2001, 2002b.) In PISA 2009, the Finnish students' index of interest in reading was almost an OECD average (+0.05). However, the gender difference was one of the widest in all the countries, because the girls' index was +0.50 and the boys' was -0.41. (Sulkunen et al. 2010, 53.) In addition, students' attitudes towards and interest in computers were addressed in PISA studies.

Although the Finnish students' use of computers was higher than the OECD average in 2000 and 2009, the interest in computers was below the average of OECD countries in both years. In almost every country the boys were more interested in computers than girls were (Leino 2002, 169; OECD 2011, 169). This interest, however, did not seem to correlate with reading literacy scores. In 2000, the interest in computers was below average in some other countries too, as in Canada, Australia and New Zealand, which did well in PISA assessments. In some countries computers were quite new in 2000. For example in Mexico the interest was high but only a fifth of students actually used a computer at least a few times a week. (Leino 2002, 169.) In 2009, the attitude had not changed. In fact, Finnish girls' interest in computers was the second lowest of all the countries that participated. Only girls in Australia were less interested in computers. (OECD 2011, 169.) In other Nordic countries the interest in computers was close to the average, although, there too, girls were less interested than boys (OECD 2011, 169).

Stating an interest in something seems to vary from country to country. This means that comparing the relationship of interest in reading to performance in assessments shows a positive relationship only within a country, not between countries. However, as time and diversity of reading were also considered, the results established the importance of reading engagement as engaged students clearly did better on reading literacy tests than those who did not show engagement. (Linnakylä 2002a, b; OECD 2001, 2002b.) Girls are, on average, more engaged in traditional reading activities than boys are (OECD 2001, 2002b; Linnakylä 2002a, b). However, boys are more interested in and comfortable with computers (OECD 2001, 2011; Leino 2002). The issue of interest in computers is discussed in sub-studies II and VI. Next, gender differences are discussed more in relation to purposes of use.

5.5 Gender differences in literacy and ICT literacy practices

Literacy activities are often gendered. Men and women might act differently, but roles are negotiated and can change. (Barton 1994, 41–42, 79–80.) Gender differences in reading are universally clearly in favour of females. On average, girls value reading more than boys and they achieve better results in reading literacy tests (Linnakylä 2002b; OECD 2001, 123–124; see also Kjellman 2002). However, this does not always mean that boys are bad

readers. For example, in PISA 2000 the Finnish boys performed better than boys in other countries did. And yet the gender gap was still large because girls did exceptionally well, finishing as the top readers of the participating countries. (OECD 2001, 123–125.)

The interest and choices of boys and girls differ according to previous studies. Boys' reported literacy choices aim at finding information and analysing it, or dealing with the business world, and girls focus on relationships, characterization and motivation. (Barton 1994, 41; Coles & Hall 2001; Millard 1997.) Marjorie Orellana (1995) found differences in writing topics. Girls tended to write portraits of friends and family, and boys wrote more action-adventure stories. This difference then can be expected to affect what the stories they read. Rosemary Hopper (2005) found that adolescents chose to read texts that their peers or family were reading. However, several studies show that the gender difference is evident: girls read printed texts dealing with fashion, romance, relationships and health, whereas boys read texts, especially magazines, dealing with computers and technology, sports and cars. However, fantasy fiction (e.g. the books of J. K. Rowling and J. R. R. Tolkien) seems to be common for both. (Hopper 2005.) These gender differences can be seen in PISA participants as interest in reading (e.g. OECD 2001, 128) as well as in interest in ICT and the purposes of its use (e.g. Leino 2002).

Several studies show that girls' and boys' needs and intentions to use the Internet do differ. Girls' self-reported use of the Internet seems to focus more often on interpersonal communication or on learning, whereas boys' purposes relate to entertainment and pleasure, such as playing games (e.g. Kaarakainen et al. 2013, 24; Kupiainen, Suoninen & Nikunen 2011, 53; Livingstone, Haddon et al. 2011; Luukka et al. 2001; Luukka et al. 2008, 87–90, 164, 170, 175–178; Mumtaz 2001; Teo & Lim 2000; Uusitalo et al. 2011, 72–73, 124; Weiser 2000). Noppari et al. (2008, 113) did find that the 14-year-old girls and boys mostly played the same games. The sample was rather small, however, so those results cannot be generalized. Suoninen (2013, 195), on the other hand, reported that Finnish sixth-grade boys most often played battle and action games, sport games, driving and flying games, and platform games. Girls of the same age most often played platform games, battle and action games, simulation games, and party and family games. Based on these findings, common for both genders were platform games and battle and action games. Suoninen (2013, 48) also found that for boys it was important and pleasing to play digital games, but it was quite meaningless for girls. Those sixth graders themselves felt that playing games was one of the most distinctive features in media use among boys and girls.

In addition, Suoninen (2013, 199) reported that, for Finnish sixth graders, the most important purposes for Internet use varied by gender. For boys, the most important purposes were watching video clips on, for example, YouTube (68% of those who answered), using social media (56%), playing games (41%), listening to the radio and music (31%), using search engines and encyclopaedias (14%), and downloading music (14%). For

girls, the most important purposes were using social media (80%), listening to the radio and music (47%), watching video clips (45%), playing games (18%), watching television programmes (using e.g. YLE Areena; 12%), and using search engines and encyclopaedias (10%). These answers clearly reveal the gender differences regarding interest in social media and in games.

According to Van Slambrouck (2000), girls use the Internet more as an aid for their daily life. They seek content that supports their offline activities. Though boys do so as well, they have, nonetheless, a tendency to use technology for technology's sake. For example, programming seems to be much more common among boys than it is among girls (e.g. Kaarakainen et al. 2013, 24).

Luke (1996, chap. 11, para. 5), however, disagrees and sees that boys' interest is not only in technological features, arguing that "males socialise around computers much as they socialise around sports". Van Slambrouck (2000, 1) also suggests that men are "more patient with the process of downloading software, while women put a premium on 'ease of use'". In addition, compared to girls' inclination, the type of information boys are looking for is characteristically pertinent to technology and institutions or companies (Teo & Lim 2000). Differences in Internet experiences (Weiser 2000), content and social assumptions about appropriate interests for young boys and girls (Healy 1998; Luke 1996) as well as differences in the medium itself (Luke 1996) seem to have an effect on gender differences in ICT usage. Interestingly, age seems to have a minor effect on such gender-based usage patterns (Luukka 2001; Weiser 2000). Gender issues are also discussed in substudies II, III, IV, V and VI.

6

Data and methods of substudies

This dissertation is based on six empirical studies. In this chapter I provide an overview of the data and methods used in them. The research questions (presented in section 1.3), data, methodological approach, and methods are summarized in Table 5 at the end of section 6.2.

6.1 Data of the substudies

The OECD's PISA survey consists of two parts: the assessment of reading literacy proficiency and the background questionnaires. The background questionnaires are directed at students and school principals. In addition, in 2009 there was a possibility to administer a questionnaire for parents, but this option was not used in Finland. In this study, national and international students' background and ICT questionnaires were used, along with students' achievement scores in reading literacy in substudies II, IV (PISA 2000), V (PISA 2003) and VI (PISA 2009).⁴

The student questionnaire consisted of general questions and international options (e.g. the ICT questionnaire). In addition, in 2000 there was also a national option used. That option derived from two questions, which are presented in Appendix 3. Those ques-

⁴ International questionnaires are available at <http://www.pisa.oecd.org>.

tions were designed for this study to complement the international questions presented in the student questionnaire. The framework of the international questionnaires was utilized when designing the choices of responses. That first, close-ended question was also repeated in the student questionnaire in PISA 2003. In 2003, there were other national questions regarding issues such as reading engagement, which is utilized in substudy V. Details about the variables included in the substudies are provided in Appendix 1.

The data for substudies I, II, III and IV were gathered in the context of the PISA survey in spring 2000. Data gathering was executed as a national option in the student background questionnaire used in the Finnish PISA survey. The number of Finnish students assessed in PISA 2000 was 4,864, constituting a representative sample of the Finnish 15-year-olds. The number of sampled schools was 155. However, in substudy I, where students gave a written response to the questions "What in your opinion are the advantages of the Internet? What are the biggest dangers or the worst problems of the Internet?", only 3,112 answers to those open-ended question were analysed because non-responses or those stating merely "I do not know" were excluded. However, there were not many answers stating "I don't know". Most of the exclusions were for non-responses. Girls accounted for 53% of these open-ended answers, whereas girls accounted for approximately 51% of the total PISA 2000 data. This question was the last one in the two-hour survey session in which students participated, which is probably the reason why there were so many non-responses. Responses written in Finnish were translated into English by a Finnish translator when they were used in publications.

The data used for substudy V were gathered in spring 2003 and it formed a part of the PISA's ICT questionnaire presented to students in 32 countries. The Finnish student sample in PISA 2003 was 5,796, but the results for reading literacy performance were available for 3,144 students due to the fact that mathematics literacy was the main domain. After excluding those with missing background information, in total 2,967 students were included in the data analysis. The sample size of schools was 197, and all schools were present also in the reduced student sample.

In substudy VI, the data were gathered in the context of PISA in spring 2009. The Finnish students' sample was 6,415 students from 203 schools, which were randomly chosen by an independent international centre of statistics. A total of 91% of the students from the sample answered the assessment. After excluding those with missing background information, 5,555 students were included in the data analysis.

In an assessment on the scale of the PISA survey, every student represents a larger group of students. Due to the complex sampling design adopted in PISA surveys (see e.g. Malin & Puhakka 2002, 224; OECD 2002a), sampling weights were applied in all data analyses to make the results representative. This process was also applied in every substudy presented here.

In substudies II, IV, V and VI, one focal variable used was reading literacy performance score. There were two kinds of estimates used for this score in the analysis of the PISA data: weighted likelihood estimates (WLE) and plausible values (PV). Weighted likelihood estimates are based on actual responses to reading literacy tasks, but plausible values are estimated also for those students who had no reading literacy tasks in their questionnaire. That is why plausible values are not optimal as scores for individuals but they instead describe the performance of the population. (Malin 2005, 46–47; Malin & Puhakka 2002, 226–227; OECD 2002a, 105–106.) The use of different estimates had a notable difference in the data of PISA 2000 and PISA 2009 when reading literacy was a major domain and all sampled students answered the reading literacy tasks, compared with the data of PISA 2003 when mathematical literacy was the major domain.

In substudies II, IV and VI, the plausible values were used, because the focus was not on individual students but on the proficiency of the different groups. However, in substudies II and VI the mean score of plausible value was used instead of the first plausible value, as in substudy IV. When examining the mean scores of different student groups, the use of mean of plausible values is possible. In substudy IV, to exam the relationship between students' multiliteracy profiles and reading literacy performance, the first plausible value in the PISA combined reading literacy scale scores (see OECD 2001) was used, because using mean scores of plausible values would give incorrect variance. This outcome occurs because weighted likelihood estimates and mean value of plausible values are more accurate estimates of a student's proficiency than a single PV-value, but when using them the variance among the student population may be underestimated.

In substudy V, the weighted likelihood estimates were used, because the aim was not to examine at the population level, but to determine relationships between the outcome variable (reading literacy score) and the background factors using statistical modelling. Therefore, the response variable was chosen to be the variable describing the performance of the same individual student, not the random numbers drawn from the distribution of scores when using plausible values.

6.2 Overview of methods

The purpose of this study was to explore the ICT literacy practices of adolescents by studying how adolescents perceive and consume the Internet, and to examine the relationship between ICT use and reading literacy. A mixed-method approach (see Creswell, Clark, Gutmann & Hanson 2003; Teddlie & Tashakkori 2003) was chosen to disentangle different perspectives. A qualitative approach produced with students' written responses was used to better understand the perceptions of students toward Internet use and to give some

additional information for the quantitative survey about the purposes and functions of ICT uses (substudy I). The quantitative approach was used to survey ICT use and confidence in skills among 15-year-old students, as well as to explore the relationship of ICT use and the reading literacy performance assessed in the PISA survey. Common to these analyses are that they can be considered as exploratory data analyses, where the basic starting point is to determine what the data uncover, not to make strong theory-based assumptions in advance. Because the data consisted of quantitative (all substudies) and qualitative data (in substudy I and for illuminative purposes in substudy III), the methods of analysis also varied. In substudies II, III, IV, V and VI, basic descriptive statistics, such as means and percentages, were used in addition to the more advanced methods described in this section. SPSS software was used for the analysis in substudies II, III and IV. MLwiN software (Rasbash et al. 2000) was used for substudy V and SAS software for substudy VI.

In substudy I, an inductive and qualitative approach was adopted to reveal students' perceptions. Students' written responses were analysed by means of the *constant comparative method* and content mapping. Data analysis involved using qualitative coding procedures (Strauss & Corbin 1994). According to the constant comparative method, analyses were performed in four stages focusing on the following: (1) close reading, (2) coding data, (3) descriptive statistics, and (4) reflection and data display. Close reading builds on the constant comparative method and corresponds to the grounded theory approach. The aim was to find types or themes that are highlighted in the data. The idea was not to draw distinctions between students, but through a grounded theory and data-driven categorization to find out how students analyse their Internet usage. Although categories originated from students' responses, sometimes concepts other than those used by students were applied as empirical generalizations. (See Huberman & Miles 1994; Strauss & Corbin 1994.) Some categories were later connected and combined into more general themes, such as how the codes "headaches" and "health" placed under the disadvantages category were combined as "physical problems".

The analysis proceeded as follows. First, all the answers were read, written and saved on the computer. Then all the answers were read a second time while taking notes and using underlining for printed texts. Next, content maps were produced to reveal the structure of students' views on the advantages and disadvantages of the Internet. After several turns of close reading, a coding scheme was developed with the help of the Atlas.ti application (Appendix 4).

In addition to close reading, a set of 400 students' responses were coded by means of Atlas.ti to identify the strongest themes and to verify the reliability of the close reading. This sample provided the quantitative data of this study. A screen shot of the atlas.ti coding is presented in Appendix 4. First, the appropriate codes were programmed into atlas.ti using the knowledge and categories formed through close reading. After coding approximately

forty answers, the codes were revised and corrected if needed. The results of coding were compared to the content maps for reflection purposes.

