Tampere University

TUULIKKI ALAMETTÄLÄ

Development of Online Research Skills among Lower Secondary School Students

The roles of formal instruction and personal factors

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ACADEMIC DISSERTATION
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ABSTRACT

The Internet has grown into an information resource that extends into all walks of life, and search engines have become an everyday tool for most people seeking information. For simple information needs, one need only type suitable search terms for the search engine and read the answer provided. More complex and thought-provoking questions, however, require skills in searching for, evaluating, and using information on the Web: *online research skills*. Although today's young people have been exposed to digital media from early on, this does not imply automatically becoming skilled in online research. In fact, studies show that their skills rarely suffice for completing school assignments that require independent online research.

Accordingly, research was conducted to investigate the role of formal learning and personal factors in the development of students' online research skills. The setting was a Finnish lower secondary school where in-service teachers were developing their instruction practices related to online research. After being introduced to a research-based pedagogical framework, Guided Inquiry Design, they carried out a teaching intervention to strengthen students' online research skills. A quasi-experimental pre-test, post-test, and follow-up design was used to investigate the effect of the intervention. Measurement of students' learning outcomes covered Web search, critical evaluation, and argumentative use of Web information. Teachers' experiences were investigated via interviews, with observations supporting the interview data.

The work considered students' overall development in online research skills more broadly by extending beyond the formal instruction to their skill profiles and to personal factors associated with those skills and skill development. Questionnaires surveyed students' self-efficacy beliefs related to online research, attitudes to learning, behavioural intentions with regard to online research, and information- and communications-technology activity.

Results showed that the participating teachers were able to apply a research-based pedagogical model as a source of inspiration and integrate some of its features into their teaching practices. Further, the pre- and post-intervention test results attest to a positive effect on students' online research performance. The intervention effect

was most apparent among those students who were less active in searching the Web or using social media and those with a lower sense of self-efficacy related to online research. Also, students who had a positive attitude toward traditional teacher-centred learning showed greater improvement in their online research skills. However, a follow-up test nine months later revealed that the effects of the intervention did not last long.

In the second part of the study, which focused on the students' skill profiles and the role of personal factors in the development of their online research skills, six skill profiles were identified that characterise performance in online research: information-literate, fact-finder, medium achiever, weak searcher, weak evaluator, and weak information-user. These profiles clarify the variation visible in students' skills and the challenges they face. Self-efficacy beliefs stood out as a factor clearly associated with students' online research skills. The results indicate also that positive attitudes to traditional teacher-centred learning might enhance the development of students' skills.

The dissertation contributes to pedagogy connected with online research skills. It indicates that teachers in Finland have good opportunities to apply research-based pedagogical models for increasing information literacy generally, as both the models and the Finnish national core curriculum are based on similar learner-centred conceptions. However, the results show that an individual teacher's efforts to adapt new instruction methods to everyday professional practice in the classroom may not be enough for lasting learning outcomes. The findings suggest that achieving sustainable learning outcomes calls for school-wide reform to pedagogical practices.

Furthermore, this research highlights a need to account for inter-student differences in online research skills when one is planning the instruction. Students are not a homogenous group and need targeted support. Still, formal instruction cannot fill all the gaps in online research skills. Self-efficacy beliefs stood out as the only personal factor associated with students' online research skills. Hence, boosting students' self-efficacy and encouraging them to stay positively tuned to learning overall is important.

TIIVISTELMÄ (ABSTRACT IN FINNISH)

Internet on kasvanut kaikki elämänalat kattavaksi tietoresurssiksi, ja hakukoneista on tullut useimmille ihmisille arkipäiväinen työkalu tiedon hankkimiseen. Yksinkertaisten tiedontarpeiden täyttämiseen riittää useimmiten, että osaa kirjoittaa hakukoneelle sopivan hakusanan ja lukea hakukoneen tarjoaman vastauksen. Monimutkaisempien, pohdintaa vaativien kysymysten ratkaisemiseen vaaditaan kuitenkin syvällisempiä taitoja hakea, arvioida ja käyttää Internetin tietolähteitä. Näitä taitoja kutsutaan tässä tutkimuksessa nettilukutaidoiksi (online research skills). Vaikka nuoret ovat altistuneet digitaaliselle medialle pienestä pitäen, se ei tarkoita, että heidän taitonsa toimia netissä olisivat automaattisesti riittävät. Aikaisemmat tutkimukset osoittavatkin, että nuorilla on vaikeuksia suorittaa koulutehtäviä, jotka vaativat itsenäistä nettitiedonhakua.

Tässä tutkimuksessa tutkittiin formaalin oppimisen ja henkilökohtaisten tekijöiden roolia oppilaiden nettilukutaitojen kehittymisessä. Lähtökohtana olivat opettajat, jotka kehittivät käytäntöjään nettilukutaitojen opetuksessa suomalaisessa yläkoulussa. Heitä informoitiin informaatiolukutaidon opetukseen kehitetystä pedagogisesta mallista (Guided Inquiry Design), minkä jälkeen he toteuttivat oppilaiden nettilukutaitojen vahvistamiseen suunnatun opetusintervention. Intervention vaikutusten tutkimiseen käytettiin kvasikokeellista ennen-jälkeen -asetelmaa sisältäen esi-, jälki- ja seurantatestit. Oppilaiden oppimistuloksia mitattiin tiedon haussa, kriittisessä arvioinnissa ja tiedon argumentatiivisessa käytössä. Opettajien kokemuksia kartoitettiin haastatteluilla. Haastatteluaineistojen analyysin tukena käytettiin havaintomuistiinpanoja.

Tutkimuksessa oppilaiden nettilukutaitojen kehittymistä tarkasteltiin myös muodollisen opetuksen ulkopuolelta ja perehdyttiin oppilaiden taitoprofiileihin ja henkilökohtaisiin tekijöihin, jotka liittyvät taitoihin ja niiden kehittymiseen. Kyselylomakkeilla selvitettiin oppilaiden pystyvyyskäsityksiä liittyen nettiluku-taitoihin, heidän oppimisasenteitaan, nettilukemiseen liittyviä käyttäytymis-aikomuksiaan sekä heidän tietoteknistä aktiivisuuttaan.

Tutkimustulokset osoittivat, että opettajat pystyivät käyttämään Guided Inquiry Design -mallia inspiraation lähteenä ja integroimaan joitain sen osia opetuskäytäntöihinsä. Esi- ja jälkitestien tulokset osoittivat lisäksi positiivisen

interventiovaikutuksen opiskelijoiden nettilukutaidoissa. Interventiovaikutus oli voimakkain niiden keskuudessa, jotka olivat vähemmän aktiivisia nettitiedonhakijoita, vähemmän aktiivisia sosiaalisen median käyttäjiä, tai joilla oli alhaisemmat pystyvyyskäsitykset liittyen nettilukutaitoihin. Myös oppilaat, jotka suhtautuivat myönteisesti perinteiseen opettajakeskeiseen oppimiseen, paransivat taitojaan. Yhdeksän kuukautta myöhemmin suoritettu seurantatesti paljasti kuitenkin, että interventiovaikutukset jäivät lyhytaikaisiksi.

Tutkimuksen toisessa osassa keskityttiin oppilaiden taitoprofiileihin ja henkilökohtaisten tekijöiden rooliin nettilukutaitojen kehittymisessä. Tutkimuksessa tunnistettiin kuusi nettilukutaitoprofiilia: informaatiolukutaitoiset, faktanetsijät, keskitason suorittajat, heikot tiedonhakijat, heikot arvioijat ja heikot tiedonkäyttäjät. Profiilit paljastivat vaihtelun oppilaiden taitotasoissa ja vaihtelun nettilukutaidon eri osa-alueilla. Pystyvyyskäsitykset nousivat esiin tekijänä, joka liittyy oppilaiden nettilukutaitoihin. Tulokset antoivat myös viitteitä siitä, että positiivisella asenteella perinteiseen opettajakeskeiseen oppimiseen saattaa olla vaikutusta nettilukutaitojen kehittymiseen.

Tämä tutkimus edistää nettilukutaitojen pedagogiikkaa. Tutkimus osoitti, että suomalaisilla opettajilla on hyvät mahdollisuudet hyödyntää tutkimuspohjaisia informaatiolukutaidon pedagogisia malleja. Sekä tässä tutkimuksessa käytetty pedagoginen malli että Suomen perusopetuksen opetussuunnitelma korostavat oppijakeskeistä oppimista. Tulokset paljastivat kuitenkin, että yksittäisten opettajien yritykset ottaa käyttöön uusia opetusmenetelmiä eivät ehkä riitä pysyvien oppimistulosten saavuttamiseen. Tutkimustulokset viittaavat siihen, että opetuksen tehostaminen vaatisi pedagogisten käytäntöjen uudistamista koulunlaajuisesti.

Lisäksi tutkimuksessa todetaan, että erot oppilaiden taitotasoissa tulisi ottaa huomioon opetusta suunniteltaessa. Oppilaat eivät ole homogeeninen ryhmä ja tarvitsevat yksilöityä tukea. Muodollinen opetus ei kuitenkaan voi täyttää kaikkia aukkoja nuorten nettilukutaidoissa. Pystyvyyskäsitykset nousivat esiin henkilökohtaisena tekijänä, joka liittyi oppilaiden nettilukutaitoihin. Siksi olisikin tärkeätä vahvistaa oppilaiden nettilukutaitoihin liittyviä pystyvyyskäsityksiä ja oppimisasenteita laajemminkin.

CONTENTS

List of Figures

List of Tables

ORIGINAL PUBLICATIONS

Publication I   Alamettälä, T., & Sormunen, E. (2018). Lower secondary school teachers' experiences of developing inquiry-based approaches in information literacy instruction. In S. Kurbanoğlu, J. Boustany, S. Špiranec, E. Grassian., D. Mizrachi, & L. Roy (Eds.), *Information literacy in the workplace* (Communications in Computer and Information Science, Vol. 810) (pp. 683-692). Cham, Switzerland: Springer. doi.org/10.1007/978-3-319-74334-9_70

Publication II   Alamettälä, T., Sormunen, E., & Hossain, M. A. (2019). How does information literacy instruction in secondary education affect students' self-efficacy beliefs and attitudes? In S. Kurbanoğlu, S. Špiranec, Y. Ünal, J. Boustany, M. L. Huotari, E. Grassian, D. Mizrachi, & L. Roy (Eds.), *Information literacy in everyday life* (Communications in Computer and Information Science, Vol. 989) (pp. 443-453). Cham, Switzerland: Springer. doi.org/10.1007/978-3-030-13472-3_42

Publication III Alamettälä, T., & Sormunen, E. (2020). The effect of a teaching intervention on students' online research skills in lower secondary education. *Information Research, 23*(2), paper 861.

Publication IV   Alamettälä, T., & Sormunen, E. (2021). Learning online research skills in lower secondary school: Long-term intervention effects, skill profiles and background factors. *Information and Learning Sciences*, *122*(1/2), 68-81. doi.org/10.1108/ILS-03-2020-0058

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Author contributions

Tuulikki Alamettälä operationalised the original research idea presented by her supervisor, professor Eero Sormunen, by conceptualising the idea and outlining the preliminary research plan. She contacted the school and negotiated the study arrangements there and wrote the final research plan. Alamettälä co-operated with the participating teachers at all stages of the teaching intervention, collected the data, and performed the data analysis. She wrote the paper manuscripts, made revisions of the submitted papers and authored the summary of the thesis. Professor Eero Sormunen supervised and commented on the work throughout the research process. Doctoral student Md Arman Hossain contributed to the literature review in Publication II.

1 INTRODUCTION

Literacy has always been a crucial component to active and participatory citizenship. However, literacy in its traditional sense – ability to read, write, and apply numeracy – is no longer sufficient. The Internet revolution has expanded the concept of, and the requirements for, literacy (Bawden, 2001; Leu, Kinzer, Coiro, & Cammack, 2004). Today, we need to make sense of controversial issues amid a constantly changing information landscape, and the ability to do so demands skills in *searching*, *evaluating*, and *using* information. In the field of information science, these skills have been referred to in aggregate as *information literacy* (Limberg, Alexandersson, Lantz-Andersson, & Folkesson, 2008; Kuhlthau, Maniotes, & Caspari, 2015). The concept of information literacy (or literacies) encompasses the abilities to recognise the need for information, locate the information needed, perform a balanced evaluation of the information found, and finally apply the chosen information ethically and effectively (American Library Association & Association for College and Research Libraries [ACRL], 2000; Library and Information Association [CILIP], 2018).

Since information literacy has been primarily a project of libraries and librarians thus far (Virkus, 2013), library resources and the online databases used by libraries have received emphasis in the efforts to promote information literacy (Donaldson, 2000; Kumar, Ochoa, & Edwards, 2012; Ukachi, 2015). Still, the term 'online research' was coined several decades ago, for the use of online databases (Hubbard, 1982; Moon, 1986) even beyond the services of libraries (Biddix, Chung, & Park, 2011; Friedman, 2004). More recently, this term has been taken up for addressing a key concept in the study of online reading/research and comprehension (Leu et al., 2015). In light of this background, the dissertation refers to 'online research' and 'online research skills' in connection with students' information-related activities and skills in the Web.

The education landscape has evolved considerably in recent decades. There has been a marked shift from teacher-led instruction to student-centred learning, empowering students to operate as active participants in their learning. Instead of teachers lecturing while students listen, more engaging learning methods are employed, involving pedagogical practices that give students greater responsibility

and require more self-direction than older, more traditional methods do. (O'Neill & McMahon, 2005; Lonka et al., 2018; Hannafin, Hill, Land, & Lee, 2014)

Assignments that require independent or collaborative searching and use of information from multiple sources have become commonplace in schools (Todd & Dadlani, 2014; Bråten, McCrudden, Stang Lund, Brante, & Strømsø, 2018). They are designed for, among other aims, training students in online research skills (Alexandersson & Limberg, 2012; Lundh, 2011; Rouet & Britt, 2011). Irrespective of the novel assignment types featured and students' exposure to digital media from early on in life, the associated skills appear underdeveloped (Kaarakainen, Saikkonen, & Savela, 2018; Coiro, Coscarelli, Maykel, & Forzani, 2015; Kiili & Leu, 2019). Moreover, students display significant differences in skills (e.g., Hatlevik & Christophersen, 2013).

This situation challenges each school to develop more effective pedagogical solutions for online research skills, yet not all teachers are skilled enough themselves (Shannon, Reilly, & Bates, 2019; Wu, Zhou, Li, & Chen, 2021). Practising teachers seem uncertain as to what constitutes effective teaching practices in this domain (e.g., Colwell, Hunt-Barron, & Reinking, 2013; Seufert, Scheffler, Stanoevska-Slabeva, & Müller, 2016) and also about what kind of skills students actually need (Head, Fister, & MacMillan, 2020). The deficit even encompasses freshly minted teachers: information literacy and related skills receive weak coverage in teacher education (Duke & Ward, 2009; Tanni, 2013; Simard & Karsenti, 2016). At issue is a complex set of skills that is neither easy to learn (Brand-Gruwel, Wopereis, & Vermetten, 2005) nor easy to teach.

Some work does exist at the level of theory. Scholars of library and information science have developed research-based pedagogical models for information-literacy instruction. One of the best-established frameworks is *Guided Inquiry Design*, or GID (Kuhlthau et al., 2015), which provides detailed guidelines for teachers wishing to guide students through the inquiry process. These models are not easy for an individual teacher to implement in the classroom, however. For example, GID assumes that the renewal of the pedagogical practice is a school-wide process – for the model to be actualised, the curriculum should acknowledge it. Another challenge is that the models often presume support from school librarians, though not all settings feature such a position. For instance, Finland has very few school librarians. Furthermore, challenges emerge in relation to how the instruction should be operationalised, since librarians and teachers differ in their understanding of information literacy and how related skills should be taught (Ojaranta, 2019).

Some teaching interventions have demonstrated that novel approaches employed by a teacher can significantly improve students' online research skills (e.g., Argelagós & Pifarré, 2012; Baji, Bigdeli, Parsa, & Haeusler, 2018; Chen, Huang, & Chen, 2017; Pifarré & Argelagós, 2020), and a few studies attest that there are individual teachers who actively develop their professional practice in online research instruction (Sormunen & Alamettälä, 2014). However, studies focused on the development work of individual teachers are lacking. Another scale-related research gap is visible in that most intervention studies have measured only short-term learning effects, whereas the long-term influence of teaching interventions on online research skills may be more crucial (Hsieh et al., 2005; Bråten, Strømsø, & Salmerón, 2011).

Finally, online research and related skills are learnt not only via formal instruction in schools but also informally in day-to-day online activities. Hence, personal factors may hold a vital role in the development of skills and might explain much of the variation in online research skills. Self-efficacy (e.g., Kurbanoglu, 2009), attitudes (e.g., Olufemi, 2012), use of information and communication technology (ICT) (e.g., Kaarakainen et al., 2018; Fraillon, Ainley, Schulz, Duckworth, & Friedman, 2020), and gender (e.g., Kaarakainen et al., 2018; Fraillon et al., 2020) have all been studied in efforts to explain the differences in skills. However, consensus has not been reached on these factors and their effects. Better understanding of them may aid in targeting instruction effectively.

A case study was carried out in response to the gaps identified above. The aim was twofold. Firstly, the research was designed to reveal what kind of pedagogical designs the teachers in a lower secondary school develop for instruction in online research upon familiarisation with a research-based framework dedicated to such pedagogy, GID. A teaching intervention to strengthen students' online research skills was designed and implemented. Importantly, both short- and long-term effects of the intervention were examined. Secondly, the research took a broader view of online research skills, looking beyond formal instruction to students' overall skills development in aims of identifying student skill profiles and ascertaining which personal factors, or student-related background factors, may be associated with the intervention effects and online research skills overall. This study examined the following personal factors: self-efficacy beliefs, attitudes, ICT activity, and gender. The overarching goal was a fuller picture of the roles of formal learning and personal factors in the development of online research skills.

The dissertation is structured such that the theoretical background and the key concepts addressed in the research are introduced next, in Chapter 2. Then, providing practical grounding, Chapter 3 presents earlier empirical studies that

proved relevant for the overall study. Chapter 4 lays out the research questions developed against this backdrop, and Chapter 5 turns the gaze to the research design and methodology applied for answering them. The main findings are presented in Chapter 6 and discussed in Chapter 7. Finally, a brief synthesis outlining the final conclusions and implications rounds out the summary. The four original publications are attached at the end of this dissertation.

2 BACKGROUND ON THEORY AND CONTEXT

This chapter examines the field of related research in greater depth. Attention is directed to three main aspects of this. Firstly, the concept of online research is considered, and its relationship to information literacy is elaborated upon. The choice of pedagogical framework for this study is covered next. Finally, the chapter outlines the Finnish school system in particular, the context of this study.

2.1   Conceptualisation of online research

Searching for, evaluating, and using information has long traditions of research in both library and information science (e.g., Kuhlthau, 1991; Wilson, 1999). Information-literacy studies situated in this realm of research have focused primarily on people's skills (e.g., Gross & Latham, 2012; Chang et al., 2012). The development of the Internet, however, has drawn other disciplines' attention to this area. In education science, skills in information search, evaluation, and use have been incorporated into novel definitions of literacy introduced by researchers examining online reading/research and comprehension (Leu et al., 2004; Leu et al., 2015). Researchers in various fields have studied the specific skills involved, under labels such as digital literacy (e.g., Gilster, 1997), media literacy (e.g., Potter, 2004), computer literacy (e.g., Simonson, Maurer, Montag-Torardi, & Whitaker, 1987), Internet literacy (e.g., Livingstone, 2008), and multiliteracy (e.g., New London Group, 1996).

The research's specific foundations lie in *information-literacy research* as established in information science (see Limberg et al., 2008; Kuhlthau et al., 2015) and the tradition of work on *online research and comprehension*, within educational sciences (Leu et al., 2015). Together these provide a solid theoretical and empirical basis for studying skills in searching, evaluating, and using information.

2.1.1   Information literacy

While, as noted above, information literacy can be defined as ability to recognise one's information need, locate the information needed, perform a balanced evaluation of the information found, and then use the chosen information ethically and effectively (ACRL, 2000; CILIP, 2018), it entails critical thinking and awareness too, alongside an understanding of both the ethics-related and political issues associated with using information (CILIP, 2018). International organisations such as UNESCO (Grizzle et al., 2014) and the Organisation for Economic Cooperation and Development (2001) have acknowledged information literacy as an important prerequisite for informed, engaged citizenship and for lifelong learning.

The traditional skill-based approach has been criticised for attempting to capture the concept of information literacy in a simple list of skills (e.g., Limberg, Sundin, & Talja, 2012; Tuominen, Savolainen, & Talja, 2005). For example, Tuominen et al. (2005) see information literacy as a sociotechnical practice embedded in various groups' and communities' activities. According to them, information literacy skills evolve in collaboration within discipline-linked and other contexts: knowledge and meanings are built through dialogue and debate. Therefore, the authors argue, the most important aspects of information literacy might not be measurable purely at the level of the individual. Likewise, Lloyd (2017) states that information literacy is not only a set of skill that are easily transferred from one context or situation to another; information literacy should be understood as a sociocultural practice as much as an individual's competence. Scholars recommend that analysis apply qualitative methods such as phenomenography, sociocultural theory, and discourse analysis, for better understanding of information literacy (see Tuominen et al., 2005; Limberg et al., 2012).

Even though skill-oriented lists and definitions of information literacy are too restrictive overall, they are useful for some purposes, as Tuominen et al. point out (2005). A skill-based conception of information literacy was chosen for use in the work presented here, accordingly: it is in line with the Finnish curriculum and the associated competence requirements pertaining to multiliteracy (see Subsection 2.3.2). Also, it is noteworthy that GID, which provided the tentative framework for the study (see Section 2.2), bridges the learning of information skills with the learning of subject content. The core aim behind GID in this respect is to engage students in a genuine inquiry process instead of learning of separate skills.

The concept of information literacy is sometimes articulated in a plural form, as information literacies. The use of the plural is intended to acknowledge that

information literacy is context-bound and connected with social practices: the underlying assumption is that information literacy learnt in one context differs from that learnt in another (Francke, Sundin, & Limberg, 2011; Lundh & Lindberg, 2012). This dissertation applies the traditional singular form, since the more neutral, generic term is commensurate with the study's emphasis on general skills that young people should learn.

The concept of information literacy was introduced in the 1970s, long before the Internet era (see Zurkowski, 1974). In information studies, students' information searches and use have been a focus of research from the late 1980s onward. One import figure in this regard is Carol C. Kuhlthau (1991; 2004). She revealed the complexity of searching for information in a real-world learning situation after conducting a long series of empirical studies, in several educational contexts. Drawing on constructivist theories of learning and a task-based approach to information-seeking, she developed and validated the Information Search Process (ISP) model. The model characterises learners' information-related behaviours and experiences of uncertainty at specific stages in the learning process. Kuhlthau's studies revealed that information-seeking is more than fact-finding: a 'simple' assignment to conduct information-seeking was found to be a complex inquiry process that involves learning from a host of sources. For true learning and successful progression through that process, students need guidance, instruction, and assistance. Accordingly, Kuhlthau, Maniotes, and Caspari (2015) developed GID, based on the ISP model, as a pedagogical framework for information-literacy instruction (Section 2.2 returns to this framework).

2.1.2   Online research

In the 1980s, librarians and information specialists coined the term 'online research' to describe professional work processes based on systematic use of online databases (Hubbard, 1982; Moon, 1986). In the decades since, the focus has moved further beyond services of a library, shifting from bibliographic databases toward use of the Web (Biddix et al., 2011; Friedman, 2004). In educational sciences, online research became a key concept in reading studies in connection with the paradigm shift from traditional reading to reading and comprehension of online materials (Leu et al., 2011). Accordingly, this field of study is now known as online research and comprehension (Leu et al., 2015). With the new paradigm, reading and writing research expanded in scope from single texts toward multiple-document literacy

(e.g., Anmarkrud, Bråten, & Strømsø, 2014), acknowledging that people must integrate and synthesise information from diverse sources, in various formats, in online environments. The enterprise is not only about reading and writing anymore; it is also about information search and selection of sources.

Scholars studying online research and comprehension regard reading on the Internet as a process of problem-based inquiry comprising five information-processing practices: 1) reading to identify important questions, 2) reading to locate information, 3) reading for critical evaluation of information, 4) reading to synthesise information, and 5) reading and writing to communicate information (Leu et al., 2015; Kiili, 2012, pp. 17–19). One can see that this list dovetails quite well with the areas of competence articulated in the definition of information literacy. Two processes that once were sequential – seeking information and reading + writing – now overlap, a condition that justifies reference to the 'online research' and 'online research skills' concepts in this study.

2.2   The pedagogical framework

The pedagogical underpinnings of the study are in both information literacy and online research and comprehension domains. These research fields share a view wherein online research is a process of inquiry and, being a process, should be taught accordingly, in line with its stages. Both approaches proceed from a constructivist understanding of learning (Phillips, 2000), whose notions are rooted primarily in the thought of Jean Piaget (1952), Lev Vygotsky (1978), and John Dewey (1929). In constructivist learning theory, the student participates actively in the learning process. Students construct their understanding in layers over their prior knowledge and interests, which should serve as the starting point for instruction. The teaching should provide experiences that interact with these aspects of the students (Phillips, 2000, pp. 30–31).

To help teachers guide students through information-literacy assignments, researchers have developed pedagogy-grounded models for information-literacy instruction. Applying constructivist pedagogy theories and the ISP model, Kuhlthau, Maniotes, and Caspari (2012; 2015) developed GID especially for information-literacy instruction. Its aim is to engage students in a genuine inquiry process. The teacher guides the process of inquiry by means of instructive interventions, offering targeted support for its discrete phases. The eight key phases of GID are to 1) open, 2) immerse, 3) explore, 4) identify, 5) gather, 6) create, 7) share, and 8) evaluate, with

particular emphasis on the phases before the information search proper (i.e., phase 5). Students are prepared for information-gathering by activities that arouse their curiosity, build background knowledge, and encourage them to explore new ideas.

Another well-known pedagogical model for information-literacy instruction is the Big Six Information Skills model (Big6), developed by Eisenberg and Berkowitz (1990). It is likewise based on constructivist theories of pedagogy. Big6 too offers conceptual and practical strategies for information-literacy instruction, and, similarly to the GID framework, it describes the learning process as a series of stages, each associated with a specific set of skills and supporting technologies. The stages are 1) task definition, 2) information-seeking strategies, 3) location and access, 4) use of information, 5) synthesis, and 6) evaluation.

Many researchers have developed further models based on the ISP and Big6. For example, Gross, Armstrong, and Latham (2012) designed the three-step approach Analyse, Search, Evaluate (ASE). The steps in this process-oriented model are to 1) analyse the kind of information one needs, 2) search for information, and 3) evaluate which information it is best to use. Gross et al. (2012) emphasised the simplicity and adaptability of their model; it is a general one focused on the most fundamental steps in finding and evaluating information.

In addition, researchers examining online research and comprehension have contributed their own pedagogical models, with Kiili, Mäkinen, and Coiro's work (2013) being one example. They suggested a multidimensional framework for academic literacies that articulates five pedagogical guidelines. With guidance for 1) setting and sharing learning goals, 2) designing the task, 3) making the requirements explicit, 4) sequencing the learning activities, and 5) providing feedback through dialogue, this framework is broader than others, operating on a more general level. However, process-based thinking and the idea of phases are present here too.

From among the many models available, GID was chosen as the tentative framework for the study because it is anchored in extensive empirical research and detailed guides exist for its implementation (Kuhlthau et al., 2012; 2015). As an evidence-based model, it establishes solid ground for such research (see, for example, Todd, 2017), and this framework has been evaluated in classroom studies before (Chu, Chow, Tse, & Kuhlthau, 2008; Chu, Tse, & Chow, 2011; Scott, 2017; Heinström & Sormunen, 2019).

2.3   The research context

2.3.1   The Finnish school system and teachers

The research was conducted in a Finnish lower secondary school. Ever since Finland's 1972–1977 broad-based reform of basic education, all children have had equal access to education. The country's comprehensive-school education, for school years 1 to 9, is designed for all children aged 7–17. The first six years are spent in primary-school instruction led by a single classroom teacher, after which students move to lower secondary school, where each subject has its own teacher.

Teachers are highly regarded in Finnish society. Within the comprehensive-school system, all teachers must possess university education in teaching and hold a master's degree. Teacher education is research-based and offers a solid foundation for individual teachers' development of their professional practices. Furthermore, teachers in Finland have been characterised as having good opportunities for professional development in the field. (Jyrhämä & Maaranen, 2012)

2.3.2   The national core curriculum and multiliteracy

The Finnish national core curriculum presents the objectives and core content for all school subjects, and it describes the education's mission, values, and structure. Municipalities, schools, and teachers themselves jointly draw up their own local curricula within the national framework (Finnish National Board of Education, 2014). Consequently, the teachers enjoy extensive autonomy in their pedagogical work. The system permits planning the teaching quite freely: while the national core curriculum specifies learning goals, it is up to the schools and teachers to select and apply appropriate pedagogical methods to reach those goals and to decide how to arrange the learning in the classroom (see, for example, Pyhältö, Pietarinen, & Soini, 2012).

The national core curriculum for basic (primary and lower-level secondary) education was revamped in 2014, with introduction of seven cross-cutting, curriculum-wide competencies extending across all school subjects. One of them, called *multiliteracy*, is defined as a set of competencies associated with accessing, interpreting, producing, and evaluating text materials of many types, with various shapes and forms. Multiliteracy practices include obtaining, evaluating, producing,

and presenting information in multiple forms and in multiple environments, by means of various tools. Multiliteracy, described as supporting the development of critical-thinking and learning skills (Finnish National Board of Education, 2014), overlaps considerably with information literacy, by its very definition. According to the Core Curriculum for Basic Education, multiliteracy should be developed in all teaching and learning, integrated into every school subject, and practised both in traditional and in digital learning environments (Finnish National Board of Education, 2014).

Although multiliteracy work is to feature in all subjects, the role of lessons in one's mother tongue is special, for these classes create the basis for literacy. Since the curriculum does not specify how this or any other teaching should be organised in detail, responsibility for ways of reaching the learning goals lies with teachers. Therefore, teachers' personal efforts – mother-tongue teachers' especially – play an important role in reaching the goals set. One aim for the doctoral research was to ascertain what kinds of pedagogical designs for online research instruction are developed specifically by a Finnish language teacher on the basis of GID.

3   PRIOR EMPIRICAL RESEARCH

The discussion below presents related empirical studies that have been conducted to gain some sense of students' online research skills and of factors affecting them.

3.1   Gaps in students' online research skills

The ubiquitous image of young people walking around with smartphone in hand might render it easy to think of these generations as having mastered Web-related skills, and talk about digital natives and the Net Generation has only strengthened this mindset (Prensky, 2001; Oblinger, Oblinger, & Lippincott, 2005). However, research shows that far from all members of the generations in question can be classified as digital natives (e.g., Nikou, Cavalheiro, & Widén, 2020). There are clear gaps in many students' skills. Moreover, remarkable differences in skills are visible between students – some are much more skilled than others (e.g., Hatlevik & Christophersen, 2013; Hargittai, 2010). The most commonly observed challenges related to students' online research skills, which informed the study setting, are discussed here.

Students display difficulties in locating information. Most of them do not end up mastering the basics of effective search that are involved in handling complex tasks (e.g., Walraven, Brand-Gruwel, & Boshuizen, 2008). For instance, students may fail to create suitable search phrases (Kaarakainen et al., 2018; van Deursen & van Diepen, 2013). One explanation posited is that few students devote time to defining the problem and outlining their search (Frerejean, Velthorst, van Strien, Kirschner, & Brand-Gruwel, 2019).

Evaluating information seems even more difficult than locating it (Forzani, 2018; Foo et al., 2014; Leino et al., 2019). For instance, students show difficulties in recognising the commercial purpose behind an online resource (Kiili, Leu, Marttunen, Hautala, & Leppänen, 2018), and they seem to ignore *sourcing* – that is, identifying and evaluating information about pertinent features of the information source (i.e., the author or publisher), or they process it only superficially (Brante & Strømsø, 2018; Coiro, Coscarelli, Maykel, & Forzani, 2015). Another tendency is that

they concentrate on content relevance at the expense of source reliability (Kaarakainen et al., 2018; Kiili, Laurinen, & Marttunen, 2008). Finding an answer seems to be the primary objective, irrespective of where the information comes from (van Deursen & van Diepen, 2013).

Another key shortcoming in students' abilities is worthy of note. This is connected with synthesising information across sources (Kiili & Leu, 2019). When using multiple online information sources, they tend to copy and paraphrase content from the resources instead of integrating information within and across them (Sormunen & Lehtiö, 2011; Kiili, Bråten, Kullberg, & Leppänen, 2020). Students also readily neglect to note the sources used (Kiili, Brante, Räikkönen, & Coiro, 2020; Barzilai, Tzadok, & Eshet-Alkalai, 2015).

3.2 Factors associated with the development students' online research skills

Young people are not a homogeneous group. Some learn better in informal settings, while others require formal instruction with a particular sort of structure (Kirschner & van Merriënboer, 2013). A clear picture of how students' background and their formal schooling might contribute to differences in online research skills remains lacking, however. The sections below summarise the review conducted of the state of scholarly understanding of personal traits' influence or students' everyday information-related practices, teachers' professional attitudes and efforts, and teaching interventions designed to support the development of students' online research skills.

3.2.1 Personal factors

Among the student-related personal factors studied in endeavours to explain the development of skills and the differences in the skill levels achieved are self-efficacy (e.g., Kurbanoglu, 2009), attitudes (Olufemi, 2012), ICT use (e.g., Kaarakainen et al., 2018; Fraillon et al., 2020), and gender (e.g., Kaarakainen et al., 2018; Fraillon et al., 2020). They have been examined mainly in research focused on ICT and Internet competencies. However, these competencies overlap with online research skills in many respects.

Self-efficacy is a key concept, referring to how individuals perceive their abilities to carry out the actions required for performing a given task or reaching a certain goal (Bandura, 1977). Individuals with low self-efficacy – those who do not have confidence in their abilities – tend to avoid challenging activities and are less likely to develop their competencies (Bandura, 1993; 1991). Considering the information domain in particular, Kurbanoglu (2009) has suggested that individuals with low self-efficacy are less inclined to develop their information literacy, whereas those with high self-efficacy are more likely to do so. Aesaert, Voogt, Kuiper, and van Braak (2017) have speculated that slightly positively biased self-efficacy judgements would be most ideal for developing competencies and learning. Their argument is that moderate overestimation motivates students to persist in their efforts.

The International Computer and Information Literacy Study (ICILS) in 2013 and 2018 found ICT self-efficacy to show a positive correlation with computer and information literacy among eighth-grade students (Fraillon et al., 2020; Hatlevik, Throndsen, Loi, & Gudmundsdottir, 2018). Similarly, Aesaert et al. (2015) found that primary-school students' ICT self-efficacy is associated with greater actual competence in locating, processing, and communicating digital information. Nikou, Brännback, and Widén (2019) confirmed a strong association between self-efficacy and information literacy. In Kaarakainen et al.'s (2018) study, however, self-efficacy appeared to have a positive effect only on male students' information skills.

Eagly and Chaiken (1993, p. 1) defined attitude more generally as 'a psychological tendency that is expressed by evaluating a particular entity with some degree of favour or disfavour'. Psychological studies demonstrate that attitudes affect individuals' behaviour (e.g., Olufemi, 2012), and some researchers have found a positive association between attitudes and learning (e.g., Petko, Cantieni, & Prasse, 2017; Perkins, Adams, Pollock, Finkelstein, & Wieman, 2005; Cahill et al., 2018). Still, the effect of attitudes on learning online research or related skills seems to be unexplored, though some scholars have called for studying the role of attitudes and self-efficacy in learning online research by means of developing and validating instruments to measure students' attitudes toward online research (Putman, 2014).

The relationship of students' computer use with their computer and information literacy has been widely studied but with mixed results. Kaarakainen et al. (2018) and Fraillon et al. (2020) recently reported that versatile use of technology and online activities are the most prominent predictors of students' computer and information literacy. Access to computers in the home and experience of computer use demonstrated a positive correlation with their computer and information literacy. Hatlevik, Ottestad, and Throndsen (2015), in contrast, found that ICT use in schools

correlated negatively with scores in a digital-literacy test taken by ninth-grade students in Norway. In more recent work, Hatlevik et al. (2018) suggested that the nature of the ICT use in schools (how ICT is used) may be more important for students' learning than is quantity (how often it is used).

Regarding associations between gender and ICT competencies, some researchers point to gender equivalence while others suggest the opposite. Of particular note are some recent studies that call into question the commonly held view that males demonstrate better computer skills (Schumacher & Morahan-Martin, 2001); these appear to suggest that any difference has disappeared or the disparity has become reversed; e.g., female students outperformed their male counterparts for computer and information literacy in ICILS 2018 results (Fraillon et al., 2020). No differences between genders were evident in recent studies specifically of information skills (Kaarakainen et al., 2018) or Web-information-related problem-solving (Argelagós & Pifarré, 2017).

3.2.2   Formal instruction and teachers' role

The educational landscape has evolved remarkably in the last few decades. One of the strongest trends is a movement from teacher-led instruction to student-centred learning and empowering students to take an active role in their learning. This general trend toward student-centred learning means that online research is a natural part of everyday school practice.