To make sure that 400 responses were enough to produce a representative coverage of the issues mentioned, a word count was employed for all the answers. This was also conducted with Atlas.ti. It verified the percentages of the strongest themes, because usually the same issue was mentioned only once in an answer (e.g. viruses).

In substudy II, students' attitudes toward computers were examined through two scales: their interest in computers, which was derived from students' responses to four statements, and their comfort with and perceived ability to use computers, which was derived from students' responses to another four questions. In addition a sum score of the reported computer use was formed. It was based on students' responses concerning the frequency of use of nine activities. On the basis of this sum score the students were divided into quartiles, and those who did not use computers at all were defined as a fifth, independent group. Then the reading literacy scores of these groups were compared.

In substudy III, students answered the 16 questions (see Appendix 3), where the response alternatives ranged on a 5-point scale from *never* to *several times a week*. The data were analysed by SPSS's *factor analysis* (FA) with Promax rotation (see Harman 1967) in order to find out what kind of functional purposes these activities fulfil. Factor analysis is mostly used as a tool in exploratory data analysis and for creating continuous indices (called factors) from the original questions. The basic idea is to find out whether there are simple patterns in the relationship of variables and whether observed variables could be explained by a smaller number of variables, called factors (Darlington 1997).

The most important difference between factor analysis and principal component analysis, which was used in substudy VI, is that factor analysis assumes that covariation in the observed variables is due to the presence of one or more latent variables (factors) that exert causal influence on these observed variables. Principal component analysis, alternatively, makes no such assumption. (Metsämuuronen 2009, 652, 666.) In addition, the rotation can be made with Varimax or Promax rotation. Promax-rotated components correlate and are overlapping, whereas in Varimax rotation the components are not overlapping. Promax rotation is considered to be fast, conceptually simple and therefore well-suited for large data sets. (Abdi 2003.) Explorative analysis was used instead of mere research-based categorization, because activities may serve different functions in different contexts and the component analysis could potentially indicate some uses of digital literacy that differ from the uses of traditional print literacy.

Following the general practice, the factor analysis brought out four factors (initial eigenvalues showing how well the factors can explain the variance of observed variables were >1.0 in the first three and .97 in the fourth) accounting for a total of 52% of the total variance, that is, how large a proportion of variance of all the variables can be explained by all

the factors discovered. All the variables had communalities greater than .40. Communalities show what proportion of variance of a single observed variable can be explained by the discovered factors, and very small communalities are usually removed from the analysis.

The factor analyses were also performed separately for boys and girls to find out what kinds of component structure could be traced by gender. Among girls basically the same components and functions as above were detected (lowest initial eigenvalue .96), and these four components explained 44% of the variance. Among boys, however, only three components could be found (lowest initial eigenvalue 1.0). They explained 50 per cent of the variance. Weighted data were used in this analysis. In addition, the findings based on the qualitative data of substudy I were exploited to better expound and understand the results of these quantitative analyses.

In substudy IV, hierarchical cluster analysis was used to identify homogeneous groups, or clusters, in the student data, according to the considered set of variables. Furthermore, the means obtained for reader groups' reading literacy levels and some background variables were examined. In hierarchical clustering, the clusters are formed by grouping individual cases stepwise into bigger clusters until all cases form a single cluster. Which cases group into the same cluster depends on the similarity of the variables. The appropriate number of final clusters depends on both subjective reasoning and on data properties, that is, on how many reasonably dissimilar clusters can naturally be distinguished in the data. The more dissimilar the clusters are, the more homogeneous they are internally.

There are several alternative clustering methods and similarity measures available. The method chosen here was Ward's method, and the similarity measure used was the squared Euclidean distance. Ward's hierarchical clustering method is based on within-group sums of squares. For each cluster the means for all variables are calculated, and then for each case the squared Euclidean distance to the cluster mean is estimated. At each step the number of groups is reduced by one, by combining the two groups that produce the smallest increase in the total within-group sum of squares. (Chatfield & Collins 1989.)

Based on their responses, Finnish students were grouped by cluster analysis into six distinct clusters, according to the frequency with which they read diverse printed materials and were involved in various Internet activities. This number of clusters (6) was chosen, first, by following the change pattern in the squared Euclidean distance and, second, because we wanted to identify as many distinct group-level reader types as possible in order to find relevant grounds for broadening and diversifying the reading interests of the different types of students.

In substudy V, students were asked to choose the statement that corresponds best with their confidence in ICT tasks. The questions presented to students are in Appendix 5. The alternatives were as follows: 1) "I can do this very well by myself", 2) "I can do this with

help from someone”, 3) “I know what this means but I cannot do it”, and 4) “I don’t know what this means”.

The PISA data are hierarchically structured and they contain two levels: the school level and the student level. To take advantage of the information included in the data structure and to avoid the problems of intra-class correlated variables, the multilevel modelling technique was chosen. The data were analysed with multilevel regression models (Bryk & Raudenbush 1992; Goldstein 2002), using the MLwiN software (Rasbash et al. 2000), with students as level 1 units and schools as level 2 units. In the models, the three domains of students’ self-reported confidence in ICT were the explanatory variables of primary interest, while the response variable was the students’ reading literacy performance. Besides the confidence in ICT tasks, several background variables, such as gender, socioeconomic background, the language of the school (Finnish or Swedish), cultural possessions of the family, and engagement in reading, were included in the models to control for their effects. Gender and the language of the school were dichotomous variables. For statistical models, the socioeconomic index was centred around the national mean.

Three separate models for the reading literacy performance were estimated, with 1) confidence in routine tasks, 2) confidence in Internet tasks, and 3) confidence in high-level tasks each serving in turn as the main explanatory variable. The above-mentioned background variables were all present in the fitted models. As for the ICT tasks, both linear and quadratic effects were included in the models to test and estimate the possible deviation from strict linear association. To examine the possible differences between boys and girls in the associations of reading literacy performance and the confidence in ICT tasks, interaction effects between gender and both the linear and quadratic effects were estimated.

In substudy VI, students’ reported ICT use was compared to the response variables indicating the students’ reading literacy practices, which were diversity of printed reading material, interest in reading and reading strategies. The analysis was carried out by multilevel regression model (see substudy V), using the SAS software. The explanatory variables were three principal components (see more about principal component analysis in substudy III) extracted from 13 questions regarding students’ leisure-time ICT use, presented in the PISA 2009 student questionnaire. Here it was natural to assume that the principal components correlated, thus they were rotated by the oblique Promax method.

The three components (eigenvalues >1.0) extracted were 1) *online social activities*, 2) *online searching-information activities* and 3) *playing games*. The first two were similar to those found in the international PISA survey (OECD 2011, 134, see Appendix 1). The component of online social activities accounted for 21.3%, online searching-information activities accounted for 20.9% and playing games accounted for 15.0% of total variance. The three principal components together accounted for 50.7% of total variance. Due to the correlation of the rotated components, the percentages of the separate components do not add

up to the total explained variance. It appeared that especially online social activities and online searching-information activities had a positive correlation (0.32), meaning that many adolescents do both (or neither).

Playing games was not restricted only to playing online games, but included playing any games with a computer. Grouping the students into four quartile groups by their frequency of using different activities by computer showed that generally the most active computer users played games frequently. That is why this third component was included in the examination of Finnish students. Furthermore, these three components were used to examine their relationship to reading literacy scores. In addition, the index for interest in reading and the index of self-confidence in ICT high-level tasks (see Appendix 1) were used to examine the relationship to ICT use.

The starting point for this analysis was the index of online reading activities that was formed by OECD experts for the PISA 2009 analysis. However, that analysis consisted of only six components. Those components were included in the analysis of this substudy, but also seven other components were included (e.g. playing games and downloading) to produce a wider collection of ICT use.

The summary of research questions, data and methods is presented in Table 5.

Table 5. An overview of the methodological design of the six substudies of the study

	Research task	Approach and data	Methods
Substudy I	Based on 15-year-old students' perceptions, what are the advantages of the Internet? What are the disadvantages of the Internet?	<ul style="list-style-type: none"> • Qualitative analysis of PISA 2000 data • Students' written responses to a national open question (question designed for this study) 	<ul style="list-style-type: none"> • Constant comparative method with help of Atlas.ti application • Content maps
Substudy II	What is Nordic students' interest in, and confidence and active engagement with the use of computers, as well as the relationship between computer usage and reading literacy proficiency?	<ul style="list-style-type: none"> • Quantitative analysis of PISA 2000 data • The international ICT questionnaire, students' background information and international scores in reading literacy 	<ul style="list-style-type: none"> • Descriptive statistics (means, percentages)
Substudy III	How common are certain network literacy activities for 15-year-old students? What kind of functional needs these activities fulfil? Are there any gender differences in terms of functions and usage?	<ul style="list-style-type: none"> • Quantitative analysis of PISA 2000 data • The national questionnaire with 16 items (question designed for this study) 	<ul style="list-style-type: none"> • Explorative factor analysis (with Promax rotation) • Descriptive statistics (means, percentages)
Substudy IV	What are reader profiles of 15-year-old students when traditional print literacy and network literacy activities are concerned? What is the performance level of groups in reading literacy assessment when several background variables (e.g. socioeconomic background and gender) were concerned?	<ul style="list-style-type: none"> • Quantitative analysis of PISA 2000 data • The international questionnaire of reading print literacy, the national questionnaire with 16 items (question designed for this study), the students' background information, the national scores in reading literacy 	<ul style="list-style-type: none"> • Hierarchical cluster analysis (Ward's method) • Descriptive statistics (means, percentages)
Substudy V	Are different categories of confidence in ICT associated with students' reading scores, and are there gender differences? When background variables are controlled for, how does familiarity with computers influence the reading performance of boys and girls?	<ul style="list-style-type: none"> • Quantitative analysis of PISA 2003 data • The international questionnaire about ICT confidence, the students' background information including the national questionnaire about reading engagement, the national scores in reading literacy 	<ul style="list-style-type: none"> • Multilevel regression analysis • Pearson correlations (2-tailed)
Substudy VI	In the context of Finnish students, what is the relationship of reported ICT use and reported diversity of reading print material, interest in reading and reading strategies? What is the relationship of digital reading and traditional reading proficiency according to the results of the international PISA 2009 assessment?	<ul style="list-style-type: none"> • Quantitative analysis of PISA 2009 data • The international ICT questionnaire, students' background information and the international scores in reading print and digital literacy and the national scores of reading print literacy 	<ul style="list-style-type: none"> • Multilevel regression analysis • Principal component analysis

7

Main results of substudies

7.1 Substudy I

The aim of substudy I was to explore the perceptions of Finnish 15-year-olds on the advantages and disadvantages of Internet literacy practices. The issue is important because the importance of critical reading is stressed in ICT literacy practices, but most of the studies focusing on those advantages or disadvantages are presented to adults or consist of interviews of a few adolescents. This substudy provides a more general view of the perceptions of Finnish 15-year-olds.

The results indicated that the advantages of the Internet can be placed into five categories related to information, communication, entertainment, profit, and other attributes. The almost unlimited scope and range of information available was clearly the best part of the Internet. It was possible to divide the information category into subcategories relating to the availability of information, as well as to its quality and its quantity. In addition to information retrieval, the Internet was considered as entertainment and a place for communication when maintaining social relationships, which obviously served also as a way to entertain oneself. Other good qualities of the Internet more or less support these three main functions. Responses relating to entertainment pointed out what fun and pastime possibilities the Internet has to offer, while profit referred to more serious activities or services which benefit the user, such as downloading software or finding information for school tasks. Other attributes pointed to more general factors, such as its global nature or ease of usage.

Categories of disadvantages related to information, addiction, violations, ideologies, alienation, physical problems and technical features. The main disadvantage was distribution of inappropriate material, such as pornography or bomb-making instructions. Teenagers also strongly disapproved of spreading computer viruses and other data security violations such as cracking into other people's computers or e-mail. The disadvantages were partly linked to the advantages, as when access to information was considered.

When the results are considered, what students avoided was as important as what they said. In the responses, there was a lack of critical reading regarding topics such as reliability of texts, marginalization and piracy, as well as a lack of criticism of online conversations, except the anonymity related to those conversations and data security issues, and a lack of evaluating the Internet as a place where active citizens can influence issues concerning them and society. The 15-year-old students did not express political activity, but they should have knowledge of the possibilities in order to become empowered as active members of society. In addition, what was not mentioned was bullying, a practice that still seems to be more common offline than online (Kupiainen 2010, 2).

7.2 Substudy II

The aim of the substudy II was to examine the different computer activities and attitudes stated by the 15-year-old students in four Nordic countries. In addition, Nordic students' interest in computers, as well as their comfort with and ability to use computers were reported. Gender differences were also considered. This article was produced to bring insight into the unity and diversity of Nordic students. The data of reported computer use and attitudes toward computer use were based on the student questionnaire in PISA 2000. In the Nordic countries, Denmark, Finland, Norway and Sweden used the ICT questionnaire as an international option.

The results showed that attitudes and reported computer use were very similar in all four Nordic countries. In all Nordic countries, boys were more interested in and more confident with computers than girls. The girls' interest in computers and the self-assessment of their comfort with and perceived ability to use computers was below the OECD average. The results also showed the positive relationship between moderate computer use and reading literacy skills. The correlation was similar in all four Nordic countries. Clearly the most alarming situation was with those students who did not use computers at all. They clearly performed worse than those who used computers at least occasionally. However, any background variables were not considered in this study, so the relationship can be spurious. Nonetheless, the results show the similarity of Nordic countries when adolescents' attitudes, their confidence in computer use and ICT use in their free time are considered.

7.3 Substudy III

The aim of substudy III was to examine ICT literacy activities in order to explore the purposes and functions of Internet usage. Gender differences and comparison to functions of traditional literacy were also presented. This substudy was produced to bring more insight to the ICT usage of boys and girls. This information may help to focus educational instructions on different kinds of users. It can also indicate whether the functions of ICT use differ from uses of traditional printed texts.

According to the factor analysis performed, the four main functions found for the whole population were technical entertainment, technical service, communication and participation, and searching for information. Factors formed for boys and girls separately showed how activities that among girls formed two components and presented the respective functions of technical entertaining and communication and participation were combined among boys. These results indicate that the level of technical skills has less significance regarding boys' entertainment activities than it has among girls. However, the most common functions of ICT literacy seem to be similar to the functions of traditional literacy.