Assignments that require independent acquisition and use of information from multiple sources have become a mainstay of school practice for training students' online research skills (Alexandersson & Limberg, 2012; Lundh, 2011; Rouet & Britt, 2011). Whole-task instruction, which requires students to solve information problems from beginning to end, thereby practising all constituent skills of the process, has proved a more effective tool for teaching complex skills than part-task, fragmented instruction is (Frerejean et al., 2019; Pifarré & Argelagós, 2020). Although whole-task online research assignments have become widespread in school settings, their pervasiveness does not imply that teachers have necessarily adopted instruction practices that solidly support the development of online research skills (see, for example, Alexandersson & Limberg, 2012; Shannon et al., 2019). Achieving the intended learning outcomes is still a challenge.

Prior research offers ample evidence of this. Teachers may be uncertain of what constitutes effective teaching practices (e.g., Colwell et al., 2013; Seufert et al., 2016;

Shannon et al., 2019) or find it difficult to transfer their information searching skills to what they teach (Pilerot & Hedman, 2009). One particularly frequent problem involves paying inadequate attention to the learning process while focused on the technical aspects of searching and citing information sources, even though students' greatest problems are related more to the former: developing their own questions, assessing information, and building meaning from sources for their own use (e.g., Limberg et al., 2008; Hongisto & Sormunen, 2010). Meanwhile, some view generic critical-thinking skills as enough to prepare students to navigate today's information environment (Head et al., 2020). Haider and Sundin (2019, p. 11) suggest specifically that many teachers lack informed understanding of search engines and, consequently, find it challenging to teach Web searching skills. Indeed, teachers have expressed doubts as how they might conceptualise search as something they could teach (Sundin & Carlsson, 2016). This is all the more understandable in that teacher education has neglected information literacy and related skills (Duke & Ward, 2009; Tanni, 2013; Simard & Karsenti, 2016; Shannon et al., 2019).

Researchers and expert practitioners alike have suggested that any pedagogical approach to information literacy and related skills should be implemented as a school-wide curricular process with emphasis on collaborative school culture (Seufert et al., 2016; Kuhlthau et al., 2015; Todd, 2021). Studies from schools implementing models such as GID have identified positive effects. Such frameworks offer support for teachers (Heinström & Sormunen, 2019), and students' skills have grown (Chu et al., 2011; Chu et al., 2008). The ideal situation entails teaching the relevant skills as an element integrated into the instruction over a long span of time (Chu et al., 2011). In other cases, individual teachers take it upon themselves to develop their professional practice with regard to online research instruction actively by implementing and developing inquiry-based learning tasks (Sormunen & Alamettälä, 2014; Sormunen & Lehtiö, 2011). This is also point of departure of the present study.

3.2.3   Interventions related to online research

Quite a few studies have been published on teaching interventions connected with online research in lower or upper secondary education. Some of the studies have been longitudinal, multi-year undertakings (Argelagós & Pifarré, 2012; Pifarré & Argelagós, 2020; Chen et al., 2017), while others have lasted only a few weeks (Baji et al., 2018; Chen, Chen, & Ma, 2014).

One of the first was Argelagós and Pifarré's research (2012) among seventh- and eighth-graders for two academic years, with later research by Pifarré and Argelagós (2020) working with seventh-, eighth-, and ninth-graders for three academic years. Both projects involved quasi-experimental studies with a pre- and post-intervention test-/control-group design. Chen et al. (2017) followed primary-school students for six years, from grade 1 to grade 6. Rather than use a control group, they took students' academic achievements as the moderating factor in their study. Both Argelagós and Pifarré's design and Pifarré and Argelagós's utilised a Web-based learning environment for the intervention, while Chen et al. used the Big6 model (Eisenberg & Berkowitz, 1990) as the intervention framework. All three studies showed a positive intervention effect.

Argelagós and Pifarré measured students' skills in defining the problem, searching for information, scanning and processing it, and organising and presenting the resulting information. The experiment-group students outperformed the controls in defining the problem and searching for information. Since the intervention group searched more effectively, they could devote more time to scanning and processing information and, finally, to organising and presenting the results. Also, the experimental group produced better task-performance scores than the control group.

Pifarré and Argelagós used tests utilising three tasks, which differed in their degree of complexity: 1) a fact-finding task that involved relatively simple searching for information on a single Web site, 2) an information-gathering task that required information to be gathered from several Web pages and then integrated, and 3) a final essay consisting of a brief persuasive piece. The researchers found that the experimental group outperformed the control group in the second and the third task – in other words, the more complex tasks.

Chen et al. (2017), in turn, examined students' memory and comprehension of content on a given subject. Their results point to improved memorisation and conceptual understanding of the content, irrespective of prior academic success. In general, the students demonstrated greater progress in comprehension than in memorising. Low-achieving students made more progress in both types of learning than did medium-level and high achievers.

As noted above, Baji et al. (2018) and Chen et al. (2014) implemented shorter-term projects. These involved quasi-experimental studies with a pre- and post-intervention test-/control-group design. Baji et al. studied sixth-graders for six weeks, and Chen et al. worked with seventh-graders for three weeks. Both research groups applied the Big6 framework in the interventions.

To perform their test, Baji et al. used a modified version of the Tool for Real-time Assessment of Information Literacy Skills, or TRAILS, instrument (see http://www.trails-9.org/), which includes multiple-choice questions. The results showed a positive intervention effect. In additional work, the team conducted a follow-up test about two months after the post-intervention test (or 'post-test') to assess the long-term learning effects. They found that the intervention effect remained.

Finally, the work by Chen et al. (2014) measured students' memory of the content apparently learnt, the students' comprehension of scientific concepts, and problem-solving skills. The team found that the experimental group outperformed the controls for comprehension and problem-solving but not in the test of subject-related content (i.e., memory).

The literature reviewed above falls into two classes with regard to measuring online research skills. Work approaching the issue from the angle of online research skills measures learning as a change in skills (Argelagós & Pifarré, 2012; Baji et al., 2018; Pifarré & Argelagós, 2020), while others conceptualise the learning in terms of changes in knowledge of the subject matter and/or in problem-solving skills, with online research having only an instrumental role (Chen et al., 2014; Chen et al., 2017).

3.3   The landscape of the literature

There seems to be consensus that, notwithstanding students' exposure to digital media from very early in life, their online research skills remain limited. It is obvious that, in addition to informal learning in day-to-day life, young people need formal instruction if they are to learn the online research skills required in formal education contexts. Furthermore, there has been almost no research into skill profiles – that is, how students' general skills in online research cohere from their skills in the various subtasks. Some attention has been directed at student-related factors, in attempts to explain the differences that arise in skill levels or development of skills (learning), yet consensus has not been reached on any of these (self-efficacy, attitudes, ICT use, gender, etc.) or their effects. Neither do we fully understand how these factors might predict the effects of online-research-related teaching interventions. Causality in the other direction – possible effects of such interventions on students' self-efficacy beliefs and attitudes – has gone entirely unstudied.

Important gaps are visible on the other side of the teaching relationship too. Prior research indicates that teachers are not entirely certain as to which teaching practices

may be effective. While studies from schools' deployment of pedagogical models have demonstrated positive effects, the models are not easy for an individual teacher or teaching team to implement in the classroom, partly since the models are oriented toward implementation school-wide.

Overall, we have little true evidence of the effects of novel pedagogical methods applied for improving online research, with studies focused on development work by individual teachers being particularly scarce. Some teaching interventions have shown promising results, displaying benefits for students; however, few follow-up studies have been presented. Not only long-term effects but also less instrumental benefits are seldom investigated: even fewer studies have measured online research skills as learning outcomes – many have restricted the metrics to subject-specific learning of content or facts.

The present study was designed to address some of the above-mentioned gaps in research into individual teachers' attempts to develop their instruction practices related to online research in aims of enhancing students' skills. Besides intervention effects, this work explored students' skill profiles across the various subtasks that online research comprises. Another central objective was to identify personal factors that are associated with students' online research skills and the development of those skills.

4   THE RESEARCH QUESTIONS

The overarching goal for the research was to develop a better understanding of the roles of formal learning and personal factors in learning of online research skills. Informed by the current state of research as outlined in the previous chapter, its more specific aim was articulated as follows: to find out how lower secondary school teachers develop their practices of instruction in online research after having been introduced to a research-based pedagogical framework (GID) and examine the short- and long-term effects of the intervention on students. Further, the study focused on students' skill profiles and student-related personal factors that are associated with how students' online research skills develop.

The research questions are as follows, addressed directly in the four publications:

1. What kinds of pedagogical designs for online research instruction do teachers develop on the basis of Guided Inquiry Design, and how do the teachers experience the development process? (Publication I)
2. What types of short- and long-term effects does the teaching intervention have on students' online research skills? (Publications III and IV)
3. How does the teaching intervention change students' self-efficacy beliefs and their attitudes related to online research? (Publication II)
4. Which personal factors are associated with the learning outcomes in the intervention condition? (Publication III)
5. What kinds of skill profiles emerge among lower secondary school students for information search, evaluation, and use? (Publication IV)
6. Which personal factors are associated with students' online research skills? (Publication IV)

5   RESEARCH DESIGN AND METHODOLOGY

This chapter outlines the research design and the methodology followed. It describes both the general research strategy and details of the participants, procedure, data-collection techniques, and analysis methods. In the final sections, data-credibility issues and ethics considerations are addressed.

5.1   Research strategy

A case-study approach was deemed an appropriate research strategy for this study. Bassey (1999, p. 47) defines a case study as a 'study of a singularity conducted in depth in natural settings'. In this study, the aim was to investigate the effect of a teacher-designed intervention on students' online research skills and also to examine personal factors' role in the development of those skills. Online research skills are a complex skillset that is not easy to acquire or teach. A case-study approach offered an opportunity to delve deeply into the theme in its natural context, with attention to both the teacher and the students. Also, this approach allows the researcher to work with several types of data and employ a variety of research methods in the investigation (Yin, 2014). Known as triangulation (Cohen, Manion, & Morrison, 2000, p. 112), this technique increases the credibility and validity of the research by means of an opportunity to see things from multiple perspectives and, thereby, corroborate the findings (see also Subsection 5.7.1). The case is normally a pre-existing setting and typically has some association with a location, such as a community or an organisation's premises. Here, the location was a lower secondary school, focused on a teacher, two of her colleagues, and three classes of students.

The research dealt with the teaching intervention designed and implemented by practising teachers at the school. Intervention research examines the effects of an intervention on an outcome of interest, with the primary purpose being to create a desirable outcome – cognitive, affective, or behavioural – for participants (Salkind, 2010) and document this scientifically. Here, the outcome sought was strengthening of lower secondary school students' online research skills, and the nature of the intervention design was quasi-experimental. In cases of field interventions and other

settings wherein randomly assigning subjects to test and control groups would be difficult, quasi-experiments prove useful (Bryman, 2008, pp. 40–41; Price, Jhangiani, & Chiang, 2015). The theoretical perspective for the research has a grounding in the constructive approach to learning (Phillips, 2000) and an assumption that the effect of teaching on students' skills can be measured in a pre–post test design.

The naturalistic setting of a case study rendered it possible also to examine students as more than mere subjects of a teaching intervention exposed to possible skill development. The study design afforded directing attention to the students' self-efficacy beliefs, attitudes, ICT activity, and gender too, any of which might have a connection to their online research skills and how they may benefit from the teaching intervention.

5.2   Participants

In all, 94 lower secondary school students participated in the research. Its intervention group consisted of three parallel classes of 58 students in total (35 females and 23 males), while the control group consisted of 36 students (19 females, 17 males) in two other classes. The intervention took place during the 2015–2016 school year, when the students were seventh-graders, aged 12 to 14. Follow-up data were collected during the autumn 2016 term, when the students were eighth-grade pupils, aged 13–15 years.

The three teachers involved were a teacher of Finnish as mother tongue, who was at the centre of the research, and two history teachers, who co-operated with her in the second intervention course. All of them had a university degree in the subjects they were teaching, they had several years of work experience, and they were also involved in training student teachers. The control group's teachers worked independently from those involved in the intervention.

5.3   The research environment

The study was conducted in a lower secondary school situated in a medium-sized city in southern Finland. The total number of students at the school was about 300, and all students lived in the surrounding area. Any student could be admitted to this school, which imposes no entrance examinations. One could make the argument that the school selected represents the current state of the art in research-based

pedagogy: it serves as a teacher-training school and operates in close collaboration with the local university. Thus, it functions as a development, experimentation, and research environment for its own staff and for university researchers.

5.4   The intervention

The intervention was targeted for integration into three courses (taught in the 2015–2016 and 2016–2017 school years); see the study-design diagram in Figure 1. All three courses fell within the school's standard curriculum and were chosen for learning goals that were associated with online research skills. The Finnish language teacher designed the intervention and implemented it in her course, while the two history teachers collaborated with her to organise the second course, which combined the Finnish language and history. The third course is discussed further on in this section.

At the outset, the researcher introduced the GID model to the teachers, but they were free to embed it in their pedagogical practices as extensively as they considered appropriate in the curriculum's framework. The key principles of GID that the teachers aimed to follow in their instruction were to emphasise the earliest stages of the inquiry process and to let students choose their own topics, ones of interest to them. To keep track of the students' information sources, inquiry logs were introduced (these are discussed in Section 6.1). Just as the teachers acted as a team for the second course, the students in all three courses worked in groups.

Course 1, part of the Finnish-language-related curriculum, was for seventh-grade students in the autumn term of their first year at the lower secondary school. The intervention entailed students creating a brochure for fifth-grade students about good social-media practices. The main learning goal was for the students to learn to seek information and apply it in writing for a particular target audience. Netiquette was the learning goal specified for the concrete content to learn.

The second course involved a joint project in the Finnish language and history carried out in the spring term of the same school year. The theme of the course was the Finnish Civil War. In the history portion of their studies, the students prepared and gave a source-based presentation about the war, and the Finnish course involved writing a piece of fiction based on facts learnt in the history lessons. The teacher team hoped that their students would learn to seek and use diverse information sources and to present justified opinions. The Finnish language teacher wanted the students to learn that seeking information contributes to writing good fiction and is

integral to it. Source criticism was specified as an important learning goal by the history teachers.

While the original intention was to integrate a GID-based intervention into three courses, the teacher's design for the third course ended up not entirely aligned with the aims of this study. In the third course, held in the autumn term of the second school year for eighth-grade students, each student prepared and presented a persuasive speech. The form of the assignment (an oral presentation) did not encourage students to search for information and hone their skills in online research. Therefore, this course was excluded from consideration. Since the first two courses seemed to give a sufficient base to analyse the intervention effects the last performance test was regarded as a delayed post-test.

The control group received standard instruction based on the curriculum.

Figure 1.   Timeline of the teaching intervention and data collection.
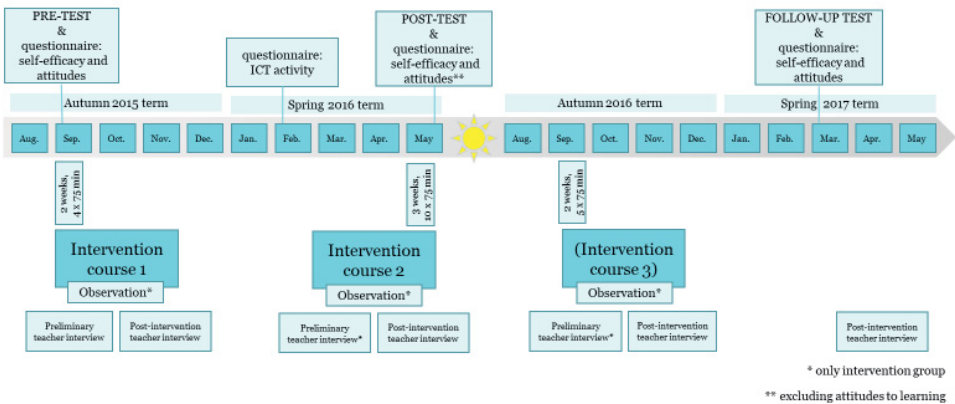
5.5   Data collection

The current research exploited multiple data-collection techniques (see Figure 1). Questionnaires, interviews, observation, and tests all were used. The questionnaires, interview guides, and tests (all in translated form) are reproduced in appendices 1–4.

5.5.1   Questionnaires

Questionnaires are widely used instruments that represent great utility for collecting information in a survey setting, providing structured data, and affording relatively straightforward analysis (Cohen et al., 2000, p. 245). In questionnaires, the variables of interest are measured via self-reporting: the participants are asked to report directly on, for example, their thoughts, feelings, or opinions (Singleton & Straights, 2010). This research employed written, paper-based questionnaires to survey students' self-efficacy beliefs connected with online research, their attitudes toward learning, behavioural intentions related to online research, and their ICT activity.

Multiple-choice questionnaires are quick and easy to conduct. One can administer them to many people simultaneously, and the results are pre-formatted. There is always the possibility, however, of an item being interpreted differently between readers. Therefore, pilot testing is crucial for success (Cohen et al., 2000, p. 260). Questionnaires used in this study contained rating-scale questions, a popular technique that combines the opportunity for a flexible response with the ability to ascertain frequencies, judge correlations, and perform other forms of quantitative analysis (Cohen et al., 2000, p. 253).

The questionnaires were pilot tested with volunteers ($n=5$), of the same age as the participants, prior to the research proper. The questionnaires were posted to their parents, who supervised administration of the survey and wrote down any comments their children might have offered on the questionnaire. In light of these comments, some of the items, which were considered unclear or difficult to judge, were rephrased or removed.

5.5.1.1   Self-efficacy and attitudes

A questionnaire was designed to survey students' self-efficacy beliefs related to online research, attitudes to learning (traditional teacher-centred learning vs. independent online learning), and behavioural intentions[1] (intent to act in a certain way with regard to what the attitude pertains to), in online research (see Appendix 1). The validated Survey of Online Reading Attitudes and Behaviours (SORAB) instrument (Putman, 2014) functioned as a framework for this tool's design. The questionnaire incorporated a set of items developed in the Academy of Finland

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[1] Behavioural intentions are one specific category of attitudes.

project eSeek!² (see also Forzani et al., 2020), along with some developed especially for this study to cover all relevant aspects. Exploratory factor analysis (EFA) supported finding reliable scales for the measurement. The analysis is described in Publication II.

Two sets of items measured attitudes to learning, four each on independent online learning and traditional teacher-centred learning. Behavioural intentions were measured with respect to online searching (seven items), evaluation (five items), and use³ (four items). Self-efficacy beliefs were examined in relation to information search and use (with three items each). The questionnaire was administered three times: before the first intervention course, after the second course, and at the end together with the follow-up test data. The items on self-efficacy beliefs and behavioural intentions were included on all three occasions, while attitudes toward learning were probed only at the beginning and at the end.

5.5.1.2   Background information

Background information on students' use of computer and Internet was collected with another questionnaire, developed in the eSeek! project (see also Hautala et al., 2018). Attention was given primarily to the purpose and frequency of students' computer and Internet use (see Appendix 2). Students' activity was measured on three dimensions: school-related ICT activity (two items), leisure-time information-seeking activity (two items), and social-media activity (two items). The questionnaire was administered between the first and the second intervention course.

5.5.2   Interviews

Interviews enable participants to discuss their interpretations and express how they regard situations from their own point of view (Cohen et al., 2000, p. 267). The present study investigated teachers' experiences via semi-structured interviews. A semi-structured interview is a type of interview that employs predetermined protocols that remind the researcher of the issues to cover while allowing new questions to be brought up during the interview in light of what the interviewee says (Edwards & Holland, 2013, pp. 29–42). The interviews were all conducted face to

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² See https://www.jyu.fi/edupsy/en/research/projects/eseek.

³ For Publication II, the term 'source-based writing' was used.

face in a one-on-one setting. For analysis, recordings made with a digital voice recorder were transcribed into text files.

The Finnish language teacher was interviewed seven times, for the first time before the intervention and for the final time afterward. The themes of the pre-intervention interview were centred on her experiences related to information-literacy instruction, and the final interview dealt mainly with her experience of the two years of the research project. There was an interview before and after each intervention course also. The former dealt with the learning goals and the practicalities connected with the course in question, and the latter surveyed experiences of the course. For the second course, the history teachers were interviewed as well.

For monitoring the instruction that the control group received, that group's Finnish language teacher was interviewed also, before the intervention, after the intervention courses, and at the end of each of the school years, 2015–2016 and 2016–2017. The first interview dealt with the plans and learning goals for the upcoming courses, while the other interviews were retrospectively oriented, examining the way in which those plans had been realised and what kind of instruction pertaining to online research the students had received. The interview guides are provided in Appendix 3.

5.5.3   Observations

Observation research is a qualitative technique wherein researchers observe participants' ongoing behaviour in a natural situation. The purpose is to gather more reliable insights; that is, the researcher can capture data on what participants do as opposed to what they say they do. Observation enables researchers to understand the context better and to move beyond perception-based data (e.g., opinions expressed in interviews). Observational data enable researchers to step into and understand the situation being described. Observations can be unstructured, semi-structured or structured. Semi-structured and structured involve using of an observation template. (Cohen et al., 2000, p. 305–307)

To afford a comprehensive picture of what occurred in the classrooms during the research project, all lessons with relevance in terms of the intervention were observed, and they were documented in written observation notes. Observations in this study were unstructured because they had only a supportive role. The

observation notes as well as all the material handed out in these lessons served as supporting material in the analysis of interview data.

5.5.4   Performance tests

There are many ways to collect evidence of student' skills in online research – e.g., by means of knowledge tests (also known as fixed-choice tests), self-assessment (including use of self-efficacy scales), and performance tests. While knowledge tests based on ACRL and other information-literacy standards (e.g., the SAILS and TRAILS instruments; see, respectively, https://www.projectsails.org/ and http://www.trails-9.org/) are widely employed and reported upon (Lym, Grossman, Yannotta, & Talih, 2010; Kovalik, Yutzey, & Piazza, 2012), these tests present a substantial limitation in that they measure factual knowledge rather than practical skills (Sparks, Katz, & Beile, 2016). With self-assessment tools, in turn, students are likely to underestimate or overestimate their skills (Bussert & Pouliot, 2010, pp. 136–137). The third option, using authentic tests or exercises carried out in real-world contexts, has proved to be the most effective way to document actual applied skills (Schilling & Applegate, 2012).

Performance assessments require students to apply their knowledge and skills in activities simulating real-world tasks. Since online research is a complex process comprising subtasks of searching for information, evaluating information, and using information, one may choose to measure performance in one subtask or encompass various subtasks. For example, Tu, Shih, and Tsai (2008) and van Deursen and van Diepen (2013) assessed students' Web-search strategies, and Coiro et al. (2015) and Forzani (2018) measured students' evaluation of sources. The measurement may cover both the process itself and outcome variables. For example, to evaluate searching for information, one could assess such process-related variables as the quality of search plans and search terms (how the students search for information) or consider search-outcome variables such as the quality of the documents selected (what the result is).

Integrated performance tests such as the Online Research and Comprehension Assessment, ORCA (Coiro & Kennedy, 2011; Kennedy, Rhoads, & Leu, 2016; Leu et al., 2014), and the Online Inquiry Experimentation System, NEURONE (Sormunen et al., 2017), are designed to expose the participants to the challenges of authentic Web search and, thereby, measure the whole online research process and its subtasks. In the ORCA, the students search for information within a controlled

collection of Web documents to complete the assignment that has been set. Students' performance is assessed at each stage in the task (Kennedy et al., 2016). In NEURONE, students complete an assignment involving online inquiry connected with a controversial issue by searching for information in a closed simulated Web environment. As in the ORCA, performance is assessed at each stage of the task (Sormunen et al., 2017).

The performance tests in the present study were two researcher-produced instruments that focused on learning outcomes from Web searching, critical evaluation of sources, and argumentative use of Web information.

5.5.4.1   Pre- and post-intervention tests

The pre- and post-tests were designed especially for this study. The tests are provided in Appendix 4. Applying the principles of integrated performance tests, these covered four dimensions of competence: 1) search-planning and query-formulation skills, 2) search-performance skills, 3) skills in critical evaluation, and 4) argumentation skills. The pre- and post-test were structured similarly but differed in theme, to avoid confounding by memorisation. In the first test, the students were asked to find an answer to the following question: 'Can a shopkeeper refuse to sell energy drinks to schoolchildren? For the second test, the question was this: 'In which school subjects might computer gaming have positive effects?' The students performed the test's assignment online but wrote the answers on paper. Neither task was a simple fact-finding problem; they both required seeking and interpreting information. However, both were formulated such that it was possible to find straightforward, justified answers.

Before beginning their search for information, the students were asked to devise various search terms. Next, they were allowed to use laptops and perform their searches, aided by online search engines. Each student was required to write down the search terms used, identify two of the best sources found, and explain the choices. Finally, the students were asked for a well-justified answer to the question. The search plans, queries, sources and accompanying justification, and ultimate answers were assessed and scored.

5.5.4.2 The delayed post-intervention test

In the test used in the pre–post assessment, the searches' success dictated the performance scores to a considerable degree. Without relevant search results, achieving high scores for one's evaluation and use of sources is not easy. To prevent this issue from cropping up in the follow-up phase too, the simulated online environment NEURONE (see https://www.neurone.info; see also González-Ibáñez, Gacitúa, Sormunen, & Kiili, 2017) was used. This provides a fully controlled system simulating a Web-based learning and search environment. Most importantly, the workflow structure affords independent assessment of performance for each subtask: search, evaluation, and use. Any student who has failed or underperformed in the first subtask is provided with the relevant sources before the evaluation subtask. This guarantees that all students are equally likely to succeed in the evaluation and information-use subtasks, without knock-on effects, and that the test scores are comparable within each of the subtasks.

The task in the NEURONE follow-up was to compose an article titled 'Computer Gaming Has Both Advantages and Disadvantages' for a hypothetical school magazine. The students began by searching for three relevant sources. Sources in hand, they then evaluated the credibility of each. Finally, the students were asked to write the article, making it at least 50 words long. The queries, the searches' effectiveness, students' evaluation of sources, and the information use all were assessed and scored.

5.6   Data analysis

The data analysis employed both qualitative and quantitative methods (see Table 1, below). The interview and observation data were subjected to qualitative content analysis, while the questionnaire and test results were analysed quantitatively. Statistical analyses were performed in SPSS, version 25.

The purpose of qualitative content analysis is to organise and elicit meaning from the data collected and then draw realistic conclusions accordingly (Mayring, 2004). Both descriptive and analytical content analysis, for the interview and observation data, were used in the work behind Publication I.

Mixed between- and within-subjects analysis of variance (ANOVA) was conducted to assess the effect of the teaching intervention. The analysis encompassed students' self-efficacy beliefs related to their online research, attitudes

to online research (for Publication II), and skills in online research (see Publication III). Mixed between–within-subjects ANOVA is an extension of repeated-measures ANOVA that is suitable for a study with two independent variables, one a between-subjects variable (e.g., group: intervention/control) and the other a within-subjects variable (e.g., time: pre-/post-) (Pallant, 2013, pp. 284–292). In addition, in the work for Publication III, independent-samples *t*-testing was conducted to compare the test scores between subgroups: those found high vs. low for various factors (see Section 6.4) and male vs. female. Paired-sample *t*-testing concretised the improvement of scores within these subgroups.

For Publication IV, an independent-samples *t*-test was conducted to compare test-score means between the intervention and the control group. Furthermore, cluster analysis was chosen to reveal how students fell into groups on the basis of their scores for the various components of the test (Web searching, evaluation, and information use). Cluster analysis has proved suitable for exploratory analysis aimed at identifying structures within the data. (Bittmann & Gelbard, 2007)

Table 1.   Summary of the data-collection and analysis methods

Study	Topic	Participants	Sources of data	Data analysis
Pub. I	Teachers' experiences	Teachers (*n*=3)	Semi-structured interviews Observation	Qualitative content analysis
Pub. II	Intervention effects on students' self-efficacy beliefs and attitudes	Students (*n*=78–82)	Questionnaire on self-efficacy and attitudes	Mixed between- and within-subjects ANOVA

Table 1.   Summary of the data-collection and analysis methods

Pub. III	Short-term intervention effects on students' online research skills	Students (n=87)	Pre- and post-tests Questionnaires on self-efficacy and attitudes, and on ICT activity	Mixed between- and within-subjects ANOVA Independent-samples t-test and paired-sample t-test
Pub. IV	Long-term intervention effects on students' online research skills Students' skill profiles Background factors explaining skill differences	Students (n=84)	Follow-up test Questionnaires on self-efficacy and attitudes and on ICT activity	Independent-samples t-test Two-step cluster analysis

5.7   Ethics considerations and the credibility of the data

5.7.1   The data's credibility

Related to the methods of data collection, the concept of reliability refers to how consistently a method produces identical results under identical conditions – in other words, whether or not the given study can be repeated (Cohen et al., 2000, pp. 117–118). Reliability issues in the study were taken into account through planning and documenting the research as accurately as possible. The research methods were applied consistently. In collection of the data, the same steps were carried out in the same way every time, the participants were given the same information, and

circumstances were kept as consistent as possible, to guarantee the same conditions for all participants.

Validity is another important concept to consider. This has to do with the data and analysis used. It refers to the extent to which the results are measurements of what the researchers intended to measure – whether the research has used suitable indicators for the concepts and yielded accurate results (Cohen et al., 2000, pp. 105–112). Whenever assessing the validity of a posited cause-and-effect relationship, one has to address both *internal validity* and *external validity*. The former is an estimate related to the design of the experiment: how well conclusions about causal relationships can be drawn on the basis of the research setting and the metrics used. External validity refers to the generalisability of the results, the degree to which the study's results can be generalised for other cases. A concept closely related to this, *ecological validity*, expresses to what degree the research results may be applied to the real world outside research settings. For a study to be ecologically valid, its methods, materials, and setting must resemble the real-life situation that is under investigation in all key respects (Cohen et al., 2000, pp. 105–112).

This research displays limitations that are commonplace in quasi-experiments. In a quasi-experiment design, there is always a risk of confounding variables, as the research is not conducted in a fully controlled environment. The groups may not be equivalent, and differences between the groups, of whatever sort, may affect the outcome of the study. Therefore, the internal validity of the research ends up weaker, so causality is harder to prove (Bryman, 2008). That said, high ecological validity may be expected from the research presented in the dissertation since it was conducted in a natural school environment and the teachers were working within the framework of the national and the local curriculum (cf. Bryman, 2008, pp. 40–41). In addition, sufficient equivalence between the intervention- and control-group students may be assumed, for they all resided in the school's neighbourhood without any filtering (there were neither entrance exams nor other ability-based selection procedures).

Case studies are often criticised on the grounds that their small samples render the findings not generalisable (Yin, 2014, p. 15). Since this case study focused on students at only a single school, caution should be exercised in any attempt to apply the results more generally. According to Bassey (1999), however, case-study research, especially in education settings, can produce benefits via *fuzzy generalisations*. Teaching is such a complex activity that straightforward conclusions about learning and the reasons behind it are impossible – many variables contribute to whether learning takes place. That is why Bassey stresses that a fuzzy generalisation identifies a possibility rather than certainty. Here, reports rooted in empirical inquiry state that

something has happened in one place and may happen elsewhere also; thus, case studies strengthen scholarship through long-term accumulation of experiences from single cases (Bassey, 1999, pp. 48–56).

In an intervention study, also *procedural fidelity* and *homogeneity* are worth taking into account. Procedural fidelity is the degree to which the interventions are implemented as designed (Barnett et al., 2014). This correspondence is necessary if one wishes to establish that a functional relation exists between an intervention and a behaviour change. The fidelity of this research was checked via observation and teacher interviews both prior to and after the intervention. Secondly, the concept of homogeneity refers to equivalence of the non-intervention-related exposure received by the intervention and control group. Here, as the instruction followed the national core curriculum and the local curriculum of the school, it can be assumed that the instruction was similar apart from the intervention. Hence, homogeneity can be assumed. Nonetheless, checks were performed (e.g., examining control-group teacher interviews).

The concepts presented above are aligned primarily with quantitative research. Credibility, transferability, dependability, and confirmability have been proposed as qualitative research's counterparts to them (Guba & Lincoln, 1982). In this study, the trustworthiness of qualitative research was ensured 1) via methodological triangulation, which strengthens credibility (see also Section 5.1); 2) by describing the characteristics of the participants, settings, and processes to permit adequate comparison with other samples (for transferability); and 3) by describing the methods in detail, to assure of dependability. The final notion listed, confirmability, represents the degree of the research's neutrality and freedom from researcher biases. Credibility, transferability, and dependability all enhance confirmability. (Miles, Huberman, & Saldaña, 2020, pp. 304–308)

5.7.2   Ethics considerations

The research fully complied with the national guidelines of the Finnish Advisory Board on Research Integrity (2012). Ethics considerations and data security were considered throughout the research process, with special attention being given to the involvement of minors.

Good scientific practice entails preparations before the research: certain permission and consent must be requested, the participants must be informed well about the research and its purposes, and all prospective subjects must be aware that

participating in the research is voluntary. These procedures honour the constitutional right to self-determination, which belongs to everyone, irrespective of age. Normally, research examining children requires obtaining informed consent from each child's guardian too. If the research is carried out in an institutional setting – e.g., a school – permission must be obtained also from the director of that institution, usually the headmaster in the case of a school. (Kohonen, Kuula-Luumi, & Spoof, 2019; Nieminen, 2010)

Teacher-training schools are unique among schools, however. Administratively, they are part of university education faculties and function in close collaboration with the university in pedagogy and research. Since they function as a development, experimentation, and research environment for their employees and other researchers, their students are involved in research projects in connection with their normal schoolwork, and participation in studies does not require the consent of guardians except in special cases (e.g., Normaalikoulu, 2020).

Permission for the doctoral research was requested and obtained from the school's headmaster in the usual manner, while the guardians were informed of the study, the aim for it, and the data-collection methods. They were also given an opportunity to prevent their children from participating in the study. No-one exercised this possibility.

According to the national guidelines, research must be conducted such that it does not cause harm to participants (Kohonen et al., 2019). The tasks that the students conducted during the intervention were in line with the learning aims specified in the curriculum, and the intervention was integrated into the courses in the Finnish language and literature and in history. This set-up guaranteed that the students were not deprived of any elements required by the curriculum. This design made certain also that the intervention and the control group received equal instruction with the exception of the intervention's presence or absence.

The participants' anonymity was guaranteed. Data that could have enabled identifying the participating students were anonymised. All data were collected, processed, used, and stored with respect for privacy and in awareness of confidentiality issues. Those data in electronic format have been stored securely, and all data in physical form are kept in a locked location. The only people with access to either the digital data or the material on paper are the two researchers[4].

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[4] The body of research data is not openly available. Participants were not asked for permission for its release at the relevant time, in 2015. The principles of open science were not as topical then as they are today.

6 OVERVIEW OF THE RESULTS

This chapter presents the main findings of the study. It is divided into six sections, corresponding to the research questions introduced in Chapter 4.

6.1 The pedagogical designs teachers created for online research instruction via Guided Inquiry Design and their experience of the development process (Pub. I)

Teachers' experiences of developing inquiry-based approaches to instruction in online research skills[5] were reported in Publication I. The focus was on the micro level: how teachers develop their practices for instruction in online research as part of their everyday work after being introduced to a new, research-based teaching model. The participating teachers ($n=3$) were interviewed for this study. The observation memos were referred to as supporting material, supplementing the interview data.

The teachers were found to use a wide spectrum of assignments in online research instruction, and new instruction models indeed can serve as a source of inspiration. Interestingly, commonalities became evident between the model introduced and elements of the Finnish curriculum. This facilitated incorporating some features of GID into the Finnish teaching practices.

GID divides the inquiry process into eight phases and places special emphasis on the orientation phases before the information-gathering proper. The idea behind this is to prepare students for it by arousing their curiosity, getting them to articulate what they already know, building a coherent base of background knowledge, and exploring ideas. Accordingly, the teachers devoted attention to the earlier parts of the inquiry process. They applied various designs for this, such as arranging group discussions about the theme, organising a museum visit related to it, and facilitating brainstorming about existing knowledge connected with the theme. The teachers

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[5] For publications I and II, the term 'information literacy' was used.

followed the model also in giving students greater room to choose topics aligned with their interests. Later reporting that investing time in the first few phases of the inquiry process had paid off, all the teachers stated that the students seemed to find topics that engaged them. However, they did mention encountering some difficulties in striking a balance among the various phases. For instance, emphasising the students' existing knowledge could encourage passivity as opposed to seeking new information.

In GID, students are guided to enhance their learning by means of various inquiry tools. One of them are *inquiry logs* that are intended to help keep track of information sources. They were introduced to the students in this study. Both printed and digital logs were tested (see Appendix 5 for the design). Regrettably, not all students used the log, and some did not fill it in completely. Despite that, the teachers saw potential in the logs. They characterised the students who had used an inquiry log as managing to synthesise information across sources better than those who had not used one.