The results also show that ICT literacy activities were partly common, partly gendered. The most popular activities for boys were communicating via e-mail, listening to and downloading music and other music-related activities, downloading programs, searching for information and pictures for hobbies and playing Internet games. Less than a third of active players were girls. In addition, programming was clearly a male-dominated hobby, as almost four out of five of those who reported they did some programming at least a few times a week were boys.

Girls also favoured communicative activities. They used email even more than boys did, and the next most popular use among girls – different discussion possibilities, such as chat, message boards and Internet Relay Chat (IRC) – was almost as popular among girls as among boys. The third most frequent activity for girls was participating in surveys and competitions; the fourth was searching for information and pictures for hobbies, while the fifth place was shared by two about equally popular options, namely music-related activities and finding and downloading logos and ring tones for mobile phones.

7.4 Substudy IV

The aim of substudy IV was to examine Finnish students' multiliteracy profiles from the perspective of both traditional printed reading and network literacy activities. Reader profiles were compared to scores of reading literacy assessments in light of several background

variables, such as socioeconomic background. This substudy is important for understanding the reading interests of various subgroups of students and enhancing these groups' literacy activities and skills.

Based on their responses, Finnish students were grouped by cluster analysis into six distinct clusters, reader groups. Cluster 1 consisted of *active traditional readers*, which meant students who were diversified readers of traditional printed texts (cf. "printers" in Herkman & Vainikka 2012a, 2012b). Cluster 2 contained *moderate social readers*, which referred to active readers of newspapers, magazines and email (cf. "communicators" in Herkman & Vainikka 2012a, 2012b). Cluster 3 was composed of *passive media readers*, those students who – by the Finnish standard – were less active readers. Cluster 4 was made up of *heavy digital readers*, who were very active in using the Internet. Cluster 5 was *active multiliterate readers*, who were not only active and diversified readers of traditional printed texts but also active users of various types of electronic texts. Cluster 6 was for *moderate multiliterate readers*, who frequently read newspapers, comics and magazines as well as electronic texts (cf. "mixers" and "book-hi-fis" in Herkman & Vainikka 2012a, 2012b). The clearest distinctions between the groups, in contrast, can be found – in terms of traditional reading materials – in their interest in fiction, and with respect to their Internet activities, particularly in their reported activity for downloading computer programs and music as well as for playing Internet games and using email. Newspapers, comics and magazines were read to a more or less similar extent in all reader groups.

The reader profiles varied by gender. Clusters 1 and 2, representing what might be called the more traditional literacy activities, showed a clear concentration of girls. Conversely, in Clusters 4 and 6, representing active Internet literacy and moderate media literacy, respectively, boys outnumbered girls. Interestingly, however, in Clusters 3 and 5, which were the most distinct clusters with regard to multiliteracy, the difference between the number of girls and boys was the smallest.

Students' performance on the combined reading literacy scale was significantly related to cluster type. The results showed that active traditional readers (Cluster 1) and active multiliterate readers (Cluster 5) reached the highest reading literacy level on the PISA reading literacy test. The lowest performance level was attained by the group of heavy digital readers (Cluster 4), who typically almost never read traditional fiction or non-fiction but were very active Internet users. The findings show that multiliteracy activities may contribute to high reading literacy proficiency as long as traditional fiction constitutes part of the reading material. They also suggest that various groups of students need different kinds of pedagogical and material practices to enhance their interest and proficiency in literacy practices.

7.5 Substudy V

The aim of substudy V was to examine whether gender differences in students' confidence in ICT tasks correlate to reading literacy achievements. The focus was on three different domains of confidence in ICT tasks: 1) confidence in routine tasks, such as starting a computer, playing games, or copying a file from a floppy disk, 2) confidence in Internet tasks, such as accessing the Internet, writing and sending e-mails, or downloading files from the Internet, and 3) confidence in high-level tasks, such as using a spreadsheet to plot a graph, creating a computer program, or constructing a website.

The results showed that high reading literacy performance was associated with students with high ICT confidence. This effect was stronger for boys. However, the association between reading literacy and confidence in ICT tasks was curvilinear and the effect of reported computer use varied between routine, Internet and high-level tasks. Especially the confidence in high-level tasks had a positive relationship with boys' reading achievements. The relationship between high-level tasks and reading scores was shaped like a gently sloping inverted U, with student achievement first increasing and then decreasing as the level of the confidence increases. The boys with highest confidence in high-level ICT tasks did not do as well in reading as boys with moderate confidence, but they still did better than girls when high-level tasks were concerned. Among girls, the best reading scores were achieved by those with a confidence level slightly below average, but those with the highest and lowest confidence in high-level ICT tasks performed the worst. The results show that, on average, high self-confidence in ICT tasks has a positive relationship with reading achievements and the moderate use is the most advantageous.

The background factors and the ICT confidence variables together explained between 22% and 24% of the total student variance in reading literacy performance. Thus, after controlling for the background variables, the confidence in ICT tasks explained only a few percent of the variance. The excluded effect of the background factors alone explained approximately 20% of the variance. This result means that, for example, students' attitudes and engagement in reading activities was a far more important explanatory factor. In this PISA survey, however, only reading of traditional printed literacy was tested. Self-confidence in ICT tasks might explain more if the reading of electronic texts were assessed.

7.6 Substudy VI

The aim of substudy VI was to examine the reported frequency of engaging in different kinds of ICT literacy activities found in the data of PISA 2009. Engaging in activities was compared with reading literacy practices and reading literacy proficiency. The response

variables indicating the practices were diversity of printed reading material, interest in reading and reading strategies.

In 2009, it was 94% of Finnish 15-year-old students who used computers actively at home, and 99.5% had a computer at home. Of the sample, 97% said they had computers and the Internet at school to use, but only 88% actually used the Internet at school. In fact, for example, only 31% of students browsed the Internet at school for schoolwork at least once a week. However, of students, 41% reported that at least once a week the computers were used in foreign language lessons, 33% in language-of-instruction lessons (for most their mother tongue), 30% in science lessons and 18% in mathematics lessons.

The results showed that the best reading literacy proficiency was among those students who used computers moderately. However, the frequency of using computers among Finnish students does not seem to relate to strategies regarding understanding and remembering, or summarizing. Instead, the purposes of ICT use seem to have an effect. The reading literacy performance was highest among the Finnish students who frequently used computers for online information searching activities. Those activities, contrary to playing games, had a positive relationship also to reading strategies, interest in reading and diversity of reading material. Interest in reading, as expected, had a positive effect on reading literacy proficiency. However, those Finnish students who used computers most frequently were less interested in reading. Interestingly, international results have suggested otherwise. Using computers for communication does not seem to have as clear a correlation with literacy practices and proficiency as searching for information and playing games does. These results are consistent with earlier studies as well as other substudies of this dissertation.

The data of PISA 2009 offered updated information about reported computer use and its relationship to reading literacy, but it also offered a new perspective with the data of digital reading assessment. Although Finland did not participate in the digital reading assessment, there were 19 countries (including other Nordic countries) which provide an interesting view to the relationship of reported computer use and reading literacy: proficiency in reading traditional and digital literacy was parallel, but some of the background factors seem to have a different relationship with them. The results suggest that there are some factors affecting digital reading that seem to benefit boys in particular.

8

Main findings and general discussion

As presented in this study, ICT use and especially the Internet has changed the definitions and exigencies of literacy and sufficient reading skills. In this chapter, I discuss the relationship between ICT use and reading literacy in the light of the six substudies presented above. First, I present an overview and a discussion of the results of the substudies. Then I evaluate the execution of this study, and suggest some ideas for further research. At the end, I discuss the results and thoughts presented in this study from an educational viewpoint.

8.1 The relationship between ICT use and reading literacy in this study

This study examined the reported ICT use and its relationship to reading literacy from the data provided by OECD's PISA studies. In addition, it offered a theoretical exploration of changing literacy needs and literacy definitions of the 21st century. The research was carried out through six empirical substudies, each of which handled different aspects of ICT literacy and a theoretical contribution in which ICT and traditional literacy practices were combined in a multiliteracy frame.

The first research task was to examine *what kinds of purposes and functions of use young people encountered in ICT tasks at the beginning of the 2000s*. Based on this study (substudies I and III), ICT literacy activities function for social and technical entertainment, informa-

tion retrieval, and services. In 2000, the most popular activity for 15-year-old boys and girls was communicating via e-mail. Music-related activities and downloading programs were also popular among boys. Boys were clearly more active than girls in playing games (see also Kupiainen et al. 2011, 53; Suoninen 2013, 37–38) and programming. Along with email, girls favoured other communicative activities, such as discussion possibilities (social media of that time), and participating in surveys and competitions. (Substudy III.) The most popular uses of the Internet shown in this study are similar to the ones found in other studies carried out later, such as Luukka et al. (2008) and Kaarakainen et al. (2013).

The comparison of results of substudy III to reading studies of traditional literacy (e.g. Linnakylä 1995; Kádár-Fülop 1985) showed that functions of Internet usage do resemble the uses of printed media, such as reading for entertainment or to support other activities, but some new dimensions do occur. A user's technical skills, confidence in them and attitudes toward the dangers and problems of the Internet (see substudies I and V) may have a major effect on what functions and activities the students seek and use. The ecology of reading is changing along with new tools, media and practices. Enjoyment of the written form is changing through new media to become more social (see also Herkman & Vainikka 2012a, 2012b; Uusitalo et al. 2011) as well as more technical (see also Leu 2002a). Literacy can even be experienced as a technical challenge if accessing a text requires advanced technical skills. At its best, this literacy is putting one's skills to use, but at its worst, it turns into cracking, that is, accessing information that is forbidden. ICT literacy skills and knowledge affect how, for what purposes and for what literacy functions the Internet is used.

Without proper tool literacy skills, individuals cannot access all the possibilities offered by the Internet, an important medium for adolescents to keep in touch or stand out among their peers, to improve skills or knowledge in hobbies and, overall, to function in the knowledge society (see also Uusitalo et al. 2011). ICT literacy practices of adolescents are part of their functioning in society, and they convey practices and knowledge related to individuals' social nature and cultural environment. In addition, as technology changes literacy, literacy needs change technology. For example, the need to communicate drives the development of faster, easier and more authentic communication applications.

However, as Leu et al. (2009) have noted, at some point the meaning of technology again diminishes. Has that moment already arrived? The level of technology needed clearly had meaning for computer use in the first years of the 21st century. But are the "digital natives" or "the Google generation", as adolescents of today are often called, so comfortable with computers and the skills needed that we can put aside the technical issue? At any rate, that is not the case with teachers, as Luukka et al. (2008), among others, have pointed out.

What is not seen in this study are the use of the Internet for self-expression and having influence on society. Interestingly, Kupiainen (2013, 120) has reported that, in his survey,

47% of students stated that “having some kind of influence was important”. In addition, 39% stated that “it was important to publish and share their own material”. Participating in society can, however, appear in many forms and places depending on what kind of influence students wanted to have and on whom they wanted to have it (also Kupiainen 2013, 120).

The many possibilities of social media, such as Facebook, Flickr, Twitter, YouTube or Instagram, as well as applications to help publish blogs, were developed and became popular in the second half of the first decade of the 21st century. Those are services that a study focusing on the Internet use today would not be done without, but unfortunately they did not make it even to the most recent PISA survey in 2009, because the questionnaires for that study were developed in 2007 (pretested in 2008). At that time, the popularity of those social media was not foreseen. However, they are very popular and even underage children may have profiles and use these services (see Uusitalo et al. 2011). Young children post content, such as my 11-year-old son with his friends, who record videos with LEGO characters and post those on YouTube or their Facebook pages. Social media increases the Internet use for social activities, but it also provides a place where people can publish or market their writings, videos and pictures. For example, many of my friends who write blogs advertise on their Facebook page that they have posted a new blog entry. As Noppari et al. (2008) as well as Herkman and Vainikka (2012a, 2012b) have observed, the private communication of email has given up ground to Facebook where one can communicate with many people simultaneously. The purpose of use, however, is still the same: communicating with others. Reaching such a wide audience, though, was not possible for everyone before the Internet became common.

The second task was to examine *the relationship between ICT use and reading literacy proficiency*. The results of this study show that the relationship of ICT use and reading performance was curvilinear (see substudies II, IV, V, VI; Leino 2002, 2005). This result means that the students who most actively used ICT were not the best readers and that moderate use seems to be most beneficial for reading proficiency. These results confirm the earlier results of reading literacy studies that the least active and least diversified readers of any kind of texts performed the most poorly on the PISA reading literacy test (see Leino 2002; Linnakylä 2002b; OECD 2001, 2006; Sweet & Meates 2004). This result was also confirmed in PISA 2009 (e.g. Sulkunen et al. 2010).

Interestingly, in an international comparison after PISA 2009, an index of computer use at home for leisure and of performance in print reading and digital reading (among 15 OECD countries) showed that the curvilinear relationship found among Finnish students was apparent also in other countries. However, computer use seems to have a more positive relationship to digital reading, because in print reading the least active users had, on average, higher scores than the most active computer users, but in digital reading this

was the other way round. (OECD 2011, 192.) One explanation may be that – as has been pointed out in this study – navigation skills are important in digital reading, and those skills are probably better with more active users. This finding relates to Kiili's (2012, 34) suggestion that the most effective online searchers had more time to concentrate on the content, which is an important point when a reading literacy assessment with limited time is concerned. However, Kivinen, Kaarakainen and Anttila (2014) observed that when the time is not limited in a reading assessment, those who spent a lot of time reading irrelevant information performed just as well as those who more effectively concentrated on relevant information; they simply spent more time. Moreover, there is a difference between unfocused actions while reading and thorough strategies to make meaning. Kivinen and Kaarakainen (2012, 371–372) also observed that some adolescents (especially girls) who succeeded in assessments had more transitions between documents than others, because they made notes, used links to clarify unfamiliar concepts and overall used a variety of reading strategies.