GID encourages collaboration and teamwork – on the part of both the students and the practitioners (teachers and school librarians). In this study, the students worked in groups of several sizes: pairs, small groups, and the whole class. As for the teachers, some instruction and preparation work for intervention course 2 was handled jointly, and they reported that the students seemed to gain from drawing together the two subjects. Their learning in one had a positive effect on the other. The teachers stated also that they were satisfied with their mutual co-operation, though they did experience lack of time as preventing some of the planned collaboration. In retrospect, they found that a joint launch and, likewise, a shared summation would have been useful. They concluded that organising the project for one class at a time instead of three would be one way to enhance the collaboration further. It is noteworthy that, in a deviation from GID, the school librarian was not involved in the teaching intervention; related contact consisted only of a separate lecture on information-seeking that was already part of the school's curriculum. It emerged that members of some professions may be quite territorial, and co-operation cannot always be taken for granted.

GID requires self-direction and initiative on the learners' part. The teachers noticed that not all students were oriented toward a learner-centred way of working. Those who need directions and clear instructions from teachers, the requirement for independence may end up rudderless and develop a sense of giving up and indifference to the assignments. This was indeed evident with some students. Also, as in all activities with dependence on technical devices, technical problems and lack of ICT skills occasionally caused difficulties and distracted students from the task at

hand. Notwithstanding these issues, the teachers all concluded that, overall, inquiry-based learning appears to be a fruitful approach that accentuates important points to consider when one is teaching online research skills.

6.2 The teaching intervention's short- and long-term effects on students' online research skills (Pub. III and IV)

Publications III and IV report the study of the intervention's effect on students' online research skills. The former focusing on short-term effects and the latter on long-term ones.

The research addressed in Publication III was conducted as a pre–post study with a control group. Students' (n=87) skills were measured with tests designed specifically for this study, as described in Subsection 5.5.4.1. This testing, carried out on two occasions (before the first intervention course and after the second), measured students' skills related to four components of online research: planning of one's search and formulation of queries, Web search, critical evaluation, and argumentative use of information found on the Web. Mixed between–within-subjects ANOVA revealed the teaching intervention's impact on the skills assessed.

The analysis of pre-test and post-test data showed that the intervention group demonstrated higher learning outcomes in online research performance than the control. The mean overall test score rose from 3.93 to 4.73 (8 points was the maximum) in the intervention group while remaining around 3.7 in the control group (F(1, 85) = 6.43, p=.013, partial η^2 = 0.070). There was a medium effect size (partial eta-squared thresholds: small=0.01; medium=0.06; large=0.14; see Pallant, 2013, pp. 217–218).

Examining the component scores (max. 2 points each) one at a time revealed the intervention effect to be most noteworthy for *search-planning and query-formulation skills* (F(1, 85) = 5.36, p=.023, partial η^2 = 0.059). The score improved from 1.37 to 1.46 in the intervention group while falling from 1.44 to 1.36 in the control group. No effect on *Web-search skills*, *critical evaluation skills*, or *argumentative use of Web information* was visible.

The study reported in Publication IV utilised the simulated online environment NEURONE (see Subsection 5.5.4.2) as a setting for measuring students' skills in a delayed post-test (n=84). An independent-samples t-test served comparison of test-score means between the intervention and the control group. The test's results indicated no difference in online research skills between the groups. Although the

control group's mean overall score was 0.11 points higher, the difference was not statistically significant ($t(82)$ = -.40, p=.694). No inter-group difference in component test scores was evident either. Therefore, the effects observed immediately after the intervention proved not to last from the seventh grade to the eight grade. Table 2 presents a summary of the intervention effects.

Table 2.   Effects of the intervention

Category of effect	Short-term effect	Long-term-effect
Online research skills	x	-
Search planning and query formulation	x	-
Web search	-	-
Critical evaluation of Web information	-	-
Argumentative use of Web information	-	-
Self-efficacy related to online research	-	-
Attitude toward teacher-centred learning	-	-
Attitude toward independent online learning	-	-
Behavioural intentions in information search	-	-
Behavioural intentions in information evaluation	x	-
Behavioural intentions in information use	x	-

x = positive effect, - = no effect

6.3   How the teaching intervention changed students' self-efficacy beliefs and attitudes related to online research (Pub. II)

Publication II proceeded from the idea that the intervention's influence may extend beyond procedural knowledge and skills. It investigated effects on students' self-efficacy beliefs and attitudes related to online research. This entailed surveying the students (n=78–82) via a questionnaire at three points: before the first course (1), after the second course (2) and at the end together with the follow-up test data (3) to gauge their self-efficacy beliefs related to online research, attitudes to learning, and also behavioural intentions in online research.

The results, judged by means of mixed between- and within-subjects ANOVA comparing the intervention and control group, provided evidence that the intervention produced effects beyond skills. However, these extended to only two factors (see Table 2, above). Analysis indicated that the teaching intervention had a positive effect on students' behavioural intentions related to evaluation of search results ($F(2, 154) = 4.05$, p=.019, partial η^2 = .050) and information use ($F(2, 152) =$

3.533, p=.032, partial $\eta^2 = .044$), with the effect size approaching the threshold for 'medium' for both. Interestingly, the development occurred within the first year in both cases. For the former, the learning effect was observed between the 1. and 3. measurements (p=.004, partial $\eta^2 = .103$) and between the 1. and 2. measurements (p=.048, partial $\eta^2 = .050$), and it emerged between the 1. and 2. measurements for the latter (p=.021, partial $\eta^2 = .069$). The lack of evident effects after the midpoint (between measurements 2 and 3) in both cases suggests that no change took place after the first year. Finally, no statistically significant difference was found between the intervention and control group with regard to other attitudinal factors or self-efficacy beliefs.

6.4 Personal factors associated with the learning outcomes from the intervention (Pub. III)

To form a better understanding of the factors affecting students' skills development in online research, the work reported upon in Publication III explored student-related personal factors that might explain short-term learning outcomes connected with the intervention.

The students in the intervention group (n=53–55) were divided into two subgroups, High and Low, for each of the following: pre-test scores, ICT activity, self-efficacy, attitudes, and behavioural intentions. One variable at a time was examined for ascertaining whether a difference could be seen between the groups in the intervention's effects. This technique should reveal whether each variable, in turn, is associated with benefits from the intervention. The two subgroups' online research scores were compared both before the intervention (via a pre-test) and after it (via a post-test). The effect of gender was analysed also. Table 3 presents the results of the analysis, which utilised independent-samples t-tests and paired-sample t-tests.

The results attest that the intervention effect was the strongest among the students who were either 1) less active Web searchers or 2) less active social-media users and among those 3) with lower self-efficacy related to online research. The results from the post-test show that the difference in online research scores levelled out between these High and Low groups during the intervention. Students with low scores in each above-mentioned category seemed to receive a boost to learning new skills. Also, analysis identified a minor reduction in the gap between genders, though females retained their lead.

Surprisingly, a student's attitude to traditional learning emerged as another variable that was associated with learning outcomes. It was unlike the above-mentioned factors, however, in that it was not linked to differences at the pre-test stage. These emerged only at the post-test point. The High group for positive attitudes toward traditional teacher- and textbook-centred pedagogy showed greater improvement in skills than the Low group did. Interestingly, the students' attitude to independent online learning was not associated with learning outcomes. The High group for students who preferred independent learning with the Internet's aid did not improve in online research skills any more than the Low group.

Table 3. Intervention effects effects for various groups of students

Grouping criterion for High and Low	Pre-test standings	Post-test standings	Intervention effect
Success in pre-test	High group outperformed Low group	Difference in skills remained on group level	-
School-related ICT activity	High outperformed Low	Skill gap decreased, with the less active improving more	x
Leisure-time-related information-seeking activity	No difference between the groups	No difference; no change	-
Social-media activity	High outperformed Low	Skill gap decreased, with the less active improving more	x
Self-efficacy	High outperformed Low	Skill gap decreased, with those having lower self-efficacy improving more	x
Attitude toward online learning	No difference between the groups	No difference; no change	-
Attitude toward traditional learning	No difference between the groups	Gap in skills emerged: those with a more positive attitude improved more	x
Behavioural intentions	No difference between the groups	No difference; no change	-
Gender	Females out-performed males	Difference in skills declined but remained	-

Leisure-time information-seeking activity and behavioural intentions related to online research were personal variables that distinguished between students in neither the pre-test nor the post-test. With regard to success in the tests, the difference between the High and Low group remained clear after the intervention. However, a learning effect still could be seen in the Low group.

6.5 Skill profiles emerging among lower secondary school students in terms for information search, evaluation, and use (Pub. IV)

One aim behind Publication IV was to identify distinct skill profiles of students (n=84) across the subtasks of online research (information search, evaluation, and use). The follow-up test yielded performance data that were independent for each subtask and thus enabled grouping students by skill profile on the basis of sub-scores.

Six skill-profile clusters were identified. Characterised in Table 4, these are information-literate students (n=16; 19%), fact-finders (n=20; 24%), medium achievers (n=17; 20%), weak searchers (n=10; 12%), weak evaluators (n=14; 17%), and weak information-users (n=7; 8%). The *information-literate* are high achievers in their evaluation and information use, and they are medium achievers in the search realm, though approaching high achievement there too. Their online research skills seem good in general. *Fact-finders* are high achievers in searching and information use and are medium achievers in evaluation. Their evaluation score trails behind the other components' values, indicating that, while they have developed good practices for finding relevant information and using sources, they may not pay much attention to the sources' reliability. *Medium achievers* were average for all three test components; hence, no particular features or specific skills stand out. *Weak searchers*, in turn, failed to find some of the relevant sources but did demonstrate moderate skill in evaluating and using the sources provided. *Weak evaluators*, in contrast, achieved medium scores in Web searching and information use but failed at evaluation. *Weak information-users* were medium-level achievers in Web search and evaluation but failed to apply the information available from the relevant sources.

Patterns emerged in overall scores on the basis of clusters: information-literate students and fact-finders constituted the *high performers* (n=36; 43%); medium achievers represented *medium performers* (n=17; 20%); and the weak-searcher, weak-

evaluator, and weak-information-user clusters formed the set of *low performers* (*n*=31; 37%).

Table 4.   Skill profiles

Test component	Information-literate	Fact-finders	Medium achievers	Weak searchers	Weak evaluators	Weak information users
Skills in search	Medium	High	Medium	Low	Medium	Medium
Skills in evaluation	High	Medium	Medium	Medium	Low	Medium
Skills in use	High	High	Medium	Medium	Medium	Low
Skills overall	High	High	Medium	Low	Low	Low
n Percentage	16 (19%)	20 (24%)	17 (20%)	10 (12%)	14 (17%)	7 (8%)
Description	High performers: medium or high scores for every component		Medium performers: average for all components	Low performers: medium achievers but failing with one component		

The results show that about two thirds of the students (64%) performed reasonably well, earning a medium or high score for every component. Those who exhibited failure for one of the components (36%) managed to stay at medium level for others. It was striking, however, that only one fourth earned high scores in searching subtest (fact-finders cluster, 24%), and even fewer, only every fifth of students, earned high scores in evaluation (information-literate cluster, 19%).

6.6   Personal factors associated with students' online research skills (Pub. IV)

The fourth study looked also for personal factors that might explain students' (*n*=84) development toward better or poor performance in online research. For this purpose, the study compared between high and lower performers on the basis of their scores from the follow-up testing. The high- and low-performance clusters of students (see Section 6.5) were compared in various respects. Table 5 presents the findings.

Results from analysis of students' pre-intervention self-efficacy beliefs, attitudes, and ICT activity showed that the groups differed in self-efficacy related to online research. A connection was visible between positive self-efficacy beliefs and skills in online research: the high performers had stronger self-efficacy beliefs than the low performers. The results indicated also that positive attitudes to traditional teacher-centred learning might support students' development in online research skills.

No difference was observed for other attitudinal factors or in ICT activity. Neither did the results reveal a difference between the groups with regard to gender: both females and males were equally represented among the high and low performers.

Table 5.   The personal factors differentiating high and low performers

Factor	Effect	No effect
Self-efficacy related to online research	x	-
Attitude toward online learning	-	x
Attitude toward traditional learning	x*	-
Behavioural intentions		x
School-related ICT activity		x
Leisure-time-related information-seeking activity		x
Social-media activity		x
Gender		x

* = borderline significance

6.7   The results in summary

A summary of the most important results follows, drawing together the descriptions above before the next chapter's synthesis and discussion of implications.

The teachers used several types of assignments and instructional activities in their teaching on online research and proved capable in some respects of adapting their teaching practices to follow GID principles. The framework introduced exhibited similarities to what the Finnish curriculum outlines, so some GID features were especially easy to implement in these practices.

The intervention group outperformed the control group in the post-test administered to seventh-grade students. Examining one test component at a time revealed that the intervention effect was most noteworthy for search-planning and query-formulation skills. Importantly, this effect observed immediately after the intervention did not last until the following year.

Over the course of the teaching intervention, students' behavioural intentions changed for the better with regard to evaluation of search results and also information use. No effect of the intervention was evident for other aspects of attitude or for self-efficacy beliefs.

In the seventh-grade context, the intervention effect was most powerful among the students who had reported being less active Web searchers or social-media users and among those showing lower self-efficacy related to online research. In addition, the students who had a positive attitude toward traditional teacher-centred learning showed an improvement in skills.

In examination of personal factors correlating with students' online research skills, self-efficacy beliefs stood out as the only one showing such an association among the eighth-grade students.

Six skill profiles emerged, characterising patterns of strengths and weaknesses in students' handling of the subtasks of online research: the information-literate, fact-finders, medium achievers, weak searchers, weak evaluators, and weak information-users. These profiles suggest that many students suffer from mediocre or poor searching and, even more so, from poor evaluation skills.

7   DISCUSSION

This chapter discusses the main findings presented in Chapter 6 and how they tie in with prior research. It highlights the contributions and practical implications of the study, including pedagogical recommendations. Finally, limitations of the work are identified with an eye to the most pressing needs for future research.

7.1   The gap addressed

This study aimed to fill some of the gaps identified in research into individual teachers' attempts to develop their instruction practices for better development of students' skills in online research. There is a lack of studies that focus on the development work of individual teachers. Concerning students, a crucial shortcoming of scholarship is the scarcity of performance testing related specifically to the online research skills of students in lower secondary education. The work also addressed the shortage of studies examining longer-term effects of online research interventions. Finally, there is hardly any previous research on skill profiles, or how students' overall skills in online research are formed of their skills in the subtasks.

The first subsection below addresses the objective of investigating what kinds of pedagogical designs lower secondary school teachers develop for online research instruction upon introduction to a dedicated, research-based pedagogical framework, and the discussion then addresses the aim of ascertaining the sorts of short- and long-term effects the resulting teaching intervention has on students. The study's efforts to identify personal factors associated with the intervention effects and with the general level of skill in online research achieved by students are addressed too, with special attention to the contribution of looking beyond the formal instruction to students' overall development via emphasis on online research skill profiles and on associations between skills and personal factors.

7.1.1   Developing online research instruction

Some research has cast doubt on the teaching practices employed in online-research-related instruction (e.g., Alexandersson & Limberg, 2012; Hongisto & Sormunen, 2010; Sundin & Carlsson, 2016) and indicates that even teachers themselves question their ability to teach the skills involved (e.g., Colwell et al., 2013; Seufert et al., 2016). At the same time, some individual teachers do actively develop their professional practice in this area of instruction (e.g., Sormunen & Lehtiö, 2011; Sormunen & Alamettälä, 2014). Hence, by accounting for such individual-level development work and inspiring the teachers with ideas from the GID model for research-based instruction (per Kuhlthau et al., 2015), the research enriched work on online research instruction. Pioneering studies of this nature could help researchers gain better understanding of the teacher's perspective on teaching practices and illuminate real-world challenges faced in schools.

In Finland, schools and municipalities draw up local curricula and annual plans within the framework of the national core curriculum, with teachers having freedom to plan their teaching quite independently and choose the pedagogical methods they deem most suited to reaching the goals set by the curriculum (see, for example, Pyhältö et al., 2012). The present study shows that a model emphasising learner-centered, phase-based way of working was relatively easy to implement in Finnish conditions. The teachers involved did not identify any major hindrances to applying the GID framework within the setting of the Finnish curriculum and existing teaching practices.

The teachers chose to devote attention to the phases earlier in the inquiry process so that the students would be prepared well for information-gathering and have something to support them when digesting new knowledge. Also, students received more space to choose topics of interest to them. This requires the learners to take initiative. The results crystallise the fact that not all students are as amenable to learner-centred methods even though these have become commonplace in schools (cf. Lonka et al., 2018). Some still need explicit directions and clear instructions, and they appeared to be unmotivated when faced with assignments requiring initiative. Another facet of the conditions that merits consideration is the teachers' problems in achieving balance among the phases. A more systematic use of GID and all its tools to scaffold the students' research process might have helped to overcome these challenges (see Heinström & Sormunen, 2019).

As GID recommends, the teachers invested in team-based work on both students' part and their own. While the teachers seemed quite content with the work

across subject boundaries, time constraints prevented some of the co-operation originally envisioned: there was not as much time as desired for working with each student group. Naturally, this restricted the possibilities for implementing new ideas and practices. In an ideal situation, renewal of pedagogical practices would be a school-wide process wherein novel practices are tested and made routine across the various subjects and courses.

GID assumes that the school library takes part in actively developing the instruction in online research skills and supports teachers' implementation of the model. Only few Finnish schools have a school library or pedagogically qualified librarians. Another factor with relevance is that, in this setting at least, the territorial nature of the professions involved could render co-operation less straightforward.

7.1.2   Short-term intervention effects – skills

The intervention demonstrated measurable positive effects on students' online research skills in that the intervention group outperformed the control group in the post-test in the seventh-grade setting. This is consistent with intervention effects reported from prior intervention studies related to online research or related skills (e.g., Argelagós & Pifarré, 2012; Chen et al., 2017; Pifarré & Argelagós, 2020).

Examining the effects more closely, one test component at a time, revealed that the intervention effect stood out the most for search-planning and query-formulation skills. This can be explained by factors related to the pedagogical design of the intervention, such as the attention paid to the first parts of the inquiry process. Students were guided to conceptualise the topic of the assignment and develop a personal focus on it before the practical work of the information search.

Previous research has shown that teachers tend to approach searching from a technical point of view (Limberg et al., 2008). The GID model offered means of overcoming this challenge. Likewise, Argelagós and Pifarré (2012) found that activating prior knowledge and specifying the information need helped students define the problem.

7.1.3   Short-term intervention effects – attitudes and self-efficacy

The investigation of the intervention's effect on student attitudes and self-efficacy beliefs related to online research was pioneering. No earlier studies of such effects in the context of online research were found. The results reveal positive impacts of

the teaching intervention on students' attitudes with regard to behavioural intention connected with two themes that were emphasised in the intervention courses: evaluation of search results and information use. The students were required to practise both, whereas search practices, while acknowledged, most likely were not addressed sufficiently. That said, since the positive change in these two behavioural intentions did not lead to improved performance, they too probably would have needed deeper assimilation before becoming realised in practice.

No effect on other attitudinal factors (toward teacher-centred or independent online learning) was evident. However, attitudes are complicated to measure and interpret, as many factors external to the intervention may affect them – especially among students going through their teenage years.