The international results of PISA 2009 revealed that 7.8% of students participating in digital assessment reached the highest level of proficiency, whereas in assessing traditional literacy on average only 1% of all participating countries reached that level. However, when only the 19 OECD countries that also participated in the digital survey were studied, the amount of best readers in print reading was 8.5%. (OECD 2011, 49, 75.) The difference is small, but shows that at least in 2009 students performed slightly better with traditional printed texts. However, because only 19 countries – countries that had IT-equipped facilities – participated in digital assessment, direct conclusions cannot be made. In addition, there are no results that compare the results of single students in both reading assessments, so this study does not confirm or contradict the results of Leu et al. (2009; also 2007) that comprehension of traditional and electronic texts is not isomorphic. However, reading literacy proficiency for traditional texts seems to relate to the reading of electronic texts in some ways. For example, the international comparison showed that attitudes towards reading, socioeconomic background and immigration had similar relationships to both dimensions of reading. (OECD 2011.) However, interest in reading explained, on average, 20% of the variance in print reading scores and 14% of the variance in digital reading scores in PISA 2009 (OECD 2011, 132).

The results of this study support earlier results that technology or the Internet itself do not increase student comprehension (Kramarski & Feldman 2000), but the effect of computers on student achievement depends on the specific ways in which computers are used (Bussière & Gluszynski 2004; Fuchs & Woessmann 2004; Leino 2002; OECD 2006; substudy IV). A moderate amount of versatile ICT use does have the most positive relationship to reading literacy proficiency (substudies IV and V).

Substudy VI showed that engaging in online searching-information activities clearly has a positive relationship to Finnish students' scores (when reading printed texts), interest in reading and to both reading strategies studied (strategies for understanding and remembering, and strategies for summarizing). The same result regarding online searching-information strategies was also found among Spanish students in a study by Gil-Flores, Torres-Gordillo and Perera-Rodríguez (2012). This result should be noted, especially when the comparison of PISA 2000 and PISA 2009 results show that, from the three aspects assessed, the reading proficiency in the aspect of retrieving information had decreased the most (Sulkunen 2012, 22). However, an international assessment of PISA 2009 showed that the relationship between searching-information activities and digital reading scores was curvilinear, meaning that moderate users performed better than most active users (OECD 2011, 135). Why the relationship is different for print reading and digital reading is an interesting question, but one which cannot be answered here. There is always the possibility of variance between countries, which cannot be tested with this data because Finland did not participate in the digital reading assessment. In addition, the results of this study showed that playing games frequently had a counter-productive relationship to print reading proficiency as well as to reading strategies for Finnish students. Using online social activities showed only a small difference in scores when reading printed texts. (Substudy VI.)

One factor explaining the above results may be the literacy practices of adolescents when using computers. Active users of high-level ICT tasks are also active readers of comics and non-fiction (Leino 2002, 177–179; substudy IV), two kinds of texts that frequently occur on the Internet. Some of these high-level users, who are eager to learn more about areas such as programming, building a website or playing certain games, are also active readers of related texts, such as printed manuals or related discussions, on the Internet (see also Uusitalo et al. 2011, 74). Those interests also provide a need to network with other peers. The variety of relationships of different uses was also noted in PISA 2009 by stating that “students who reported frequent online searching activities also read a diversity of print material more frequently, and more often reported enjoying reading” (OECD 2011, 137). However, some results also contradict that finding. Substudy VI revealed that in 2009, those Finnish students who are the most active users of ICT are the least interested in reading. Those adolescents may be inclined to spend all their time on computers, with no interest in other literacy practices. They are often “heavy users” of games and frequently engage in programming. Their ICT use seems to be too one-sided and they lack interest in reading more traditional texts (substudy IV; see also Leino 2002, 177–179), which is seen to be important, especially when reading literacy is assessed only as reading traditional printed texts. It is self-evident that, for example, one-sided programming or game playing does not strengthen high-level reading proficiency, which demands skills and knowledge

of how to critically evaluate and interpret nuances of language, how to analyse, compare and contrast information, and how to fully comprehend long texts. These skills can only be achieved through the use of diversified reading materials and engagement in reading.

The third question addressed *what kind of subcultural differences, such as gender, exist in ICT literacy practices as well as among the reading of traditional texts and what their relationship to reading performance is*. Finnish 15-year-olds are rather homogeneous in traditional reading literacy, especially when newspapers, magazines and comics are considered (see also Luukka et al. 2008, 160–161). Their reading literacy skills are the best in the world (OECD 2001, 2004). However, when examining their literacy culture from the perspective of multiliteracy activities (substudy IV), the existence of subcultural groups became evident. The most distinctive factors for different kinds of reader groups seem to relate, on the one hand, to students' interest in traditional fiction, and, on the other hand, to the more technical and entertaining aspects of modern Internet literacy, such as downloading programs and music, and playing computer games. There is also a clear difference between the literacy subcultures of Finnish girls and boys: girls clearly concentrate on more traditional reading activities than boys do (substudy IV) but more on social activities when ICT literacy is concerned (substudy III). Finnish boys, however, are more interested in the electronic, technical and entertainment aspects of literacy (substudies I, III and IV). (See also Herkman & Vainikka 2012a, 2012b; Luukka et al. 2001; Luukka et al. 2008; Uusitalo et al. 2011.) But it should be noted that in the groups of the most and the least active users as well as in that of the diversified multiliterate readers, the division by gender was minor (substudy IV).

As expected, those most active in reading traditional printed literacy, fiction in particular, were the most proficient in reading literacy when their information literacy skills in traditional literacy were assessed. However, the difference in scores was minor when compared to the group of active multiliterate readers, whose focus was on traditional print literacy as well as on ICT literacy. (Substudy IV.)

Gender differences were also distinguished in computer usage (see above) as well as in reading proficiency. In PISA 2009, international results showed that even though girls (on average) had better scores than boys in both traditional and digital assessment, the gender difference was smaller in digital reading (OECD 2011, 52–53, 207; substudy VI; see also Kivinen & Kaarakainen 2012). In fact, when girls and boys who reached the same level in traditional reading were compared, the boys actually did better in digital reading than girls (OECD 2011, 52–53, 207; substudy VI). Gender differences in affective propensities are described in the following paragraphs.

Of the affective propensities that influence reading literacy, the essentials are self-confidence and engagement in reading (e.g. OECD 2001), which in PISA studies were examined in areas of reading practices and reading attitudes. The fourth question in this study asked

about *the relationship of affective propensities, such as students' confidence in ICT tasks and interest in computers, to reading literacy proficiency.*

Attitudes and interest are important factors in ICT use. This study suggests that because boys are more confident with their ICT skills, especially when high-level tasks are considered (substudy V; also Kangas & Cavén-Pöysä 2011, 11; Luukka et al. 2008, 87), the requirements of tool literacies do not define their ICT use as much as among girls (whose literacy functions were divided into two categories: technical entertainment, and communication and participation) when engaging in ICT literacy activities for entertainment purposes was considered (substudy III). Active use of ICT clearly correlates with confidence (substudies III and V), which is no surprise.

Comparing the results of PISA 2003 and PISA 2009, Finnish students' confidence in ICT skills had increased, except when the use of spreadsheets to plot a graph was concerned. In addition, the PISA 2009 digital assessment showed that the lowest scores in digital reading were clearly with the students who did not have confidence in their ICT skills (OECD 2011, 196). In summary, although confidence in ICT tasks can explain only a few percent of variance in reading literacy, the relationship is still positive (substudy V).

But this result contradicts the fact that Finnish students, especially girls, showed interest in computers and confidence in ICT tasks that were below the OECD average (substudies II, V and VI). In fact, the latest result of PISA 2009 showed that Finnish girls had the second-lowest interest in computers among all the participating countries (substudy VI). Finnish girls, however, were the top readers in the assessments.

Uusitalo et al. (2011, 122–125) have also reported high confidence in ICT tasks. It is interesting to note that in those results students were particularly confident with Internet security issues (also Kupiainen 2013, 131–132; Livingstone, Haddon et al. 2011, 27–28), whereas students of this study considered those areas to be one of the dangers of the Internet in 2000 (substudy I). Unfortunately, security issues were not asked about in the questionnaire on students' confidence (e.g. in substudy V). Perhaps the student's confidence has improved without actual skills (in security issues) or it's possible that these issues have been under discussion at home or at school and students can deal with them better today than they could in 2000. Suoninen (2013, 78–79) observed that girls seem to be careful about things such as who they accept as a friend in social media or what they publish on the Internet. Boys seemed to be more carefree. According to Suoninen, this may be the result of parental involvement, because girls more often reported that their parents had warned them about making contact with strangers. Overall, it should be noted that Internet security issues are related to students' critical reading skills.

The results of substudy V also indicated that confidence in different ICT tasks was more positively associated with boys' reading scores than with those of girls. Especially the most technically difficult, high-level tasks were reinforcing for boys. However, also in this case

the best performers were those whose confidence was slightly above average. The most active and confident users were not the best performers in the PISA test.

The results of this study show a positive relationship between moderate use of ICT literacy activities and information literacy skills assessed by the PISA reading literacy tests. Substudy I gave more profound insight on students' information literacy practices but also on their media literacy skills as the fifth research question examined *how students evaluate the use of the Internet: What are the advantages and the disadvantages of Internet literacy practices?*

Students brought up a wide range of features concerning the advantages and disadvantages of the Internet. Access to information was considered the best advantage, but one-fifth of the students also felt that there are too many pages with inappropriate content. Advantages could be placed into five categories: information, communication, entertainment, profit and other attributes. (Substudy I.) An important aspect of this media was considered to be the possibility for and ease of social interaction (substudies I and III).

The qualitative approach (substudy I) showed that 15-year-olds can even be critical readers regarding information and media literacies. Categories of disadvantages related to information, addiction, violations, ideologies, alienation, physical problems and technical features. For many the amount of information was the best as well as the worst aspect of the Internet, because information overflow complicated the information search and also led users to websites that were inappropriate for adolescents. The most critical readers pondered social and ethical viewpoint issues, such as piracy, open information or marginalization, an approach which is stressed as an important aspect of critical literacy by, for example, Luke (2000, 74).

Kupiainen (2013, 133) reported students describing the same kinds of disadvantages in his study as the ones that were reported in substudy I. There is also a resemblance to the results of EU Kids Online study in which students were asked about risks on the Internet. The most common risk stated among Finnish 9–16-year-olds was “communicating online with people whom they have never met face-to-face”. However, half of the children viewed these experiences in a positive way. (Kupiainen et al. 2011, 55.) This disadvantage was not stated in substudy I, but some of the comments pointing to the anonymity of the participants on the Internet could be interpreted to mean the same thing. One reason that this was not emphasized in 2000 is that many forms of social media have been developed since that time. Another risk stated in the EU Kids Online study was pornography. Of Finnish students, 29% stated that they had seen sexual images on the Internet (Kupiainen 2010, 5; Kupiainen et al. 2011, 55). Inappropriate material on the Internet was also found to be the biggest disadvantage in this study (substudy I). What is alarming is that children in the Nordic countries (and in some Eastern European countries) seemed to encounter sexual content more often than children in other countries (Livingstone, Haddon et al. 2011, 23). More unusual were things such as misuse of someone's data (e.g. stealing passwords and

cheating money; Kupiainen 2010; Kupiainen et al. 2011, 56) or lack of sleep because of addiction (Livingstone, Haddon et al. 2011, 28). These trends are found to be same in the data of this study.

Students' responses reflected Bruce's reader profiles, which were presented in chapter 3. Here are some examples from the data of substudy I to illustrate these confluences, because they were evident even though these findings were not published earlier due to the limited scope of the article. These quotations illustrate how differently students evaluate the Internet. Some students clearly achieved the skills of a reader that Bruce (2000) would call *dialectical* (see Chapter 3), because they critically evaluated the contents and practices of Internet use through their own experiences:

The Internet is an excellent way to obtain information about different things. Moreover, information search is easy and fast on the Internet. As the biggest problem I find the spreading of various "negligent" things... e.g. bomb-building instructions etc. For instance small children should not, in my opinion, use the Internet without control, since the things available are not necessarily the best possible ones with regard to child's growth into a well-balanced and healthy adult, e.g. porn sites (An answer of a girl)

The best; you can communicate easier with people, information can be found on any subject, you can read newspapers, send splendid cards, spend time. Worst; someone can easier invade personal life of others, Old cultures; books, nature and live music give place to Internet. If you don't use the Internet, you are a zero; the one without possibility to use the internet every day gets easier displaced in the society. (An answer of a girl)

The responses clearly showed that the students exploit computers and the Internet in a versatile manner, but they greet them with enthusiasm as well as with suspicion. Overall, there were only a few answers that viewed the Internet as solely negative. These *dogmatic* answers (see Bruce 2000) indicated a negative attitude against developing technology in general, and respondents showed sympathy and anxiety for older cultures and people who do not want to or cannot participate in the increase of technological applications (see also "printers" in Herkman & Vainikka 2012a, 2012b). Disagreeing with Bruce's taxonomy, these few students, unlike most of the respondents, grasp the values and appreciation of artefacts (see also Herkman & Vainikka 2012a, 105–106; 2012b, 25) and affairs. Despite the side they had chosen, they went beyond details and criticized the tendencies of the industrial countries.

The bad thing is that soon the only essential thing left in the world (or at least in the high-level industrial countries) will be the uncontrolled, insidious piece of plastic that makes people numb and which masses blindly worship. All genuine, really constructive and safe things and objects such as books, the nature and spending time together etc. will be drowned under the surge of the mighty Internet and computer hype. The only positive point in that technological contraction is that it can be used for

writing. Though for that purpose we already have typewriters, which moreover make relaxing tap and clink sounds to listen to! People have managed thousands of years without the Internet. We'll manage in the future as well!!! (An answer of a girl)

However, when comparing the students' answers with Bruce's (2000) definition of competent online readers, a majority of the answers seem to reflect agnostic reading (which could be compared to "producers" or "book-hi-fis" in Herkman & Vainikka 2012a, 2012b). Although the respondents considered many features of the Internet, their answers showed some shortcomings. Few mentioned specific problems with regard to information, such as problems in determining the time of writing, or the function and relevance of images (see Bruce 2000). Instead, the students typically kept their responses at a more general level mentioning, for instance, that "you need to know how to find information" or "it may not always be reliable". Still, those answers show evaluation and some critical reflection.

Surveys are not necessarily worth participating in, unless they are absolutely official and reliable. In chatting you must watch out for impostors and you ought not to give any personal information to the net. Some links (e.g. Winnie-the-Pooh's honey trip) may encompass porn pages or other inappropriate material. Downloaded programs may contain viruses (unknown), so that the whole computer might have to be renewed. (An answer of a girl)

The best points: there you can find information for different things. You can discuss with other people, download programs, updates for games, drivers for devices and of course games by private people. Dangers: Children can go to adult pay sites, and download warez games from the net, i.e. illegal games made by companies. (An answer of a boy)

What was clearly evident in some students' answers, but not specifically mentioned by Bruce (2000), was reflection from an ethical point of view. A few students not only sought to understand political, social and historical issues but went even further to consider ethical aspects with relation to the Internet. They realized the fundamental point that the Internet is what the users make it. It is everyone's own choice, whether they use it in the right way or in the wrong way. For example, being able to download illegal material does not mean you have to do so. This action may seem harmless, but it has complex effects on copyrights and that way on the subsistence of the artist and numerous other people involved in the production. Not to mention how it encourages people to engage in other illegal actions. Still, only 2% of students mentioned ethical problems, such as downloading music illegally from the Internet. Some answers actually praised the possibilities of finding and downloading the latest music and hit game for free or gaining access to adult sex sites without thinking of the ethical aspects. Those responses reflect the latest research of the National Research Institute of Legal Policy (Oikeuspoliittinen tutkimuslaitos 2012), which showed that in Finland 71% of 15–16-year-olds had downloaded illegal material from the Internet and almost one-third did it weekly. In addition, Uusitalo et al. (2011,

5) reported responses in which students said that most of the services they use are legal, but that some of the students admitted that they use also illegal services. Herkman and Vainikka (2012b, 23) found that approximately one-third of young adults (18–30 years) said that they are not ready to pay for such content on the Internet as newspapers or magazines, television series or radio. Because ethical evaluation was evident in so few answers in this study, it is an issue that clearly needs attention in education.

Versatile information. Easy for everyone to publish and deliver information. The problem is the commercialism, as information is hard to get and equality is lost (poor people don't get information). (An answer of a boy)

On the internet there is lots of information that can be used e.g. school. It is not always easy to find information...Using information is though a bit bothering when some use the information taken from there as such, e.g. take someone else's essay. It is not fair! Most dangerous is everything doing with money. Someone can knock off my money... (An answer of a girl)

When considering the changes in literacy in the past few decades, it is obvious that the literacy needs of the 21st century are different than they were at, say, the beginning of the 1990s. Electronic communication, searching for information, playing games and downloading are now everyday literacies of adolescents. In many respects, the skills and practices needed in reading traditional printed texts are inadequate in today's literacy context. Literacy is still, of course, searching and locating information, developing an interpretation, reflecting on it, and evaluating the text. Literacy still involves making use of the same text types and genres (e.g. informative expository texts, argumentative blogs, instructions and advertisements, maps, timetables, jokes) and serves largely the same functions. The purposes of use also affect how similar the reading strategies used in ICT are compared to those used in reading a book (see Schmar-Dobler 2003). If the reading aspect only is considered, reading a novel on a computer is no different than reading a novel on paper.

What the Internet has changed is the skills and knowledge needed to access relevant information and to evaluate and use this information, which, in turn, necessitates skills and knowledge as to how information on the Internet is produced and by whom. Before reading a chosen website, for instance, the reader must be able to access the Internet and use browsers and search engines or type the right address. Then the reader must choose from several alternatives using various strategies for all of them. This process also includes, for example, understanding the meaning of the anonymity of the author, whether the text appears in a synchronous chat or on a website. This selection may, of course, have to be applied with more traditional printed texts as well, but with online reading the strategies and tools are different, because the reader can, for example, read short introductions that the search engine presents and use the Find command. Navigation and critical reading skills are emphasized with hypertexts.

Electronic texts also combine different modes of communication: seeing and listening, reading and writing, switching codes, signs and symbols, visual as well as aural, and animations, as has been evident in this study (e.g. substudy I; also Quéau 1993/1995; School librarians unveil first-ever national standards for information literacy, 1998). In this study, I have used the concept of multiliteracy, which consists of several related literacies, such as ICT literacy, media literacy, visual literacy, critical literacy, computer literacy and network literacy as well as traditional literacy of printed texts. A multiliterate person can process and transform the multimodal information which means he or she can search, retrieve, interpret, reflect and use texts, signs, pictures, videos and sounds properly in different situations and contexts. (Cope & Kalantzis 2000; Kaufmann 1993; McClure 1997; Moje et al. 2000; OECD 2001; Tyner 1998.) Multiliteracy even includes ethical evaluation of information, concerning both content and media (Quéau 1993/1995). In this study, I have defined multiliteracy as three equally important levels: tool literacies, media literacies and information literacies, which all include critical, ethical, social and cultural literacies (see section 4.4).

This study suggests that reading only electronic texts is not enough to reach a high level of literacy. Indeed, reading fiction frequently and engagement in various reading literacy activities are still the most important factors in promoting literacy skills. Computers and the Internet cannot replace these activities, but they do provide alternative reading material and modes. Versatile use supports the literacy skills and practices needed in the 21st century. One reason for this positive relationship is undoubtedly the literacy skills that reading on the Internet demands. Reading online requires not only new ways to read, but also new ways to think, perform ideas, use language and different modes and new netiquette for social and cultural interaction (Luke 1996). How adolescents really handle the skills and knowledge required for electronic texts is an interesting challenge for future research.

8.2 Evaluation of the study

At the time of PISA 2000, there were only a few previous studies concerning the relationship of ICT use and academic performance. Discussion about changes in the definition of literacy was active, but the field of concepts was confusing. At that time, the explorative approach seemed the best way to bring some clarity to the literacy perceptions and, in particular, the ICT literacy practices of the 21st century. Later, notably in 2004, some studies appeared concerning the relationship of reported computer use and reading literacy, especially in the context of PISA (e.g. Bussière & Gluszynski 2004; Sweet & Meates 2004). At that time, I had finished my related substudies, but the process of publishing was still unfinished. However, these studies do not replace but complement each other. This also holds for the later studies. For example, study of Luukka et al. (2008) complements in a

positive way the results of these substudies and also confirms some results. Indeed, when finishing this study the discussion about the relationship of ICT use and reading literacy is active from several perspectives.

Although this study deals with multiliteracy practices mostly from the perspective of Internet use, the same literacy practices are common to all the information technology products. As technology develops, computers, phones and televisions are converging. Mobile phones can receive email messages, have wireless access to the Internet and digital television enables more interactivity and even the possibility to use the television as a computer with Internet access. In addition, on television there are programmes discussing the use of computers and the Internet and tips for websites of different topics. On the Internet, alternatively, there are television guides, television programmes' own websites and often the possibility to interact with a programme by sending opinions to a live broadcast or to contact the host or producers of the programme or even possibility to watch it from a website. Even the electronic newspaper, where information is downloaded through a wireless Internet connection to a reusable sheet, has been developed and will probably be a reality for consumers in the future (see <http://searchmobilecomputing.techtarget.com/definition/electronic-newspaper>). This intertextuality demands as well as suggests that skills and knowledge of one media are the basis for others and must and can be shared.

Studying technology is always challenging, because of the rapid change in the field. When researchers begin to describe empirical evidence supporting the effects of a particular technology on an educational practice, that technology itself is changing and in some cases even becoming obsolete. For example, the popularity of email seems to be giving way to social media (see also Noppari et al. 2008, 86). Moreover, substudy III showed that the third most frequent activity for girls was participating in surveys and competitions, but Kaarakainen et al. (2013, 24) show change as those activities were not popular in their study in 2012.

Educational research is hopelessly behind technological progress not only because of the time that research takes from planning to publication, but also because of problems related to assessing the quality of ICT use in actual conditions. As Kalantzis et al. (2003) have argued, standardized tests, especially large-scale assessments, have been problematic regarding multiliteracy. Tests have not taken into consideration the collaboration and know-how it conveys. They have usually relied on memory, when in real life knowledge can be searched for from different media. (Kalantzis et al. 2003.) Such elements as collaboration in knowledge management, does not seem to be part of digital literacy assessment environment even in next PISA assessment. This validity issue is relevant in assessments because it is expected that an indicator of the assessment will describe the chosen phenomenon as well as possible. That is why when assessing ICT literacy the circumstances should resemble the real conditions. However, more interactive and authentic assessments of ICT

literacy are being developed, for example in the context of PISA studies, and with interest we are awaiting what results they will bring. Instead of standardized tests, Kalantzis et al. (2003) suggest that more importance should be paid to project assessment, performance assessment, group assessment and portfolio assessment. Those approaches are a good fit for observing and assessing ICT literacy activities and practices of small groups and are also assessments that teachers can easily use with their own class.

The strengths and the restrictions of the PISA assessment can be considered to be strengths and restrictions of the substudies presented here as well. According to OECD (2011, 23), the PISA assessment is unique because of its regularity, which allows tracking progress, its extent, which enables comparisons between countries and offers information for education policymakers, and its points of view on literacy and learning as lifelong processes and skills needed to be able to participate in society. The PISA survey offers a great possibility to gather a large, representative data set of 15-year-olds Finnish students, obtained with the high-quality sampling design of an international assessment. Collecting the data during an ordinary school day yielded a high response rate, making the non-response problem – often encountered for mail surveys especially – almost nonexistent. The PISA survey also employs carefully field-tested questions and the student background questionnaires (see OECD 2001) and strong methodological knowledge nationally and internationally. Overall, the large amount of data, either qualitative or quantitative, offers accurate and reliable results on reading literacy and enables the results to be generalized.

Some restrictions were set by the data itself as only printed reading literacy performance was assessed in PISA 2000 and 2003. The digital reading performance was assessed in only PISA 2009 in 19 countries, and Finland was not one of these. That study gave a new perspective on this study, but it also confirmed that many earlier results concerning the relationship of reported ICT use and traditional reading literacy were valid also when examining digital literacy proficiency. The missing assessment of ICT literacy activities and practices of Finnish students in actual conditions is clearly one limitation of this study.

When I started this study in 2000, the first-round process of the PISA survey had already started. On short notice, I planned the national questions to be added to the students' ICT questionnaire of PISA. In general, survey questionnaires are easily too vague or not extensive enough. That was the case, to a certain degree, in this study as well. Although the PISA frame enabled the inclusion of the national questionnaire, that questionnaire was attached to the rather large background questionnaire and all the national options added had to be answerable in a certain time. For that reason, mostly questions assessing students' opinions and frequencies of use were able to be included. It was impossible to include, for example, all the possible uses of computers. Time restriction made it possible to include only one short, open-ended question with the student questionnaire. As it is, there was no sense in making a questionnaire that would have been too long to answer in a given time or too

burdensome so students would have lost the motivation and focus to answer. In addition, I later realized that some of terms I used (e.g. *keskustelukanava*; in English discussion possibilities referring to chat, IRC and message boards) perhaps had different meanings for different students. When planning the questionnaire, all the most common activities were considered and terms were chosen according to the best knowledge of that time. However, technology and what is popular among young people may change faster than the process of putting international assessment into practice, not to mention the time that writing and publishing the substudies have taken. At the time of gathering the data in 2000 and 2003, things like Facebook were unknown, but today they are an essential part of Internet use.

On the background questionnaire the focus was on both traditional reading of books and other printed materials, such as newspapers and comics, and a range of Internet activities. However, responses presented the self-reported – not observed or interviewed by researcher – diversity and the frequency of students' encounters with various reading materials in their free time. Self-reported answers may always have some bias because responses might reflect the points of view that respondents think the research wants. They may respond based on what they think or feel is desired in that context. For example, they may overstate the time spent on some activities if they feel they actually should do that more based on the expectations of society. This raises questions about the actual skills in use, such as with spreadsheets, compared to self-evaluated skills. It also raises questions about reported interest in computers. Perhaps computers are too common and they have lost their novelty value in Finland, so that statements measuring the interest in computers did not describe the attitudes of Finnish students. For example, the statement *It is very important to me to work with a computer* may evoke thoughts like "No, it's not especially important, it's more like everyday and obvious". Those students who have always had computers at home may not even be able to think about alternative ways of doing things. For example, contacting friends with electronic communication may be very important to them. However, students who have only recently gained this possibility may value it more and recognize its importance more when they compare it to the time before they had that possibility.

This study took qualitative and quantitative approaches to ICT literacy activities and practices of adolescents. By using different approaches and methods in substudies, this research builds on the strength of each type of method and minimizes the weaknesses of a single approach. A mixed method approach to evaluation increases both the validity and reliability of evaluation data. (Creswell et al. 2003; Frechtling & Sharp 1997, chap. 1.; Teddlie & Tashakkori 2003.)

ICT use and its relationship to reading literacy are explored from the perspective of Finnish 15-year-olds as a group, not in terms of activities or practices of individual students. This perspective is one reason why the quantitative approach has received more emphasis.

The quantitative approach is often used to examine trends and tendencies, which was the case also in this study as some comparisons between different subgroups and PISA rounds were made. For a more individual examination, a more qualitative approach would be needed, and it was not possible using the chosen data. The data were quantitative because the student questionnaire was restricted to only one open-ended question, and the ICT questionnaire was, both as international and national options, built as a quantitative survey. The advantage of the survey is that a large group of participants can be studied. It also enables repeating the same study with the same questions in the same way. In this scale, this approach was undoubtedly the only choice because the interviews or observations would have been impossible to conduct. In addition, interviews would not have eliminated the bias in students' self-reported actions and attitudes.

In this study several different quantitative methods were used which set demands for methodological knowledge, but their use also enabled the versatile consideration of different variables influencing reading literacy and ICT literacy. These methods were well-suited for large-scale assessment with a representative sample of 15-year-old students. Statistical modelling, which was used in substudies V and VI, is not common in literacy research, even though it is used widely across different subject matters and branches of science. This lack can be seen how, for example, in the *Handbook of Reading Research, Volume III* (Kamil, Mosenthal, Pearson & Barr 2000) and in the *Handbook of Reading Research, Volume IV* (Kamil, Pearson, Moje & Afflerbach 2011), there is only one article in each that discusses the use of statistical modelling in literacy research. However, statistical modelling has been used to establish the viability of potentially important variables and constructs, to identify relationships and causal conclusions, and to estimate the amount of error in results of observations and how to minimize those errors. It is a good tool to identify the constructs of reading literacy and to understand the relations of those constructs. Using statistical models may give ideas about what background factors count the most for strong performers, and building on that point, how to improve teaching and engagement with reading literacy. (Schatschneider & Petscher 2011.) Chris Schatschneider and Yaacov Petscher (2011, 63) even state that "every literacy researcher should have statistical modelling in their methodological toolbox as one of the useful means by which questions in literacy can be answered".