Self-efficacy measurements too should be interpreted with caution. People often judge their skills better than they really are, and this is especially true of inexperienced individuals (Bellini, Isoni Filho, de Moura, & de Faria Pereira, 2016; Aesaert et al., 2017). As skills develop, one's judgements usually grow more accurate and realistic. Therefore, because the performance of the intervention group showed improvement, some positive bias in their self-efficacy beliefs might have disappeared. Regrettably, comparing any bias-related changes between the experimental and control group was not possible with the instruments used in this study. Hence, it is impossible to state with certainty whether the intervention influenced the accuracy of students' self-efficacy beliefs.

7.1.4   Factors associated with a stronger intervention effect

The research contributed also to awareness of which kinds of students may be most responsive to such interventions and of possible links between their personal characteristics and the intervention effect experienced. That effect turned out to be strongest among the less active Web searchers, the less active users of social media, and those with lower self-efficacy related to online research. For each of these groups, the post-test results indicated that the intervention decreased the gap between the groups in online research skills. It seemed to boost less active and less confident students' learning of online research. The intervention probably added a useful supplement to their online routines.

Those students who had a positive attitude toward traditional teacher-centred learning benefited also from the teaching intervention. Surprisingly, students who preferred independent online learning did not show this pattern, even though the

intervention specifically focused on this. It might be that a positive attitude to teacher-centred learning is indicative of greater engagement in learning in school overall. High engagement leads to more effective learning (e.g., Perkins et al., 2005; Cahill et al., 2018), and it probably does not matter whether the goal is to learn online research skills. It could be that, in contrast, student who express more positive views of online learning may be less engaged in their schoolwork overall. After all, some view online study as an easier way of getting one's school assignments done or see it as an opportunity to escape from normal study routines and learning. This may well have been a factor in the intervention setting.

7.1.5   Long-term intervention effects

It is telling that the follow-up test revealed the intervention effect not to last until the students' eighth-grade studies. Learning outcomes were observable only immediately after the most intense instruction, in the previous school year. Successful online research requires a complex set of skills, and these are not easy to learn and maintain. Advancing in them demands continuous practice across school subjects, over several years (cf. Lakkala & Ilomäki, 2011; Brand-Gruwel et al., 2005). Modifications to single courses seem not to be enough.

Studies of long-term intervention effects of endeavours to improve online research skills or information literacy are virtually absent. A rare exception, Baji et al.'s (2018) study confirmed a positive intervention effect. Methodological issues may explain the divergence between their finding and the results of the study reported upon here. Baji et al. conducted an intensive six-week intervention (with two 45-minute sessions each week), and their delayed test came only two months after the intervention. In the doctoral research, the delay was substantially longer, with the follow-up test taking place nine months after the second course. It is noteworthy also that Baji et al. used a knowledge test with multiple-choice questions to measure students' learning outcomes. It might be easier to recall fact-oriented knowledge than it is to maintain good practices and genuine skills.

7.1.6   Students' skill profiles

By not concentrating purely on the intervention and its effects, the research enriched understanding further. Investigating the skill profiles of intervention-group and

control-group members across all subtasks of online research yielded valuable information about students' skillsets related to online research.

Earlier research has shown that there are remarkable differences in online research skills between students (e.g., Hatlevik & Christophersen, 2013; Hargittai, 2010). Through developing the skill profiles characterising strengths and weaknesses in students' performance for the subtasks (information-literate, fact-finder, medium achiever, weak searcher, weak evaluator, and weak information-users), the work elaborated the variation of students' skills in the subtasks of online research. The results show that those who failed with one component may have performed moderately well in others. Thus, the clustering pinpointed a challenge for teachers, in that students need targeted, personalised support. On the other hand, the finding is encouraging also: most students have skills in at least some components, on which they can build.

Across the board, however, many students were found to suffer from poor evaluation skills. Only students in the 'information-literate' cluster scored well for the evaluation subtask. Evaluating information has proved to be one of the most complicated parts of online research, as prior research attests (Forzani, 2018; Foo et al., 2014; Leino et al., 2019; Paul, Macedo-Rouet, Rouet, & Stadtler, 2017). Several studies indicate that students easily ignore features of particular sources, though this effect may stem from not only lack of skills but also lack of motivation (Brante & Strømsø, 2018).

Typically, tests measuring students' online research skills have focused on a single subtask or a catalogue of their performance, subtask by subtask (e.g., van Deursen & van Diepen, 2013; Paul et al., 2017; Kiili & Leu, 2019). This study provided a broader picture of students' skills.

7.1.7   Factors supporting the development of online research skills

While no long-term effects of the teaching intervention on students' skills were found, the performance tests indicate that some students achieved a higher level of online research skills than others. Because these students all had the same educational background, formal learning cannot explain the difference in these skills. Yet the only personal factor for which an association stood out is self-efficacy – it was higher among the high performers than the poor performers. This is in line with prior research. Self-efficacy has demonstrated a correlation with computer and information literacy (Fraillon et al., 2020; Hatlevik et al., 2018; Aesaert et al., 2015;

Nikou et al., 2019). Also, scholars have speculated that high self-efficacy contributes positively to skills development and learning (Kurbanoglu, 2009; Aesaert et al., 2017).

The results point to positive attitudes toward traditional teacher-centred learning as possibly associated with students' online research skills. As noted above, this link may reflect the students' engagement with the school's pedagogical practices in general. That is, the connection may be explained by their general interest in learning, whether during or outside school hours, and lead them to activities that aid in learning online research skills. Also, as Aesaert et al. (2015) detected, students' learning style seems related to their competencies (in their study, ICT competencies); a more controlled learning style was associated with stronger abilities.

7.2   Practical implications of research

This research offers a solid contribution to the pedagogy of online research skills. Firstly, the intervention serves as an example of how individual teachers may draw inspiration and ideas from research-based pedagogical models and develop their instruction practices accordingly. Furthermore, a more detailed picture of students' skill profiles and the factors associated with skill development aids in understanding both formal and informal learning of online research skills.

We cannot rely on the assumption that students develop online research skills simply by performing certain kinds of assignments at school or that their skills develop spontaneously through outside activities. Hence, this work demonstrates the importance of well-designed organised activities for instruction in online research. These proved effective even though the effects demonstrated in this case were limited to one subtask: planning searches and formulating queries. Balanced progress encompassing all sub-skills may be achieved by operationalising learning goals for each subtask more concretely.

To maintain the skills they have gained, students need practice throughout their schooling. Obviously, the chances of an individual teacher or teacher team in this respect are limited. In an ideal situation, the whole school would be involved, as most of the pedagogical models recommend. Collaboration among all the teachers to develop long-term instruction in online research skills is recommended. Small-scale interventions may bring short-term gains, but they are not enough to maintain skills as complex as online research skills. Accordingly, it is important that schools and municipalities ensure allocation of sufficient time and other resources for

teachers to develop strong instruction in these skills. It is vital also that teachers learn to identify the gaps in students' skills.

The results highlight clear room for improvement in students' online research skills. However, the study simultaneously showed that so-called low-performing students usually failed only in one test component while managing the others relatively well. This indicates that failing in one subtask does not necessarily mean that the student could not manage other tasks – if given the opportunity. Clearly, then, it is important to remember that students are a heterogeneous group and to identify each student's weak points and provide targeted support accordingly.

Self-efficacy beliefs were found to be associated with students' online research skills. The results indicate also that positive attitudes to traditional teacher-centred learning might enhance the development of students' skills. Encouraging students to believe in themselves and motivating them to study appears crucial when it comes to online research skills. Flexible and targeted assignments may make a difference here; through successful experiences, the students will perceive themselves as more competent, and this might lead, in turn, to stronger competencies (see also Aesaert et al., 2015).

7.3   Limitations of the study

Some limitations should be noted at this point. Firstly, the core of the research was a case study focused on a single teacher (alongside two of her colleagues) in a single school. The intervention was conducted within the confines of one subject for the most part (partly two). Therefore, caution should be exercised in any generalisation. However, the setting describes the reality of Finnish schools well. In particular, the situation is typical for a lower secondary school teacher: the central practitioner worked independently, with her influence on the students being bounded accordingly and her opportunities to carry out broader-based changes remaining limited.

Secondly, measuring skills is challenging. Evidence of student' skills in online research can be collected in various ways, but all of these have their limitations. Performance-based testing was chosen for this research since this has been shown to be the most effective way to document actual applied skills. Still, this type of test only simulates realistic online research tasks and information environments. Furthermore, performance tests cannot assess students' real practices in their school assignments requiring online research.

A third caveat is that, traditionally, the two tests in a pre-test–post-test experiment design should be identical, presenting the same questions. In this case, the pre- and post-test had the same form but different themes, in the interest of ruling out memorisation effects. However, care was taken to keep the subtasks and the flow of operations similar between the two tests. Both measured learning outcomes in respect of students' Web searching, critical evaluation of sources, and argumentative use of Web information. Also, for the delayed post-test, the test form too was changed. Naturally, this change made comparison between pre-/post-test results and results from the delayed post-test impossible.

The reliability and validity of the study are addressed more thoroughly in Subsection 5.7.1.

7.4 Recommendations for future research

The research showed that the possibility of any individual teacher's efforts having a lasting effect on students' online research skills is limited. For this reason, it would be important to involve the entire school in one's research, in aims of implementing larger-scale interventions.

The possibly short-term nature of teaching interventions' effects draws attention to the need for longitudinal follow-up studies. Further intervention studies with delayed performance tests are required. Also, scholars should carry out more research involving pedagogical models such as GID, for accumulating greater experience of their effectiveness and recommendations for how to operationalise them in specific real-world conditions.

The scope of this research did not encompass investigating the connection between overall levels of academic achievement and students' skills in online research. Future studies could monitor and analyse students' academic achievement in this connection. In addition, the association between reading fluency and skills in online research would be worth examining. Finally, motivation-related factors are naturally always at the heart of learning and should be studied also in the context of online research.

8 CONCLUSIONS

This dissertation yielded new knowledge of teachers' practices for instruction in online research and their ways of applying new instruction methods, in the setting of work in a Finnish lower secondary school. Furthermore, it deepened understanding of students' online research skills and the factors affecting their development. Thus, it should support further advances to online research instruction methods.

The study revealed that Finnish lower secondary school teachers have good opportunities to utilise research-based pedagogical models for information literacy and online research, as these models dovetail in several respects with the Finnish curriculum. Primarily, they share the aim of learner-centred learning wherein students take more responsibility for their learning.

Any individual teacher's endeavours to apply new instruction methods in everyday professional practice in the school might not be enough, however, to produce lasting learning outcomes. More thorough changes (including allocation of enough resources) on school level and in local curricula are required if one wants to ensure more powerful, larger-scale actions.

Those planning the instruction need to account for variations between students and in their skill levels. No group of students is homogenous, and learners need targeted support in developing their online research skills. It is to be noted, though, that evaluation of information seems to be a common stumbling block that demands special attention.

Just as formal learning does not explain the differences in online research skills, it cannot level out the landscape entirely. Still, boosting students' self-efficacy and urging them to stay positively tuned to learning overall is a step in the right direction. This is crucial to developing their online research skills and other skills as well.

This type of intervention studies has been relatively rare in information studies. Most are education-science efforts instead. The dissertation steps into this void in the literature and strengthens scholarship addressing information literacy and online research skills in Finland. It offers a coherent account of a longitudinal study in an authentic environment with a compact but typical sample of Finnish lower secondary school students.

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Questionnaire

Name: _____

School: _____

Class: _____

Your previous school: _____

A. How good are your skills?

In this section, you are asked to assess your own skills in information-searching and use related to school assignments.
For each statement, think about how well you manage in the matter.
Tick the option that best describes you (one at each point).

READ THE STATEMENT AND CHOOSE THE OPTION THAT BEST DESCRIBES YOURSELF.	I can do this…				
	Very well	Well	Quite well	Poorly	Not at all
1. I can solve school tasks that require searching for information also somewhere else than in the textbook.	☐	☐	☐	☐	☐
2. I can search for information on the Internet.	☐	☐	☐	☐	☐
3. I can choose suitable search terms.	☐	☐	☐	☐	☐
4. I can choose the best link from search results (e.g., a list provided by Google).	☐	☐	☐	☐	☐
5. I can scan through a website to decide if it is useful for me.	☐	☐	☐	☐	☐
6. I can find out what foreign words on the website mean.	☐	☐	☐	☐	☐
7. I can search for information on Wikipedia.	☐	☐	☐	☐	☐
8. I can choose the information I need from the found website.	☐	☐	☐	☐	☐
9. I can assess whether the information on a website is reliable.	☐	☐	☐	☐	☐
10. I can find out the name of the author of the website or the administrator of the website.	☐	☐	☐	☐	☐
11. I can combine information from different websites and write a summary of them.	☐	☐	☐	☐	☐
12. I can write in my own words based on sources.	☐	☐	☐	☐	☐
13. I can make a reference list for my essay.	☐	☐	☐	☐	☐
14. I can identify what is relevant information in the texts that I read.	☐	☐	☐	☐	☐
15. I can take notes from what I read.	☐	☐	☐	☐	☐
16. I can write in my own words what I read.	☐	☐	☐	☐	☐
17. I can write factual texts.	☐	☐	☐	☐	☐
18. I can write imaginative stories.	☐	☐	☐	☐	☐
19. I can check through an online library if a book can be found in a nearby library.	☐	☐	☐	☐	☐
20. I can reserve material through an online library.	☐	☐	☐	☐	☐
21. I can search for books or magazines in the library.	☐	☐	☐	☐	☐
22. I can borrow material from the library.	☐	☐	☐	☐	☐

B. What do you think?

For the following statements, consider <u>whether you agree or disagree with the statements</u>.
Tick the option that best matches your opinion (one in each section).

CHOOSE THE OPTION THAT BEST DESCRIBES YOUR OPINION	I...				
	Totally agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Totally disagree
1. Using the Internet for information searching is beneficial because it saves time.	☐	☐	☐	☐	☐
2. I find school assignments that require searching for information and reading online more useful than other types of assignments.	☐	☐	☐	☐	☐
3. I would rather gather information for my essay on the Internet than using a book or magazine.	☐	☐	☐	☐	☐
4. I prefer to read things from textbooks.	☐	☐	☐	☐	☐
5. I prefer to get to know new topics under the guidance of a teacher.	☐	☐	☐	☐	☐
6. I like to do assignments in exercise books.	☐	☐	☐	☐	☐
7. I like to make presentations.	☐	☐	☐	☐	☐
8. I prefer to search information together with someone.	☐	☐	☐	☐	☐
9. There is too much information on the Internet.	☐	☐	☐	☐	☐
10. I find searching information online annoying.	☐	☐	☐	☐	☐
11. It is very important to me that I understand what I find online.	☐	☐	☐	☐	☐
12. I rely on textbooks more than information found online.	☐	☐	☐	☐	☐
13. Wikipedia articles are easy to read.	☐	☐	☐	☐	☐
14. I am willing to spend time searching for information.	☐	☐	☐	☐	☐
15. I like searching and reading new things online.	☐	☐	☐	☐	☐
16. I find it annoying that there is often contradictory information on the Internet.	☐	☐	☐	☐	☐
17. I learn a lot when I search for information and read online.	☐	☐	☐	☐	☐
18. I like to search for information at the library (books, magazines).	☐	☐	☐	☐	☐
19. I only read books if I have to.	☐	☐	☐	☐	☐
20. If a topic interests me, I search the web for information.	☐	☐	☐	☐	☐
21. I could not be less interested in things found on the Internet.	☐	☐	☐	☐	☐
22. I find writing laborious and time-consuming.	☐	☐	☐	☐	☐
23. It is important to me that I'm good at searching for information online.	☐	☐	☐	☐	☐
24. I am constantly striving to learn to be a better information searcher online.	☐	☐	☐	☐	☐

C. How do you search and use information in school assignments?

In this section, you are asked to think about what you do when you have a school assignment that requires information-searching (e.g. a presentation). Tick the option that best describes you (one at each point).

1. When giving a presentation, where do you search for information / who do you ask for help?	I do this...				
	Almost always	Quite often	Sometimes	Rarely	Never
a) I look at the textbook.	☐	☐	☐	☐	☐
b) I ask the teacher.	☐	☐	☐	☐	☐
c) I ask other pupils.	☐	☐	☐	☐	☐
d) I ask my parents.	☐	☐	☐	☐	☐
e) I ask my siblings.	☐	☐	☐	☐	☐
f) I search for information on the Internet / on Wikipedia.	☐	☐	☐	☐	☐
g) I search for literature at the library.	☐	☐	☐	☐	☐
h) Somewhere else, where?_____					

2. When searching for information online for a presentation, how do you proceed?	I do this...				
	Almost always	Quite often	Some-times	Rarely	Never
a) When I get a task from a teacher, I first think about how I will accomplish the task.	☐	☐	☐	☐	☐
b) Before I begin the task, I look to see if I can break the task into smaller pieces to make it easier.	☐	☐	☐	☐	☐
c) Before beginning information search about a topic, I think about what I know about that topic.	☐	☐	☐	☐	☐
d) I think carefully before searching which search terms to use.	☐	☐	☐	☐	☐
e) I do the search with the search terms that first come to mind.	☐	☐	☐	☐	☐
f) While I am conducting an information search on the Internet, I stop at times and think about how well I am doing and change strategies if necessary.	☐	☐	☐	☐	☐
g) I stop searching as soon as I find something suitable.	☐	☐	☐	☐	☐
h) I try different search terms to find everything I need.	☐	☐	☐	☐	☐
i) I follow interesting links to find useful pages.	☐	☐	☐	☐	☐
j) I search Wikipedia for links to original sources of information.	☐	☐	☐	☐	☐

3. When you read the search results, how do you proceed?	I do this...				
	Almost always	Quite often	Sometimes	Rarely	Never
a) When reading information on the Internet, I think about whether it matches the required information I am looking for.	☐	☐	☐	☐	☐
b) When I have trouble understanding information I found on the Internet, I reread the assignment.	☐	☐	☐	☐	☐
c) Before using information from a website, I check to see if the author is reputable.	☐	☐	☐	☐	☐
d) If I am searching for information on the Internet, I can motivate myself even if the topic is boring.	☐	☐	☐	☐	☐
e) When I navigate to a website on the Internet, I tend to read the whole page before clicking on any hypertext (links).	☐	☐	☐	☐	☐
f) When I become confused about something I am reading on the Internet, I do not give up but reread the text.	☐	☐	☐	☐	☐
g) Before I begin to read or scan through a source, I think about what I am supposed to be looking for.	☐	☐	☐	☐	☐
h) I only use Wikipedia if it provides an answer.	☐	☐	☐	☐	☐
i) I skim through the entire website to decide whether or not the information is useful for my question.	☐	☐	☐	☐	☐
j) I stay focused on the information I need from a website rather than getting distracted by things I do not need (e.g. adverts).	☐	☐	☐	☐	☐
k) I always think about where a website link might lead before I click on it.	☐	☐	☐	☐	☐
l) I always investigate if the information on a website is a reliable and trustworthy.	☐	☐	☐	☐	☐
m) I try to find out who is the author of the website.	☐	☐	☐	☐	☐
n) When I find a source of interest, I write down the address or save the link (bookmark).	☐	☐	☐	☐	☐
o) I print interesting sources for later use.	☐	☐	☐	☐	☐

4. When writing a presentation using sources, how do you proceed?	I do this…				
	Almost always	Quite often	Sometimes	Rarely	Never
a) I first familiarize myself with the sources I have found to understand the matter properly before I begin writing.	☐	☐	☐	☐	☐
b) I prepare to write by first taking notes on the sources.	☐	☐	☐	☐	☐
c) I combine information from more than one website.	☐	☐	☐	☐	☐
d) I copy the text parts if they fit my own text.	☐	☐	☐	☐	☐
e) I always write in my own words and avoid direct copying.	☐	☐	☐	☐	☐
f) When writing a factual text, I often return to examine the sources to see if I have understood things about them correctly.	☐	☐	☐	☐	☐
g) I list the sources on the reference list as soon as I have used them in my text.	☐	☐	☐	☐	☐
h) When I have completed a school assignment, I think about how well it went and what I could have done differently.	☐	☐	☐	☐	☐

Please check that you answered each point.