However, there are limitations in using statistics, as discussed above, and statistical models. One of the limitations of statistical models, as identified by Schatschneider and Petscher (2011, 63), is that they rest upon certain assumptions that can be presented in a mathematical way. Assumptions are related to the substance of phenomenon that is the focus of the research. These assumptions can include for example, how different groups are divided according to some variable. However, it is a researcher who decides which constructs are included in a model (e.g. weights on data, explanatory factors, use of weighted likelihood or plausible values etc.), not the model itself.

Another limitation relates to the fact that statistical models deal only with numbers (or categories). This limitation informs the questions that can be asked and answered. (Schatschneider & Petscher 2011, 63.) That is a common limitation of all quantitative research.

The third challenge is often faced in interpreting the results. Schatschneider and Petscher (2011, 56–57) point out that, in the end, it is the researcher who draws the conclusions. A statistical model may show correlations, but before causation can be reported different kinds of models and constructs must be tested. This requirement is why more complex analysis is needed to reveal how much of the variance the chosen factor can explain and what are the other factors that may have an influence on the relationship. Statistical modelling is a multiphase process, in which different models are studied with different combinations. (Schatschneider & Petscher 2011, 63–64; see also Malin 2005, 154–155.)

The qualitative approach was added to the study to bring more in-depth information with the voices of students about the attitudes that adolescents take toward the Internet and how they perceive their Internet use. Open-ended questions were not planned to measure students' critical literacy, which affected the depth of the analysis. Connections between students' critical literacy skills and their responses were noticed only later when students' responses highlighted the importance of critical literacy as part of ICT literacy practices. Because the questionnaire was designed to explore students' perceptions of the Internet, close quantitative analysis at the level of critical reading was not reasonable. However, participation in nation-wide assessment gave an excellent possibility to survey the ICT literacy practices of 15-year-olds in Finland with great variation in the answers and enabled some discussion about critical aspects in students' responses. At the same time, this whole subject is so vast that in the future, to deepen the knowledge gained, especially from this kind of qualitative substudy, the use of interviews and observation would be advisable. The number of respondents would be smaller, of course, but an interactive dialogue with them would give richer responses than these simple questions.

In large-scale studies, on the one hand, the challenge of the open-ended questions is the coding of responses. The same idea can be presented in different words and to a different degree of accuracy. Closed questions, on the other hand, are quite easy to alter for usable data, but the answer is also restricted in advance for some choices which may or may not be suitable to the respondent's situation. The advantage of open-ended questions is clearly that it "permits the respondents to answer in his or her own words". (Visser, Krosnick & Lavrakas 2000, 237–238.) In this study, the responses to open-ended questions were coded by the means of Atlas.ti application. Once again, it was ultimately the researcher's decision about what answers fall under certain categories, and that is why the coding was rechecked after coding a small amount of answers. Students' own words brought important insight to the subject and were also used to illustrate statements, but sometimes vague answers were difficult to categorize.

Content-specific examination was materialized through students' responses to the open-ended questions. Responses were more superficial for some and more detailed for others. Students' responses indicated that some students had personal experience of the disadvantages, while some others clearly based their opinion on what they had heard from friends, adults or the media (see also Noppari et al. 2008, 102). These acquired opinions became apparent through utterances such as "I haven't delved into this matter...", "I wouldn't use it, but..." and "as can be read in the newspapers". Of course, this is not a surprise because attitudes and opinions are often adopted from outside sources. In most cases responses were not long and explanatory enough to draw conclusions on how thoroughly students personally had considered the aspects of the Internet. In fact, fewer than one out of ten responses stand out as being more extensive than a list of a couple of features. It is very likely that the form of the questions lead to responses that were lists. However, surprisingly few went into details such as the purpose of the texts or for whom some types of content are meant or what could be an alternative way to present something. Perhaps students would have paid attention to these things if some specific texts had been presented to them. In addition, one of the students' main concerns was focused on the harm on the individual level that hackers (also called crackers) could do to computers and the fear that they would use their bank accounts. In responses, students' fear and disapproval were present but it was not clear that they actually questioned this power that crackers use or even considered what their actions mean for the economy or services. We should also be worried about students that said there are no problems on the Internet. Were these answers due to a lack of experience or to an inability to evaluate the Internet? Noppari et al. (2008) noticed that some students did not take the problems of the Internet seriously. Children were aware of them, but most of them seem to think that they can handle the problems, such as recognizing those using false identities (Noppari et al. 2008, 101–103).

Despite the lack of assessment of authentic ICT use, this study provides new information about the literacies needed in the 21st century and confirms earlier results about the positive relationship between moderate computer use and reading literacy. It examines reading literacy from a perspective that has not been studied in Finland, especially not with data of this scale. This study can also function as a benchmark for future studies to examine the development and trends in ICT literacy activities and practices. In fact, some items of the national option of this study presented in PISA 2000 were later adopted in the student ICT questionnaire that was presented in different countries.

8.3 Further research

ICT literacy practices are a much more complex and wider issue than is taken up for discussion in this study (see Hagood, Leander, Luke, Mackey & Nixon 2003). As recent studies have indicated that ICT literacy practices, and especially some specific activities, do have a positive relationship to reading literacy proficiency, one of the key issues for future work is what kinds of texts, skills and practices teachers should lead pupils to learn. To clarify this issue, more research on the relationship between ICT use and reading literacy is needed: What is the relationship of ICT use and reading literacy skills when ICT is concerned as a source for texts and even as a place to take a test? What kind of electronic texts are the most useful for improving reading literacy skills? What are the good readers using computers for? In addition, results about the relationship of interest between reading and computer use have been contradictory. This clearly needs to be studied more to find out whether computer use affects reading printed texts. Moreover, more research is needed to understand the different skills and strategies needed in reading print compared to reading digital texts.

I also find several other related questions interesting: How do adolescents – as well as other age groups – already handle the literacy practices needed in ICT use? How do readers process hypertext? What strategies do they use to search for and evaluate texts? In PISA studies, students' abilities in different activities were self-assessed. What, then, is the actual level of skills in using, for example, spreadsheets, word processing software and Internet browsers?

It would also be interesting to study a small group of students and see how they use critical reading and different reading strategies when using the Internet in real time. Guiding questions presented in the situation to reveal information about the process and strategies, such as "Why is it like that? What do you think is the reason behind this action? What are the consequences of that action? Who will benefit and who will be disadvantaged?" would probably yield interesting and informative results. That is, observing students' actual Internet use with the help of verbal protocol analysis or the think-aloud method could be fruitful. (See e.g. Kiili 2012 for related research.) Another perspective would be to focus on gender differences, examining why boys seem to succeed better in digital reading assessments than in reading print assessments. These suggested studies and the results of this study form an excellent basis for intervention studies in order to develop good pedagogical practices. As teachers are overwhelmed with the issues they should teach, the important focus is also to transform research results into guidelines and practices.

In addition to my personal interest, Leu (2002a) suggests that research and assessment should also look at features unique to ICT, such as the speed with which an individual can locate the highest quality information available and the ability to quickly evaluate the utility of different information sources for a specific problem. Nell Duke and Joanne Car-

lisle (2011, 219–220) also express the need for the study of ICT. Indeed, assessing all these features is important in further research to better understand the ICT literacy needs, skills and practices that students have in the 21st century. As ICT is multimodal, the research into multimodality may also illuminate the subject. Carey Jewitt (2008, 362, 365) brings up some interesting questions, such as the following: What is the role of representations in thinking and learning? How is dialogue in different modes different? How are multimodality and different modes valued in school? What forms of communication are students expected to be familiar with? Some interesting research in the area of ICT use and critical reading has already been done, for example, in Finland (e.g. Kaarakainen et al. 2013; Kiili et al. 2008, 2009; Luukka et al. 2008; Uusitalo et al. 2011). Technology develops at such a speed that new evaluations and explorations of literacy culture and the needs of adolescents as well as adults are unquestionably needed.

8.4 Educational implications

This study was conducted from 2000 to 2009, in which time computers and the Internet have established their place in homes and at school. However, as almost all students nowadays use the Internet at home (OECD 2011; substudy VI), the use has changed much less at school: compared with the results from 2009 presented in substudy VI to the results of, for example, the SIALS study from 2006 (Kankaanranta & Puhakka 2008), computer use in language lessons has not changed much in Finland.

Literacy skills are not simply one stable skill, but instead they are viewed as a progressive set of knowledge, skills and strategies that are built on throughout life. In this study, reading is considered in industrialized countries where it is a bit severe to say that someone is illiterate. It is more about different levels or skills of related literacies as well as confidence in literacy practices, not so much about an absence of literacy skills. Context and sociocultural demands determine what kinds of literacies are needed. Kauppinen (2010, 222) highlights the message of several studies that what is special in new media and literacies is not anymore so much the technology itself or textual features, but rather how to use, adapt and integrate the information and how to regard the information (see also Leu et al. 2009, 265). To be able to face this challenge, literacy skills must be practiced and developed. What is needed to be literate today was not the same a decade ago and may not be enough in the future. The ability and the willingness to continuously learn new literacies are more important than knowing, for example, the current version of some program which probably is out of date next year. Students should learn to communicate in unfamiliar contexts and face unfamiliar kinds of texts without feeling alienated and excluded from them. (See also Kalantzis et al. 2003.)

Continuous change emphasizes learning to learn and problem-solving skills. Students “learn as they go” as new technologies and software emerge, and the best learners are those who can autonomously and in a self-directed way study new environments and search for information. (Kalantzis et al. 2003; Leu 2000, 2002a.) According to Kalantzis et al. (2003), the excellent learners of today and of the future will be autonomous and self-directed, flexible, possessing problem-solving skills and multiple strategies for tackling a task, and collaborative. Effective learners will be multiskilled, able to engage with different contexts of information and able to work with cultural and linguistic diversity. Literacy involves effective communication in diverse settings and with different tools. (Kalantzis et al. 2003.)

Jenkins et al. (2009, 15), however, advises against a *laissez-faire* approach, despite the fact that children and adolescents sometimes seem to be autonomous and self-directing in learning about ICT. They find three main problems in such an approach. First, young people have differing possibilities to access and participate in ICT, which may foster inequality and create a participation gap. Second, in the approach it is often assumed that young people actively reflect on their media experiences and are aware of what they have learned, which can be called transparency problem. Third, it is assumed that children can, on their own, develop ethical norms that they can use to cope online, an issue that Jenkins et al. call the ethics challenge.

The results of this study show that versatile but moderate ICT use seems to have a positive relationship to reading literacy proficiency. According to this study, diversified readers reach the highest level of reading literacy, but for different reader groups the emphasis on reading material must be different. ICT literacy practices seem to promote especially boys’ literacy skills, but although it is notable, gender is not the only sorting factor (see substudy IV). When reading different kinds of texts in different media, students learn that texts have many forms and functions. In some contexts texts are predetermined with agreed standards, but there are also texts and contexts in which combining and playing with different forms, modalities and functions is allowed. (See also Luukka et al. 2008, 61–62; Kauppinen 2010, 232.) However, how computers and the Internet are used is not insignificant. This study showed that searching for information, in particular, seems to support reading literacy skills. Moreover, different strategies are needed for different texts and media, and the lack of these skills may partly explain why finding information on the Internet is difficult for some students (see substudy I). This study suggests that good skills in assessing and evaluating texts gained in traditional reading literacy also help to process ICT literacy tasks, and vice versa. Many teachers fear integrating electronic texts as part of their teaching and they say that they do not have time to teach any more new issues, but evaluating electronic texts does benefit traditional reading literacy as well.

The use of ICT and digital texts may motivate those who consider, for example, reading a novel to be challenging. There are still some students who define reading as an activity

they participated in during their mother tongue lessons and do not include their personal reading in that definition. In addition, literacy practices at school seem to socialize mainly to school literacies, whereas out-of-school and new media practices receive less attention from teachers (Luukka et al. 2008; also Kauppinen 2010). If schools valued out-of-school literacies, that is, those things students are already doing with literacy, it would, as Donna Taylor (2004, 293) suggests, increase their sense of self-efficacy with reading and writing, and encourage them to read and write more for enjoyment as well. It is pedagogically challenging to consider teaching literacy practices from the perspective of adolescents with differing interests, needs and aims, but using literacies common to students from their free-time might promote such instruction. However, as this study shows, all students do not have to be the same kind of readers: versatile ICT users succeeded almost as well in PISA assessments as the ones who focused on printed texts, especially fiction. In addition, the use of ICT at school for various uses might also increase students' self-confidence with ICT-related tasks, and self-confidence again might promote students' interest in ICT. To note, in this study confidence in ICT tasks had a positive relationship to reading literacy. Kauppinen (2010, 167) refers to the so-called third space, which is like a mental space that allows scaffolding from known practices and contexts to new ones, a safe environment in which it is possible to compare different social practices, to practice surviving in new environments and to examine both formal and informal texts. School should be that kind of place. This is clearly an area in which the information society programme has failed: ICT is not integrated as part of everyday schoolwork and Finnish students, especially girls, are not confident in their ICT skills (see section 1.1).

This study clearly indicates that ICT literacy practices and especially online electronic texts should be part of school curricula, not only because they are part of adolescents' everyday practices but also because they support multiliteracy practices that are required later when those adolescents move on to working life. The International Reading Association (2001) stated over a decade ago that proficiency in ICT literacy will be essential to students' future literacy.

Changes in youth culture and related literacy practices are clearly bringing literacy needs closer to individuals' everyday activities. To manage and succeed among peers and society, one needs multiliteracy skills and knowledge, which means fluency with different kinds of texts and practices. The traditional content of school literacy is no longer enough to fulfil the needs of individuals and society. Especially in youth culture it is important to be able to participate in electronic communication – in this study this was emphasised especially among girls – but even more generally the needs of society are pointing in this direction, because already many official forms and applications can or even must be completed and sent electronically.

In today's society, information literacy skills are essential, including such knowledge as how to pick effective keywords for a Boolean search or how to evaluate the reliability and validity of a website. The results indicate that teachers and parents should pay special attention to guiding youngsters in the ethical and moral reflection about websites and quality of information. In other words, attention should be paid to the understandability and relevance of images, to the acknowledgement of biases, to how sources of information are indicated, to how the reputation of the author is judged, as well as to a website's primary purpose or the time of its writing (Bruce 2000, 104). It is challenging for most people to think of how we could better see the forms of prejudice, misinformation or questionable ideas (Kellner 2002) that are present on the Internet. To reinforce that process, evaluation of and discussion about language differences (cultural, subcultural, regional/national, technical, context specific etc.) and multimodal channels of meaning should be placed alongside traditional language and literacy education, as suggested by Cope and Kalantzis (2000, 6).

This study – as well as others presented here – shows that students need guidance in the use of ICT, especially in handling the vast amount of information. The basic uses of technologies are common to most adolescents, but teaching multiliteracy skills at school is necessary for students to become critical and active citizens of the knowledge society. This need exists despite the fact that students, as reported in Uusitalo et al. (2011), believed in their skills and did not expect media use or media education to be taught at school. Students do need knowledge and skills of how to produce, use and interpret electronic texts. For example, students should be taught how to design and write texts that are easy to scan on websites, so that a reader can decide if the site is worth reading more closely. These skills include, for example, presenting references and the time of writing. The same situation also holds for modes other than writing. If one knows how something is done, one is also aware that it is done and that it could be done otherwise. (Burbules 1998, 118–119.) For example, understanding how information can be modified helps students to question the information he or she comes across. Suoninen (2013, 124) reported that 62% of Finnish fourth graders and sixth graders think that it is possible to say by looking at the appearance of a website whether the site is reliable or not. That such a large number of students think this way is clearly a concern. However, having only the skills and knowledge of how something is done is not enough for traditional literacy or for ICT literacy. This means that students need to understand how meanings are constructed at the technical, media and text level and how sociocultural aspects influence each level.

Instead of teaching merely media literacy, we should also teach critical media literacy (see Kellner 2002) or better yet, critical multiliteracy, which applies a critical aspect to tool, media and information literacies. Openness, constant change and the enormous scope of information demand critical literacy so that computers and the Internet can be exploited

and used safely. Easy access and the enormous amount of information is a double-edged sword. As shown in this study, perceptions about the Internet's goodness or evilness vary according to people's experience and the intensity of their critical analysis. Technology is often seen as a mechanical tool for practical activities, but it can also be an organic, ideological tool that merges with our social, physical and psychological constructs. (Bruce & Hogan 1998; Leu 2002a.) However, critical literacy skills do not come spontaneously for most students. For example, only 2% of students in this study mentioned illegal copying, cheating in school tasks and piracy. Online reading requires instruction from the teacher in the same way that print texts do (Kymes 2005). Becoming a critical reader who consumes and evaluates is a developmental process, one that occurs through practice and social reflection.

To be able to critically reflect on the texts and images on the Internet – as well as on those in print-based texts – pragmatic, social, political, cultural and environmental knowledge are needed. Students should understand that their view is actually influenced by these factors. What they take for granted may appear differently in someone else's context where the combination of these factors varies. Critical literacy should be a necessary component of day-to-day literacy instruction and in all subject areas, not just in a single exercise. Practices should extend to the literacy of adolescents and treat high culture and low culture equally. In addition, it should be kept in mind that critical literacy does not include criticizing artefacts and perceptions that are important to students, but it promotes "critical respect for difference and inquiry into the nature and effects of media culture" (Kellner 2002, 52).

In this study, the teenagers did not show any wider interest in having social influence, despite how the Internet offers easy connections with local authorities and leaders as well as to various organizations and media channels. For example, there are websites where adolescents can launch initiatives to improve their hometown (e.g. <http://www.aloitkanava.fi/>). In the near future, even general elections may be carried out over the Internet. Are teenagers unaware of these possibilities to influence or do they simply think that they have no influence anyway? When guiding students to social activity, educators could find a communication-oriented approach useful and productive. A discourse with shared values and common positions can help to deal with diversity and different cultures, and be a breeding ground for "building citizenship and furthering social justice and democracy" (Johnson & Kress 2003, 9). Media literacy instruction may help learners to better situate themselves in their sociopolitical context (Hobbs & Frost 2003).

The deictic nature of information technology has an impact on classroom learning contexts, teacher education and public policy, which all should be elaborated with this change in mind (Leu 2000). Lankshear and Knobel (2013, 8) point out that technologies also require changes in school practices; adapting new technologies to old routines

is not enough. Fortunately, in Finland the most recent school curriculum emphasizes the integrated themes of communication and media education, and humans and technology (Perusopetuksen opetussuunnitelman perusteet 2004) and the emphasis on those is even greater in the new planned curriculum (OPH 2012, 2014a, 2014b, 2014c). Unfortunately, computer literacy and media literacy in comprehensive schools' everyday practices still often have their own courses or the teaching of them is focused on one or two subject areas (see also Kupiainen 2013). Media education at school often concentrates on movies and television along with newspapers and magazines. Although using and evaluating media and information concern almost all subjects at school, these practices are mainly taught in mother tongue and art lessons, and to some degree in foreign language classes. (See also Luukka et al. 2008; OECD 2011; Tarnanen et al. 2010.) In a study by Luukka et al. (2008, 79–80), almost half of the students said that they never used the Internet in language lessons, including mother tongue and other languages. In PISA 2009, 67% of Finnish students reported that they never used computers in mother tongue lessons and 59% said so about their foreign language lessons (OECD 2011). This low rate of use is one aspect that needs to be addressed so the modern educational environment can better meet the needs of the students as well as those of the future.

When looking at specific schools and teachers, however, the differences are significant. Even among my own acquaintances this can be seen: some children use smartboards and digital games whereas some schools do not have more than a couple of computers for the entire school. Teacher-specifically, ICT is used in different subjects, but as the results above show, not so much from the language perspective.

Kauppinen (2010) observed that curricula do clearly guide towards functional literacy, but the sociocultural approach to literacy is sporadic and disintegrated. The sociocultural approach is at its strongest in elementary instruction. In the Finnish national curriculum (i.e. Perusopetuksen opetussuunnitelman perusteet 2004), there is no connection to features typically related to sociocultural literacy, such as the support of the community, guidance of an expert or supported exploration for unknown textual worlds. In the curriculum the social use or cultural evaluation of texts is not visible. (Kauppinen 2010, 174.) It is paradoxical that teachers admit that students have good media skills but at the same time they feel that students' ability to read and write has become weaker (Luukka et al. 2008; Tarnanen et al. 2010). Is the focus on rehearsing traditional or basic reading and writing skills because teachers feel that students already have media skills that are often superior to what teachers have (cf. Jenkins et al. 2009, 15)?

Important as they are, teaching literacy should be more like teaching multiliteracy: understanding that literacy is connected, in a broad sense, to all texts and to every subject area, not to only mother tongue instruction, and that it has a strong social connection. The division into tool, media and information literacies may help to piece together the

concept of multiliteracy and share the responsibilities of teaching these different literacy aspects. However, these aspects should be seen as overlapping and taught in an integrated way. Working in integrated projects with several subject areas would also help the mother tongue teachers who complain about lack of time and say that there are not enough lessons to process and analyse all kinds of texts. And yet it should be noted that reading, interpreting and evaluating electronic texts promote the understanding of traditional print texts. Reading and exploring traditional printed texts is important, but electronic texts related to ICT literacy practices are even more a part of the everyday literacies of adolescents. The exploration of a website can, as well, improve knowledge and the use of tool literacies, media literacies and information literacies.

Computers, the Internet and the challenges related to them have become more common for everyone. Because parents were not involved in PISA 2000, there is no data for showing how much parents guided their children. However, Livingstone, Haddon et al. (2011, 110) did report that in 2010 approximately 90% of households which have 9–16-year-olds had some kind of restrictions or rules concerning the use of the Internet, such as restricted access or rules not to download images. The same amount of parents also discussed with their children about the children's online activities, one in five helped their children and more than four out of five had explained why some of the websites on the Internet are good or bad. In addition, almost three out of four had guided their children to use the Internet safely. (Livingstone, Haddon et al. 2011, 103–110.) According to Noppari et al. (2008, 169–170), the first discussions that parents have with their children about media concern separating fact and fiction. The next issue is recognising persuasive messages. In that area the focus seems to be on the persuasiveness of commercial messages. The study revealed that students do recognize clear advertisements but not the meaning of brands or using friends as a marketing network. (Noppari et. al. 2008, 169–170.)

Over two decades ago, Allan Luke (1991, 519) presented four steps as instructions for “making students active critics of cultural discourses and texts”. Those steps included the following: “(1) encouraging children at the earliest stage to contest, debate, and argue with texts; (2) comparing texts which foreground differing versions of the same events or actions; (3) altering traditional classroom talk which puts texts and teachers beyond criticism; and (4) analysing print and media texts of popular culture”. These steps can still be used as guides to critical literacy, also in the context of ICT literacy. They involve teachers and parents, who should not only supervise, but also guide in navigation and reflective discussion about websites and content. These kinds of Internet sessions can also be educational for adults, especially if the Internet is more familiar to the younger users. Getting to know the subject and recognizing what is good and bad online is the best basis for giving tips and setting rules for ICT use, because then the rules can be negotiated together and not simply dictated from above. Adults and adolescents should talk about their experiences, so

that morals and ethics develop through adolescents' own thinking, not simply by imitating adults or other role models. Software-based control is only a technical tool of supervision and should not be a substitute for conversational means. Teachers and parents have an important role in guiding teenagers to develop critical awareness, so that they become critical consumers and producers of texts and images. The values, knowledge and evaluation in one's own head and heart are the best companions when wandering through the varied textual landscape of today.

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APPENDICES

Appendix 1: Variables used in substudies

Access to books

Access to books was assessed as an estimated number of books at home (choices ranging from 'non' to 'over 500 books'), and as the frequency of borrowing books from the library (ranging from 'never or hardly ever' to 'several times a month'). This variable was used in substudy V.

Access to computers

Access to computers was assessed as students' reports on the availability of computers at home. This variable was used in substudy V.

Comfort with and perceived ability to use computers

The PISA index of comfort with and perceived ability to use computers was derived from students' responses to the following questions: How comfortable are you with using a computer? How comfortable are you with using a computer to write a paper? How comfortable are you with taking a test on a computer? If you compare yourself with other 15-year-olds, how would you rate your ability to use a computer? For the questions, a four-point scale (for first three: 'very comfortable', 'comfortable', 'somewhat comfortable', 'not at all comfortable'; for the last: 'excellent', 'good', 'fair', 'poor') was used. (OECD 2001, 225.) This variable was used in substudy II.

Computer use at home for leisure

The index of computer use at home for leisure was derived from students' reports on how often they use a computer for the following activities: 1) play one-player games, 2) play collaborative online games, 3) use e-mail, 4) chat on line, 5) browse the Internet for fun, 6) download music, films, games or software from the Internet, 7) publish and maintain a personal website, weblog or blog, and 8) participate in online forums, virtual communities or spaces. (OECD 2011, 226.) This variable was used in substudy VI.

Computer use at home for schoolwork

The index of computer use at home for schoolwork was derived from students' reports on how often they use a computer for the following activities: 1) browse the Internet for schoolwork, 2) use e-mail to communicate with other students about schoolwork, 3) use e-mail to communicate with teachers and submit of homework or other schoolwork, 4)

download, upload or browse material from the school's website, and 5) check the school's website for announcements. Higher values on this index indicate more frequent computer use at home for schoolwork. (OECD 2011, 226.) This index was used in substudy VI.

Computer use at school

The index of computer use at school was derived from students' reports on how often they use a computer for the following activities at school: 1) chat on line at school, 2) use e-mail at school, 3) browse the Internet for schoolwork, 4) download, upload or browse material from the school's website, 5) post their work on the school's website, 6) play simulations at school, 7) practice and drilling, such as for foreign language learning or mathematics, 8) do individual homework on a school computer, and 9) use school computers for group work and to communicate with other students. (OECD 2011, 227.) This variable was used in substudy VI.

Confidence in ICT tasks

Confidence in ICT tasks in PISA 2003 was derived from students' reports on the extent to which they are able to do different kind of ICT tasks (23 tasks, e.g. open a file, write and send emails, construct a web page; see appendix 5). For the each option, a four-point scale ('I can do this very well by my self', 'I can do this with the help from someone', 'I know what this meant but I cannot do it', 'I don't know what this means') was used. The different options formed three different categories used as an explanatory variable: confidence in routine tasks, confidence in Internet tasks, and confidence in high-level tasks. This variable was used in substudy V.

In 2009, students' confidence in ICT tasks was formed as an index of self-confidence in ICT high-level tasks, and it was derived from students' reports to five tasks: How well you can 1) edit digital photographs or other graphic images, 2) create a database, 3) use a spreadsheet to plot a graph, 4) create a presentation, and 5) create a multi-media presentation. As all items were inverted for scaling, higher values on this index indicate higher self-confidence. Among these items, the following three items were asked in the same way in PISA 2003 and 2009: use a spreadsheet to plot a graph; create a presentation; and create a multi-media presentation. (OECD 2011, 227.) This variable was used in substudy VI.

Diversity of reading materials

Diversity of reading materials was assessed by 5-point ordinal scale (ranging from 'never or hardly ever' to 'several times a week') questioning how often students read for enjoyment magazines, newspapers, comics, and fiction and non-fiction books. This variable was used in substudy V.

Engagement in reading

The PISA index of engagement in reading was derived from students' level of agreement with nine statements. Those questions were included to PISA 2003 as national option. Engagement in reading scale comprised of following nine statements: *I read only if I have to; Reading is one of my favourite hobbies; I like talking about books with other people; I find it hard to finish books; I feel happy if I receive a book as a present; For me, reading is a waste of time; I enjoy going to a bookstore or a library; I read only to get information that I need; I cannot sit still and read for more than a few minutes.* Attitudes towards reading were rated with a four-point scale ranging from "strongly disagree" to "strongly agree". Engagement in reading scale was based on factor analysis. The factor scores with mean 0 and standard deviation 1 were used to describe the students' engagement in reading, so that the positive values indicate higher levels of engagement. (Linnakylä 2002b; OECD 2001, 223.) This index was used in substudy V.