Thank you for your answers!

Background information

Name: _____

Year of Birth: _____

Class: _____

This survey studies how you use the Internet as well as various IT devices such as a computer or a smartphone at home and at school.

For the following questions and statements, choose the option that best describes you.

Do you have access to a computer, tablet, or smartphone?	Yes	No
We have a computer at home (desktop or laptop) that I can use.	☐	☐
We have a tablet at home (e.g., iPad, Samsung) that I can use.	☐	☐
I have a smartphone.	☐	☐
At school, we use tablets (e.g., iPad) in lessons.	☐	☐

Do you have access to the Internet?	Yes	No
I can access the Internet at home from a computer (e.g., laptop, tablet).	☐	☐
I have a smartphone to access the Internet.	☐	☐

Do you use email?	Yes	No
We have a computer at home (e.g., laptop, tablet) that I use for email.	☐	☐
I have a smartphone for using email.	☐	☐
I have my own email address.	☐	☐

Think about how often you use your computer, tablet, or smartphone for the following purposes.	Hardly ever	Seldom (once or twice in a month)	Once or twice in a week	Almost every day	Every day max 2 hours	Every day more than 2 hours
For entertainment use (e.g., playing games, watching videos, listening to music)	☐	☐	☐	☐	☐	☐
For reading and writing emails	☐	☐	☐	☐	☐	☐
For chatting with friends (e.g., chat, WhatsApp, Facebook, Skype)	☐	☐	☐	☐	☐	☐
To search for information (e.g., for hobbies, school assignments, music, fashion, etc.)	☐	☐	☐	☐	☐	☐
For sharing text, images or videos I have created (e.g., in a blog, Twitter, Facebook, Instagram, YouTube)	☐	☐	☐	☐	☐	☐
For something else? _____	☐	☐	☐	☐	☐	☐

How often do you use a computer to do school assignments?	Hardly ever	Seldom (once or twice in a month)	Once or twice in a week	Almost every day	Every day
I use a computer, tablet, or smartphone at school to do assignments given by teachers.	☐	☐	☐	☐	☐
I use a computer, tablet or smartphone to do my homework at home.	☐	☐	☐	☐	☐

Think about how often you use the Internet to search for information	Hardly ever	Seldom (once or twice in a month)	Once or twice in a week	Almost every day	Every day
At school, I search the web for information to do assignments given by a teacher.	☐	☐	☐	☐	☐
After school, I search the web for information to do homework.	☐	☐	☐	☐	☐
In my free time, I search the Internet for information about things that interest me (e.g., hobbies, music)	☐	☐	☐	☐	☐

Next, think about how you have been advised to use the Internet.	Never	At least once	More than once
The teacher has advised me on how to search information online.	☐	☐	☐
My father, mother, or some other adult has advised me on how to search information online.	☐	☐	☐
The teacher has told me how to know whether the website can be trusted.	☐	☐	☐
My father, mother, or some other adult has told me how to know whether the website can be trusted.	☐	☐	☐
The teacher has advised me on how to write emails.	☐	☐	☐
My father, mother, or some other adult has advised me on how to write emails.	☐	☐	☐

Next, think about how often you read different texts online.	Hardly ever	Seldom (once or twice in a month)	Once or twice in a week	Almost every day	Every day
Newspaper websites (e.g., Aamulehti, Iltalehti)	☐	☐	☐	☐	☐
Websites on various topics (e.g., interests, hobbies, sports, resorts, goods)	☐	☐	☐	☐	☐
Blog posts	☐	☐	☐	☐	☐
e-books	☐	☐	☐	☐	☐
Forums (e.g., discussions about games, artists, hobbies)	☐	☐	☐	☐	☐
Something else, what? _____	☐	☐	☐	☐	☐

And how often do you read the following texts printed on paper?	Hardly ever	Seldom (once or twice in a month)	Once or twice in a week	Almost every day	Every day
Books (stories, youth books, non-fiction)	☐	☐	☐	☐	☐
Comics	☐	☐	☐	☐	☐
Newspapers (e.g. Aamulehti)	☐	☐	☐	☐	☐
Magazines (e.g. Villivarsa, Koululainen, Urheilulehti, Demi)	☐	☐	☐	☐	☐
Something else, what? _____	☐	☐	☐	☐	☐

Please check that you have answered each question.

Thank you for your answers!

APPENDIX 3: INTERVIEW GUIDES

Translation (originals in Finnish)

Intervention 1

INTERVIEW WITH FINNISH LANGUAGE TEACHER BEFORE INTERVENTION 1
September 2015 / Course FI1

New curriculum and multiliteracy

Multiliteracy is included in the new curriculum 2016, what kind of thoughts does it evoke?

What is multiliteracy? What does it contain?

How does it relate to the subject of Finnish language?

Does it bring something new? What?

Current instruction of information searching

How has teaching of information searching been organized in the past?

Have there been any problems?

What kind of development needs have emerged?

Abilities of lower secondary school students

What kind of IL skills do students have on average? 7th-graders? (8th? 9th?)

- What goes well / what does not go well?

Has the information searching module in 7th grade worked?

Learning objectives

What learning objectives does the course FI1 have according to the curriculum?

What are the learning objectives of the information searching module?

What are the learning objectives related to multiliteracy in the course / in the information searching module?

What learning objectives are related to working together: as a class / pair?

Guided Inquiry

What are your expectations for Guided Inquiry?

What do you think is worth trying?

What does the course / the information searching module include?

Possibilities / benefits of the inquiry log?

Practical implementation of the course (schedule, etc.)

What kind of program does the course FI1 have?

What does the information searching module include?

What kind of a final assignment will the students have?

- How is it implemented? Schedule?

- Will students work on it at home?

How are pairs formed?

- What do you think the pair work will be like?

Teacher preparations

Implementation is slightly different from last year, have you made any special preparations for the course before the start?

Guiding and watching students

The role of the teacher as a supervisor of project assignments in general?

How will you introduce the project to the students?

How are you going to be involved in the students' work during the lessons?

How are you going to follow and guide their work?

How is class / pair work alternated? Will you guide it?

- Will you watch the cooperation of the pairs?

How will you follow the progress of the students' work/learning?

- Will you provide feedback during the project?

- What points will you pay attention to?

Process and outcome evaluation

How are the completed assignments handled in class?

How will you evaluate the project? By what evaluation criteria?

Will you watch and evaluate students' teamwork?

- What do you think are the characteristics of successful pair work?

What is the role and weight of the project in the overall evaluation of the course?

Overall assessment of the project

What kind of positive possibilities do you think are associated with the project?

What kind of problems or challenges do you think you will face during the project?

(What do you hope Guided Inquiry will offer?)

Next

Are there any other courses during the year that may affect the learning of information searching skills, etc.?

What learning objectives do courses FI1 & FI3 have related to this theme?

- What are the goals for the spring?

- How will they be combined?

Cooperation with history – what are the possibilities, expectations?

INTERVIEW WITH FINNISH LANGUAGE TEACHER AFTER INTERVENTION 1
September 2015 / Course FI1

Course implementation

Did the project go as planned?

- Were there any changes? What kind? Why?

What kind of problems did you encounter during the project?

How well did the project assignment (brochure for 5th-graders) work? Why did it work/ why did it not work?

Student work

How did the students greet the project? Was there any unusual confusion, enthusiasm, etc.?

How did the students work during the project?

Did the students focus on work or did they do something else during the lessons?

With what kind of things did the students have problems?

- Was there a certain section in the work that caused problems?

Learning objectives

Were the learning objectives of the project achieved? What goals were not achieved?

Did the students understand the goals of the project? Did something remain unclear to the students?

What do you think the students learned from the project? Which skills were developed?

Pair work

Was the pair work successful? In what ways? What could have been improved?

Did the students discuss enough with each other?

- Did you get a picture of what kind of discussions the students had?

- Did you take part in the discussions yourself? How?

How did the students get acquainted with the articles of the other pairs? Did it work?

Guiding and watching students

How did you follow the progress of the pair work?

How did you guide the students' work?

How did the pair work affect your own role as a teacher compared to regular class work?

With what kind of issues did the students ask for help? How did you respond to requests for help?

Did the students easily ask for help or did they try to solve problems independently?

In what kind of situations did you decide to intervene in the work of the students, even though they did not ask for help?

Process and outcome evaluation

Do you think the work produced by the students was successful? Were the goals met?

How successfully did the students use information sources?

How extensive is the material that the works were based on? Were there enough sources?

How did it go with the inquiry logs?

How did the referencing of the sources succeed?

How much did the assignments contain students' own text? Was there a lot of copying?

Were there differences in students' skills in information searching and use? Did it show in their finished work?

Overall assessment of the assignment

What aspects did you find successful in the project?

Would you change something in the implementation of the project? What? Why?

What are the positive possibilities for the project in the future? (Spring term: cooperation with history)

CONTROL GROUP

PRELIMINARY INTERVIEW / September 2015

Background

How long have you been working here?

Have you instructed this course (including the information searching module) for the 7th-graders before?

- What kind of experiences have you had? / has it worked?

- Has there been any problems? / are there any development needs?

Abilities of lower secondary school students

What kind of IL skills do students have on average? 7th-graders? (8th? 9th?)

- What goes well / what does not go well?

Learning objectives

What kind of learning objectives does the course FI1 have according to the curriculum?

What are the learning objectives of the information searching module?

What kind of learning objectives are related to cooperation: as a class / in pairs?

- will they work in pairs / groups?

Practical implementation of the course (schedule, etc.)

What kind of program does the course FI1 have?

What does the information searching module include?

Is there any larger final assignment?

If there is:

What kind of an assignment?

- How will it be implemented? Schedule?

- Will the students work on it at home?

IN CASE OF a pair / group project

- How are pairs / groups formed?

- What do you think the work of the pairs will be like?

(If there is no final assignment: what will they do?)

Questions in italics included in case of pair / group project:

Guiding and watching students

The role of the teacher as a supervisor of project assignments in general?

How will you introduce the assignment to the students?

How are you going to be involved in the students' work during the lessons?

How are you going to follow and guide their work?

How is class / pair work alternated? Will you guide it?

- Will you watch the cooperation of the pairs?

How are you going to follow the progress of the students' work / learning?

- Are you going to provide feedback during the project?

- What points will you pay attention to?

Process and the outcome evaluation

How are the completed assignments handled in class?

How will you evaluate the assignment / the course? By what evaluation criteria?

Will you watch and evaluate student's teamwork?

- What do you think are the characteristics of a successful pair / group work?

What is the role and weight of the task in the overall evaluation of the course?

Overall assessment of the assignment

What positive opportunities do you think there are with the assignment?

What kind of problems or challenges do you think you will face during the assignment?

Next

Are there any other courses during the year that may affect the learning of information searching skills, etc.? In the Finnish language / in other subjects?

Will there be cooperation with other subjects?

New curriculum and multiliteracy

Multiliteracy is included in the new curriculum, what kind of thoughts does it evoke?

What is multiliteracy? What does it contain?

How does it relate to the subject of Finnish language?

Does it bring something new? What?

Intervention 2

INTERVIEW WITH FINNISH LANGUAGE TEACHER BEFORE INTERVENTION 2
April 2016 / Course FI3

Practical implementation of the course (schedule, etc.)

What kind of program does the course FI3 have?

Cooperation with history - how will it be implemented?

What is the aim of interdisciplinary cooperation in particular?

How does the work in the Finnish language course prepare students for the history course?

What will they 'take' to HI2 from the Finnish language course?

And on the contrary: what about from history to FI3?

Finnish language:

- What will they do?

- Will they work independently / in pairs?

> o   How will the pairs be formed?

> o   What do you think the pair work will be like?

Learning objectives

What kind of learning objectives does the course FI3 have according to the curriculum?

What are the learning objectives related to multiliteracy in the course?

Guided Inquiry

What are your expectations for Guided Inquiry?

What to include in this course?

Guiding and watching students

How will you introduce the project to the students?

Will you highlight the cooperation with history? How?

How are you going to be involved in the students' work during the lessons?

How are you going to follow and guide their work?

How is class / pair / individual work alternated? Will you guide it?

How are you going to follow the progress of students' work/learning?

- Will you provide feedback during the project?

- What points will you pay attention to?

Process and outcome evaluation

How are completed assignments handled in class?

How will you evaluate the project? By which evaluation criteria?

Will you watch and evaluate students' teamwork?

What is the role and weight of the project in the overall evaluation of the course?

Overall assessment of the project

What kind of positive possibilities do you think are associated with the project?

What kind of problems or challenges do you believe you will face during the project?

Cooperation FI + HI

Cooperation with history - what possibilities, what expectations?

INTERVIEW WITH HISTORY TEACHERS BEFORE INTERVENTION 2
April 2016 / Course HI2

New curriculum and multiliteracy

Multiliteracy is included in the new curriculum, what kind of thoughts does it evoke?

What is multiliteracy? What does it contain?

How does it relate to the subject of history?

History and information searching

Has information searching and evaluation been taught during history lessons?

What kind of information searching skills do 7th-graders have on average?

Have you collaborated with other subjects in the past (e.g., with Finnish language)?

Learning objectives

What kind of learning objectives does the course HI2 have according to the curriculum?

What kind of learning objectives have you set for the Civil War project?

What learning objectives are related to multiliteracy in the course?

What learning objectives are related to working together: as a class / pair?

Guided Inquiry

What are your expectations for Guided Inquiry? Does it bring something new?

What to include in this course?

Practical implementation of the course (schedule, etc.)

What kind of program does the course HI2 have?

Project implementation:

- How is the project implemented? Schedule?

- What are the main stages of the project?

- How will the teacher motivate and guide students to get acquainted with the project topic?

- How is the topic introduced before starting the information search?

- Are students instructed to search and evaluate historical sources?

- Will students work on it at home?

- How will pairs be formed?

- What do you think the pair work will be like?

Guiding and watching students

The role of the teacher as a supervisor of project assignments in general?

How will you introduce the project to the students?

Will you highlight the cooperation with Finnish language? How?

How are you going to be involved in the students' work during the lessons?

How are you going to follow and guide their work?

How is class / pair work alternated? Will you guide it?

- Will you watch the cooperation of the pairs?

How are you going to follow the progress of students' work/learning?

- Will you provide feedback during the project?

- What points will you pay attention to?

Process and outcome evaluation

How are the completed assignments handled in class?

How will you evaluate the project? By which evaluation criteria?

Will you watch and evaluate students' teamwork?

- What do you think are the characteristics of successful pair work?

What is the role and weight of the project in the overall evaluation of the course?

Overall assessment of the project

What kind of positive possibilities do you think are associated with the project?

What kind of problems or challenges do you believe you will face during the project?

(What do you hope the Guided Inquiry will offer?)

Cooperation HI + FI

Cooperation with the Finnish language: what are the possibilities and expectations?

INTERVIEW WITH FINNISH LANGUAGE TEACHER AFTER INTERVENTION 2
May 2016 / Course FI3

Course implementation

Did the project go as planned?

- Were there any changes? What kind? Why?

What kind of problems did you encounter during the project?

How well did the project assignment (poem / short story / play) work? Why did it work / why not?

Student work

How did the students greet the project? Was there any unusual confusion, enthusiasm, etc.?

How did the students work during the project?

Did the students focus on work or did they do something else during the lessons?

With what kinds of things did the students have problems?

Learning objectives

Were the learning objectives of the project achieved? Which goals were not achieved?

Did the students understand the goals of the project? Did something remain unclear to the students?

What do you think the students learned from the project? Which skills were developed?

Independent work

Was the individual work successful? In what ways? Was there room for improvement?

Did the students work in small groups / as a whole class during the project?

- Was there discussion?

- Did you take part in the discussion yourself? How?

How did the students get acquainted with the work of others? Did it work?

Guiding and watching students

How did you follow the progress of the students' work/learning?

How did you guide the students' work?

With what kind of problems did the students ask for help? How did you respond to requests for help?

Did students easily ask for help or did they try to solve problems independently?

In what kind of situations did you decide to intervene in the work of the students, even though they did not ask for help?

Process and outcome evaluation

Do you think the work produced by the students was successful? Were the goals met?

Had students used sources in their work?

- Would there have been a need?

- Did anyone have a reference list at the end of their work?

Overall assessment of the project

Finnish language & history: did the cooperation work?

- Was it useful?

- Could it be seen in the students' work?

What aspects did you find successful in the project?

Would you change something in the implementation of the project? What? Why?

What are the positive possibilities for the project in the future?

The entire year

Was there any connection between the projects in the autumn and in the spring?

Was the autumn project useful for spring?

INTERVIEW WITH HISTORY TEACHERS AFTER INTERVENTION 2
May 2016 / Course HI2

Course implementation

Did the project go as planned?

- Were there any changes? What kind? Why?

What kind of problems did you encounter during the project?

How well did the project assignment (essay) work? Why did it work / did not work?

Student work

How did the students greet the project? Was there any unusual confusion, enthusiasm, etc.?

How did the students work during the project?

Did the students focus on work or did they do something else during the lessons?

With what kind of things did the students have problems?

Learning objectives

Were the learning objectives of the project achieved? Which goals were not achieved?

Did the students understand the goals of the project? Did something remain unclear to the students?

What do you think the students learned from the project? Which skills were developed?

Independent work

Was the individual work successful? In what ways? Is there room for improvement?

How did the selection of topics go? Did the students choose topics of interest to them?