Enjoyment of reading activities

In PISA 2009 also the index of enjoyment of reading activities was derived from students' level of agreement with the following statements: 1) I read only if I have to; 2) reading is one of my favourite hobbies; 3) I like talking about books with other people; 4) I find it hard to finish books; 5) I feel happy if I receive a book as a present; 6) for me, reading is a waste of time; 7) I enjoy going to a bookstore or a library; 8) I read only to get information that I need; 9) I cannot sit still and read for more than a few minutes; 10) I like to express my opinions about books I have read; and 11) I like to exchange books with my friends. As all items that were negatively phrased (items 1, 4, 6, 8 and 9) were inverted for scaling, the higher values on this index indicate higher levels of enjoyment of reading. (OECD 2011, 225.) This index was used in substudy VI.

Frequency of borrowing books from library

Frequency of borrowing books from library was assessed by five-point ordinal scale ranging from 'never' to 'several times a week'. This variable was used in substudy V.

Interest in computers

The PISA index of interest in computers was derived from the students' responses to the following statements: it is very important to me to work with a computer; to play or work with a computer is really fun; I use a computer because I am very interested in this; I forger the time, when I am working with the computer. A two-point scale ('yes' and 'no') was used. (OECD 2001, 225; 2011, 225.) This variable was used in substudies II and VI.

Metacognition strategies: summarizing

The index of summarizing strategies was derived from students' reports on the usefulness of the following strategies for writing a summary of a long and rather difficult two-page text about fluctuations in the water levels of a lake in Africa: a) I write a summary. Then I check that each paragraph is covered in the summary, because the content of each paragraph should be included; b) I try to copy out accurately as many sentences as possible; C) Before writing the summary, I read the text as many times as possible; D) I carefully check whether the most important facts in the text are represented in the summary; and E) I read through the text, underlining the most important sentences, then I write them in my own words as a summary. This index was scored using a rater-scoring system. (OECD 2011, 226.) This variable was used in substudy VI.

Metacognition strategies: understanding and remembering

The index of understanding and remembering strategies was derived from students' answers on the usefulness of the following strategies: a) I concentrate on the parts of the text that are easy to understand; b) I quickly read through the text twice; c) After reading the text, I discuss its content with other people; d) I underline important parts of the text; e) I summarise the text in my own words; and f) I read the text aloud to another person. This index was scored using a rater-scoring system. (OECD 2011, 226.) This variable was used in substudy VI.

Possessions of classical culture

The PISA index of possessions related to "classical" culture in the family home was derived from students' reports on the availability of the classic literature, books of poetry and works of art in their home (OECD 2004, 309). This index is a continuous variable, and the scale was constructed so that the positive values indicate higher levels of cultural possessions (OECD 2001, 223). This index was used in substudy V.

Socio-economic status

The PISA *international socio-economic index of occupational status* was measured by the occupational status of the parents. The students' open-ended responses were coded in accordance with the International Standard Classification of Occupations (ISCO). From those responses was derived the PISA International Socio-Economic Index of Occupational Status (ISEI) which based on either the father's or the mother's occupations, whichever was higher. (OECD 2001, 221; 2004, 307). This index is a continuous variable, ranging from 16 to 90. Low values represent low socio-economic status and, correspondingly, high values represent high socio-economic status. The mean in the Finnish sample in 2000 was 50.2

and standard deviation was 16.9 (OECD average 49, standard deviation 16; OECD 2001, 139). This index was used in substudies IV and V.

In 2009 also the PISA *index of economic, social and cultural status* (ESCS) was formed, and it was used in substudy VI. This index derived from three indices: highest occupational status of parents, highest educational level of parents in years of education according to ISCED (see OECD 1999), and home possessions. The *index of home possessions* comprises all items on the indices which included questions whether students' had at home, for example, own room, a dishwasher, a DVD player, a computer and the Internet connection, and some work of art, as well as books in the home recoded into a categorical variable (0–10 books, 11–25 or 26–100 books, 101–200 or 201–500 books, more than 500 books). (OECD 2011, 223, 225.)

The PISA *index of economic, social and cultural status* (ESCS) was derived from a principal component analysis of standardized variables (each variable has an OECD mean of zero and a standard deviation of one), taking the factor scores for the first principal component as measures of the index of economic, social and cultural status. Principal component analysis was also performed for each participating country and the analysis revealed that patterns of factor loading were very similar across countries, with all three components contributing to a similar extent to the index. The imputation of components for students missing data on one component was done on the basis of a regression on the other two variables, with an additional random error component. The final values on the PISA *index of economic, social and cultural status* (ESCS) have an OECD mean of 0 and a standard deviation of 1. (OECD 2011, 225.)

Appendix 2. Related literacies

Concept	Short definition	Includes
ICT literacy	Interest, attitude and ability to use and interpret communication tools and information presented via Information and Communication Technologies. Includes computer, Internet, television, mobile phones.	Technical and cognitive proficiency, and affective propensities
Digital literacy	Interest, attitude and ability to use and interpret communication tools and information presented via digital technologies. Nowadays synonym for ICT literacy.	Technical and cognitive proficiency, and affective propensities
Computer literacy	General understanding how computers work and ability to use them.	Technical proficiency
Network literacy	Knowledge about networked information, its uses and skills to use. Focus on Internet and Intranet. Nowadays synonym for ICT literacy.	Technical and cognitive proficiency, and affective propensities
Technology literacy	Integrated process including people, procedures, ideas, devices and organization concerning technology.	Cognitive and affective proficiency
Information literacy	Search, retrieval, evaluation and use of information.	Cognitive and affective proficiency
Audio-visual literacy	Understanding, evaluation and use of visual images and sounds.	Cognitive and affective proficiency
Media literacy	Understanding, evaluation and use of verbal, graphical and audio including all media.	Technical and cognitive proficiency, and affective propensities
Critical literacy	Evaluation of information that goes further than just content level and emphasizes the socio-cultural perspective. It is about considering options.	Cognitive proficiency and affective propensities

Appendix 3. National questions in PISA 2000

54 How often on the Internet you*(Please tick one box in each row)*

	Almost every day	A few times a week	1 - 4 times a month	Less than once a month	Never
a) search for information for school?	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃	<input type="checkbox"/> ₄	<input type="checkbox"/> ₅
b) search for information for hobbies?	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃	<input type="checkbox"/> ₄	<input type="checkbox"/> ₅
c) search for information about computers?	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃	<input type="checkbox"/> ₄	<input type="checkbox"/> ₅
d) use discussion possibilities?	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃	<input type="checkbox"/> ₄	<input type="checkbox"/> ₅
e) send/receive e-mail?	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃	<input type="checkbox"/> ₄	<input type="checkbox"/> ₅
f) use newsgroups?	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃	<input type="checkbox"/> ₄	<input type="checkbox"/> ₅
g) play games?	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃	<input type="checkbox"/> ₄	<input type="checkbox"/> ₅
h) download programmes?	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃	<input type="checkbox"/> ₄	<input type="checkbox"/> ₅
i) download or listen to music?	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃	<input type="checkbox"/> ₄	<input type="checkbox"/> ₅
j) find graphics or ringtones for mobile phone?	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃	<input type="checkbox"/> ₄	<input type="checkbox"/> ₅
k) programme?	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃	<input type="checkbox"/> ₄	<input type="checkbox"/> ₅
l) make/update homepages?	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃	<input type="checkbox"/> ₄	<input type="checkbox"/> ₅
m) use services of on-line stores?	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃	<input type="checkbox"/> ₄	<input type="checkbox"/> ₅
n) pay bills?	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃	<input type="checkbox"/> ₄	<input type="checkbox"/> ₅
o) participate in competitions/surveys?	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃	<input type="checkbox"/> ₄	<input type="checkbox"/> ₅
p) study in a web-based environment?	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃	<input type="checkbox"/> ₄	<input type="checkbox"/> ₅

56. What are the advantages of the Internet? What are the biggest dangers or problems of the Internet?*(You may continue your answer to the end of the questionnaire.)*

Appendix 4. Screenshot from atlas.ti coding

The screenshot shows a text editor window with a list of numbered items. The text is in Finnish, and there are handwritten annotations in red and blue ink. The annotations are organized into a list on the right side of the page, corresponding to the numbered items.

Text in the editor:

- 11 7 18 parhaat puolet: sieltä löytyä tietoa enlaisiin asioihin. Voi keskustella toisten ihmisten kanssa mmuronda ohjelmaa, parantuksia peitelm, ajur että laitteisiin ja neuvot yksityisten ihmisten pelejä. [] Parat Lapset voivat menia aikojen maksullisille sivuille ja mmuronda metistä warez pelejä eli laittomia pelejä, jotka yritykset on tehnyt.
- 11 7 20 saa tietoa + kuvia
- 11 7 21 Pelien ja Musiikin lataaminen korvalle. Tilaaminen. Esim. Viikkeset ovat vaara.
- 11 7 25 Sieltä saa kaikkial
- 11 7 26 ""sieltä saa paljon tietoa ja sitten kun se tieto on vielä mukavaa"
- 11 7 27 musiikki sivut että saa nuotteja
- 11 7 28 En oikein tiedä. Parhaimmat keskustelukanavat. [] Sähkölaskun ja puhelilaskun nousu on ongelmia.
- 11 7 29 Vaarat on se, että lojut internetissä liian kauan ja sitten on isot laskut. [] Huonot puolet on se, että se maksaa lukkaa
- 11 7 32. Pajon monipuolista, opettavista ja viiasta sekä hauskaa tietoja, kuvia, asioita.
- 11 7 33 Sielt voi hakee tieto
- 11 7 34 (+) Saa tietoa ym. [] (+) oppu käyttämään jaremmun tietokoneita [] (-) nettipuuruus [] (-) jos netti yleisty lukkaa (esim. kaupat, posti, ym. sutyvat sinne kotonaan)
- 11 7 35 On kiva keskustella ulkomaalaisten samankäisten ihmisten kanssa. oppu englania ja oppu tutumaan ihmisiä eri maista. Sähköposti on ihmisten ja tosi tärkeä rinaulle vaarat on viikkeset ja sen sellaset. Ongelmat: aika uuhituu, ja se maksaa lukkaa.
- 11 8 3 Internetissä ei saa kertoa mitään itsestään... Ei nimeä, ei mitään. Mitää sieltä saa mieteltömästi kaiken näköistä tietoa! Se on hyvä!
- 11 8 5 Se on hyvä vehje!
- 11 8 7 mrahtem

Annotations on the right side:

- hyvä tieto: monenlaista
- hyvä tieto: saa/föytää
- hyvä: kopiointi, lataaminen hyvä: voi keskustella
- huono: viikkeset
- huono: koptilla tiedetty materiaali
- huono: laittomuudet
- hyvä: tieto: saa/föytää
- hyvä: kopiointi, lataaminen hyvä: saa musiikkia
- huono: viikkeset hyvä: verkkokokoukka
- hyvä: monipuolisuus
- hyvä: tieto: paljon
- hyvä: tieto: saat/föytää
- hyvä: saa musiikkia
- hyvä: voi keskustella
- huono: laskut
- huono: unohdas ajankulun
- huono: laskut
- hyvä: tieto: hauskaasti
- hyvä: tieto: hyödyllistä
- hyvä: tieto: saat/föytää
- hyvä: tieto: monenlaista
- hyvä: tieto: saa/föytää
- hyvä: oppi käyttämään tietokoneita
- hyvä: tieto: saa/föytää
- huono: palvelut sutyvat nettiin
- huono: koulukkaan pääminen
- hyvä: avaa koko maailman
- hyvä: voi keskustella
- hyvä: ilmaiset
- hyvä: sähköposti
- huono: viikkeset
- huono: unohdas ajankulun
- huono: laskut
- huono: yksittäilyiden merittämien
- hyvä: tieto: monenlaista
- hyvä: tieto: saat/föytää
- hyvä: tieto: saat/föytää
- huono: piratismi

Appendix 5. Question used in substudy V from the international ICT questionnaire in 2003

6 How well can you do the following tasks on computer?

(Please tick one box in each row)

	I can do this very well by myself	I can do this with help from someone	I know what this means but I cannot do it	I don't know what this means
a) start a computer game?	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃	<input type="checkbox"/> ₄
b) use software to find and get rid of computer viruses?	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃	<input type="checkbox"/> ₄
c) open a file?	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃	<input type="checkbox"/> ₄
d) create/edit a document?	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃	<input type="checkbox"/> ₄
e) scroll a document up and down a screen?	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃	<input type="checkbox"/> ₄
f) use a database to produce a list of addresses?	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃	<input type="checkbox"/> ₄
g) copy a file from a floppy disk?	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃	<input type="checkbox"/> ₄
h) save a computer document or file?	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃	<input type="checkbox"/> ₄
i) print a computer document or file?	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃	<input type="checkbox"/> ₄
j) delete a computer document or file?	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃	<input type="checkbox"/> ₄
k) move files from one place to another on a computer?	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃	<input type="checkbox"/> ₄
l) get on the Internet?	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃	<input type="checkbox"/> ₄
m) copy or download files from the Internet?	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃	<input type="checkbox"/> ₄
n) attach a file to an email message?	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃	<input type="checkbox"/> ₄
o) create a computer program (e.g. In Logo, Pascal, Basic)?	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃	<input type="checkbox"/> ₄
p) use a spreadsheet to plot a graph?	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃	<input type="checkbox"/> ₄
q) create a PowerPoint presentation?	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃	<input type="checkbox"/> ₄
r) play computer games?	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃	<input type="checkbox"/> ₄
s) download music from the Internet?	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃	<input type="checkbox"/> ₄
t) create a multi-media presentation (with sounds, pictures, video)?	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃	<input type="checkbox"/> ₄
u) draw pictures using a mouse?	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃	<input type="checkbox"/> ₄
v) write and send emails?	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃	<input type="checkbox"/> ₄
w) construct a web page?	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃	<input type="checkbox"/> ₄

FINNISH STUDENTS have proved to be excellent readers in the Programme for International Student Assessment (PISA). They are also active users of Information and communication technology (ICT). What is the relationship between computer use and reading literacy?

The relationship between ICT use and reading literacy is explored in six substudies that take a various views to the subject. This study also presents a view to the change in literacy paradigm and discusses the similarities and differences between reading traditional printed texts and digital texts providing a multiliteracy frame for literacy needs in the information society. It provides useful information to literacy researchers as well as teachers and other educators interested in multiliteracy view.