Did the students work in small groups / as the whole class during the project?

- Was there discussion?

- Did you take part in the discussion yourself? How?

How did the students get acquainted with the work of others? Did it work?

Guiding and watching students

How did you follow the progress of the students' work?

How did you guide the students' work?

With what kind of issues did the students ask for help? How did you respond to requests for help?

Did the students easily ask for help or did they try to solve problems independently?

In what kinds of situations did you decide to intervene in the work of the students, even though they did not ask for help?

Process and outcome evaluation

Do you think that the students' work was successful? Were the goals met?

How successfully had the students used the information sources?

How extensive is the material that the works are based on? Were there enough information sources?

How did it go with the inquiry logs?

How did the referencing of the sources succeed?

How much did the articles contain the students' own text? Was there a lot of copying?

Were there differences in students' information searching and using skills? Did it show in the finished work?

Overall assessment of the project

Finnish language & history: did the cooperation work?

- Was it useful?

- Could it be seen in the students' work?

What aspects did you find successful in the project?

Would you change something in the implementation of the project? What? Why?

What are the positive possibilities for the project in the future?

CONTROL GROUP

INTERVIEW AFTER 2015-2016 SCHOOL YEAR

May 2016

Were there any major projects including information search / evaluation / use during the year?

(Or a smaller one?)

- What kind?

- What did they do? Alone / in pairs / in a group?

- How did you follow the work?

- How did you guide the work?

- How did you evaluate the work?

- How were the completed assignments handled in class?

Were there other tasks etc. during the year that could affect the learning of information searching skills etc.?

Was there cooperation with other subjects?

Intervention 3

INTERVIEW WITH FINNISH LANGUAGE TEACHER BEFORE INTERVENTION 3
September 2016 / Course FI4

Skills of 8th-graders

- what kind of skills do the students have after the 7th grade?

- last year's projects: what was learned – if anything? Is there something to build on this year?

Learning objectives

What kind of learning objectives does the course FI4 have according to the curriculum?

What are the learning objectives related to multiliteracy in the course?

"Persuasive speech" - what does it include / what are the goals?

Practical implementation of the course (schedule, etc.)

What kind of a program does the course FI4 have?

"Persuasive speech" - the implementation of the task?

- the role of information searching in the task?

What elements of Guided Inquiry are included in this task?

- initial stages: is the topic of their own choice; how will they work on the topic and plan information searching?

Guiding and watching students

How will you follow and guide the students' work/learning?

How will you follow the progress of the work?

- Will you provide feedback during the work?

- What points will you pay attention to?

Evaluation

How are the speeches presented in class?

How will you evaluate the speeches? By what evaluation criteria?

- The importance of information searching?

What is the role and weight of the speeches in the overall evaluation of the course?

Overall assessment of the project

What kind of positive possibilities do you think are associated with the speech assignment in terms of information searching and evaluation?

Next

Are there any other courses during the year that may affect learning information searching skills etc.?

8th grade learning objectives as a whole; in what ways do students develop cognitively, practically, and socially?

INTERVIEW OF FINNISH LANGUAGE TEACHER AFTER INTERVENTION 3

December 2016 / Course FI4

Course implementation

Did the assignment go according to plan?

- Were there any changes? What? Why?

What kind of problems did you face?

How well did the assignment work? Why / why not?

Student work

How did the students greet the assignment? Was there any unusual confusion, enthusiasm, etc.?

How did the students work during the assignment?

With what kind of things did the students have problems?

Learning objectives

Were the learning objectives of the task achieved? What goals were not achieved?

Did the students understand the objectives of the task? Did something remain unclear to the students?

What do you think the students have learned from the assignment? What skills have been developed?

- Information searching?

Were any elements of Guided Inquiry involved in the assignment?

Independent work

Was the individual work successful? In what ways? What could have been improved?

Did students work in small groups / as a whole class during the assignment?

Watching and guiding students

How did you follow the progress of the students' work?

How did you guide the students' work?

Did the students ask for help?

Did you intervene in the students' work, even though they did not request for help?

Process and outcome evaluation

Do you think the speeches produced by the students were successful? Were the goals met?

Did students use information sources in their work?

- Would that have been necessary?

Overall assessment of the project

What did you find successful in the assignment?

Would you change something in the implementation of the assignment? What? Why?

What are the positive possibilities for the assignment in the future?

The entire year

Was there any connection between this and last years' projects?

Was last year useful in this regard?

Next

Are there any other courses during the year that may affect learning of information searching skills etc.?

CONTROL GROUP

INTERVIEW / December 2016

Were there any major information search / evaluation / use projects during the autumn?

- What kind?

- How was it implemented?

- Instructions?

- How did you follow the work?

- How did you guide the students?

- How did you evaluate?

- How were the completed assignments handled in class?

Were there any other smaller tasks, etc. during the year that may affect learning information searching skills, etc.?

Speech

- How was it implemented?

- Did students search information for it?

Was there cooperation with other subjects?

What kind of plans are there for spring?

Final interviews

FINAL INTERVIEW WITH FINNISH LANGUAGE TEACHER / spring term 2017

Three projects 2015–2016 & 2016–2017:
- Social media brochure 7th grade
- Civil War-themed short story / poem / play 7th grade (with history)
- Speech 8th grade

Objectives and implementation - project by project:
Which things were new to you
- concerning the learning objectives?
- concerning the implementation?

How did the implementations succeed? Were the goals reached? (Project by project)

Benefits for students:
- How have the students' information literacy / multiliteracy skills developed over the last two years?
- How does it come out in their activities?

Did new ideas come up for teaching information literacy / multiliteracy?

Are you going to conduct similar projects in the future?
- Are you developing them somehow? How?

Benefits for the teacher:

Have these two years changed your perception of the role of the teacher in guiding information literacy / multiliteracy?

Did you learn anything new about teaching?

CONTROL GROUP

FINAL INTERVIEW / spring term 2017

Were there any major projects including information search / evaluation / use during the year?
- What did the students do? Alone / in pairs / in a group?
- How was it implemented?

Instructions?
- How did you watch their work?
- How did you guide them?
- How were the completed assignments handled in class?

Were there any other smaller tasks, etc., during the year that may have affected the learning of information searching skills, etc.?

Speech: how did it go?

Were there any collaborations with other subjects during the year? (At the 7th grade?)

Two-year period:

Did you try any new implementation in teaching IL?
IF yes: How did the implementations succeed? Were the goals reached?

How have the students' information literacy / multiliteracy skills developed over the last two years?
- How does it come out in their activities?

Did new ideas come up for teaching information literacy / multiliteracy?
Are you going to develop the old implementation somehow? How?

APPENDIX 4: TESTS

Translation (originals in Finnish)

PRE-TEST

Name and class: _____

A. Think:

You are asked to find out the answer to the following question using the Internet:

Many schools have banned the use of energy drinks at school based on health risks. But can a shopkeeper refuse to sell energy drinks to schoolchildren?

You decide to research the question by googling.

Which search terms would you use to search for information?

search terms: _____

Can you come up with other potential search terms?

search terms: _____

search terms: _____

B. Conduct the following task using the Internet:

Find sources to answer the question:

Many schools have banned the use of energy drinks at school based on health risks. But can a shopkeeper refuse to sell energy drinks to schoolchildren?

Write down <u>two of the best</u> sources you found, and give

        a)   a brief justification as to why you think that the source is good and
        b)   the search terms you used to find the source

    1. source: _____

a) justifications:_____

    _____

b) search terms:_____

    _____

    2. source: _____

a) justifications:_____

    _____

b) search terms: _____

    _____

Did you find a source that you didn't think was useful?
Give an example and justify why it didn't look good.

_____

_____

_____

Finally, how would you answer the question based on the sources you found? How would you justify your answer?

_____

_____

POST-TEST

Name and class: _____

A. Think:

You are asked to find out the answer to the following question using the Internet:

Young people are often warned about the dangers of excessive computer gaming. However, studies have found that computer gaming might have positive effects on success in certain school subjects.

In which subjects?

You decide to find out by googling.

Which search terms would you use to search for information?

search terms: _____

Can you come up with other potential search terms?

search terms: _____

search terms: _____

B. Conduct the following task using the Internet:

Find sources to answer the question:

Young people are often warned about the dangers of excessive computer gaming. However, studies have found that computer gaming might have positive effects on success in certain school subjects.

In which subjects?

Write down <u>two of the best</u> sources you found, and give

    a) a brief justification as to why you think that source is good and

    b) the search terms you used to find the source

      1. source: _____

a) justifications:_____

          _____

b) search terms: _____

          _____

      2. source:_____

a) justifications: _____

          _____

b) search terms:_____

          _____

C. Answer the question:

In which school subjects has the positive effect of gaming been noticed?

_____

According to the sources you found, what is the reason for the positive effect?

_____
_____

APPENDIX 5: INQUIRY LOG

Translation (original in Finnish)

INQUIRY LOG

NAME & class: _____

Use this log to keep track of your information sources!

1. Write down sources that look promising
   - Evaluate its importance (tick)
   - Describe shortly its contents
2. At the end, mark whether you used it or not

Source (URL / title of a book)	Important		What important things does it include?	Used	Rejected – why?
	Yes	Maybe			

PUBLICATIONS

PUBLICATION
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Lower secondary school teachers' experiences of developing inquiry-based approaches in information literacy instruction

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Lower Secondary School Teachers' Experiences of Developing Inquiry-Based Approaches in Information Literacy Instruction

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Abstract. Inquiry-based assignments are commonly used in information literacy (IL) instruction. However, guiding pupils through the inquiry process is challenging as the school's traditional instruction practices are teacher-centered. Yet, there are teachers who continuously develop their personal pedagogies in IL instruction, but we have very little research insight into that. This paper reports on a two-year longitudinal case study based in the classrooms of a lower secondary school teacher. The teacher and her two colleagues were engaged in enhancing their pedagogical practices in IL instruction. The findings based on interviews and classroom observations indicate that the teachers use various types of assignments and instructional activities for IL instruction.

Keywords: Information literacy instruction · Teachers
Lower secondary schools

1 Introduction

Previous research into information literacy pedagogies indicates that IL receives minimal specific attention in teacher education [1]. Studies among practicing teachers suggest that IL instruction is often weakly designed, concentrates mainly on technical aspects and leaves the crucial stages of the learning process without adequate attention [2]. Although the overall picture of the current situation in schools is overshadowed, there are teachers who continuously develop their instructional practice in IL [3].

Pedagogical models for IL instruction have been developed within library and information science. Guided Inquiry might be one of the most established, research-based frameworks [4]. There is also a body of literature introducing related instructional designs from the viewpoint of teachers' professional development [5]. The problem is that these models have not been integrated into national development projects and are not widely applied in schools.

In this paper, we focus on the micro level: what happens in classrooms where a lower secondary school teacher develops her professional practice in IL instruction. We adopted a longitudinal approach enabling us to study IL instruction in various curricular situations during a two-year period. The aim of the study is to create a better

understanding of teachers' IL instruction practices and their ways of developing their methods in IL instruction.

2   The Framework of the Study

Most scholars in education acknowledge that teacher-directed instruction as well as the sole use of textbooks and workbooks are no longer meaningful pedagogical practices [6]. Inquiry-based learning is a well-known learner-centered pedagogical approach that actively involves students in their own learning. Inquiry-based learning requires the learner to observe, ask questions, discover gaps in their own knowledge base and study resources to bridge these gaps [7, 8].

The need to improve students' information literacy is closely connected to the progress towards learner-centered pedagogies. Inquiry-based assignments, such as essays, are commonly used in IL instruction since they require independent acquisition and use of information sources. However, adoption of new pedagogical practices is still a challenge for teachers as they have to guide students to work independently in information environments that teachers cannot fully control [4].

2.1   Guided Inquiry

Guided Inquiry (GI) [4] is grounded in Kuhlthau's extensive studies of the Information Search Process (ISP) model [9]. GI is built around the ISP with specific direction for guiding students in each phase of the inquiry process. It is based on the idea that information literacies are best learned by training appropriate information practices in a genuine collaborative process of inquiry.

GI divides the inquiry process into eight phases: (1) open, (2) immerse, (3) explore, (4) identify, (5) gather, (6) create, (7) share, and (8) evaluate. The teacher steers the process with instructive interventions, offering targeted support for the specific phases of the process. GI emphasizes the phases before collecting information (i.e., phase 5). Students are prepared for information gathering by arousing their curiosity, sharing what is already known, building up background knowledge, and exploring ideas [4].

Students are guided to enhance their learning by using three inquiry tools. *Inquiry journals* help reflect on personal learning. *Inquiry logs* help keep track of important information sources. *Inquiry charts* help visualize ideas about the topic being studied. GI applies two types of collaborative forum. The whole class (*inquiry community*) is used to introduce and motivate the assignment and share results. Small groups (*inquiry circles*) are the main forum for learning activities.

GI recommends that teachers and librarians with varied expertise are organized to create flexible teams. Teams plan and supervise the inquiry. The school librarian is a specialist on information resources. Teachers work as curriculum content experts [4].

2.2   Pedagogical Practices in Finnish Schools

It has been argued that teachers in Finland have good opportunities for professional development. Teacher education is research-based and offers teachers knowledge and

methods to develop teaching and to solve pedagogical problems [10]. It has been argued that the curricular framework supports the change of practices. However, the mainstream form of instruction has appeared to be quite conservative using traditional instructional methods with textbooks [11].

The Finnish national core curriculum presents the objectives and core contents of all school subjects, and describes the mission, values, and structure of education. Municipalities, schools and teachers themselves draw up their own local curricula within the national framework [12]. This approach provides teachers with an opportunity to take their own classroom context into account.

The national core curriculum for basic education emphasizes the learning goals in *multiliteracies*. Multiliteracies are defined as being competences associated with acquiring, interpreting, producing and evaluating a variety of texts. By definition, multiliteracies strongly overlap with information literacy. Multiliteracies should be developed in all teaching and learning, integrated into all school subjects [12].

3   Research Setting

This paper reports on a two-year case study in the classrooms of a lower secondary school teacher and her two colleagues who were engaged in enhancing their pedagogical practices in IL instruction. Guided Inquiry was introduced to the teachers but they were free to apply it as they saw fit. The aim was to create a better understanding of the pedagogical challenges that teachers face when they apply inquiry-based approaches as an everyday school practice. The research questions of the study were:

1. What kind of pedagogical designs do teachers develop for inquiry-based information literacy instruction?
2. To what extent were the observed pedagogical designs similar to the designs of Guided Inquiry?
3. How do teachers experience their possibilities and success in developing inquiry-based information literacy instruction in their everyday school context?

3.1   School Context

Compulsory education in Finland consists of a nine-year comprehensive school system, from the age of 7 to 16. The first 6 years are spent at primary school under the leadership of a classroom teacher. For the last 3 years, pupils move to lower secondary school where classes are taught by a variety of subject teachers.

This study followed the work of a Finnish language and literature teacher for two years from the 7th to the 8th grade. The lower secondary school studied also serves as a teacher training school in Southern Finland and has approximately 300 students. The school is a part of, and works in close collaboration with, the local university. It functions as an environment for development, experimentation and research for its own employees and university researchers. It can be argued that the school represents the current state of the art in research-based pedagogies.

3.2   Participants and Modules Studied

Data were collected during the 2015–2016 and 2016–2017 school years. The Finnish language and literature teacher (the Teacher for short) taught three parallel classes (19–20 pupils per class). She had six courses with them during the study period. We collected data during the first, third and fourth courses. The courses were chosen as it was easy to see that their learning goals were explicitly associated with IL themes. Two history teachers were also involved since the Teacher organized the third course in close collaboration with a history course. One of the history teachers taught two of the classes, and the other took one class.

The Teacher has a Master's degree and subject teacher education in Finnish language and literature. She has 11 years of work experience in teaching. She has supervised student trainees for five years. The history teachers were experienced teachers with similar work roles.

The Teacher planned and implemented three modules for information literacy instruction. Modules 1 and 3 were part of Finnish language and literature courses (Finnish language for short). Module 2 was integrated into a joint project of Finnish language and history. In module 1 (Sep 2015), pupils made a brochure about social media. In module 2 with history (Apr–May 2016) pupils gave a presentation and wrote a fictive text about the Finnish Civil War. In module 3 (Sep–Nov 2016), each pupil prepared and presented an argumentative speech.

3.3   Data Collection and Analysis

Data were collected through thematic interviews, which are designed to provide insight into what participants know and think about the research question [see e.g. 13]. The first author interviewed the Teacher for the first time at the beginning of her first course in August 2015 and for the final time after the fourth course in April 2017. The themes of the pre-interview were built on the Teacher's earlier experiences regarding IL instruction: what kind of problems she had faced, what kind of development needs had arisen and which Guided Inquiry activities she found useful. In the last interview, the Teacher was asked about her experiences of the whole two-year period: what new things she had experienced, how implementation had succeeded and how she felt that the pupils or the Teacher had benefitted from the projects. The pre-interview lasted 30 min and the post-interview 15 min.

Additionally, the Teacher was interviewed before and after each module. The pre-interviews dealt with the learning goals and the practicalities of the courses. Experiences of the modules were surveyed with post-interviews. The history teachers were interviewed regarding the second module too. The interviews lasted from 15 to 35 min. The Teacher was interviewed separately, the history teachers together.

In order to get an overall picture of what was happening in the classrooms, the first author observed all the relevant project lessons (3–4 lessons per class during the first module, 8–10 lessons per class during the second module, 3–5 lessons per class during the third module) and wrote memos. Lessons lasted 45–75 min. The memos and all the material that was handed out during the lessons were used as a support material for analysing the interview data.

Data were exposed to content analysis. The analysis was divided into two parts; descriptive and analytical. In the descriptive part, data were analyzed based on the research questions and taking the research setting into account. In the analytical part, data were exposed to deductive, theory-guided, content analysis. In the deductive content analysis, the themes are drawn from existing theoretical ideas that the researcher brings to the data [14] - in this case from Guided Inquiry [4].

The transcribed interviews were hand-coded directly into the text documents. The interviews were reviewed with attention paid to the research questions for themes. The observation memos and the handouts were used to support the analysis. Lastly, the themes were interpreted using Guided Inquiry as an analytical framework.

4   Results

The results of data analyses are presented one module at time. Firstly, the themes and goals of the module are introduced. Next, the applied design patterns are presented (1st descriptive part), and compared with the designs of the Guided Inquiry (analytical part). Finally, teachers' experiences are described (2nd descriptive part).

4.1   Module 1

The first module was carried out with the 7th graders during the Fall term of their first year at lower secondary school. The pupils created a brochure about social media for 5th graders emphasizing how to use it appropriately. The Teacher said that the main learning goal was for the pupils to learn to seek information and to apply it in writing for a target audience. Netiquette was the learning goal in the subject content.

Design. The Teacher defined the target audience so that the pupils had to think about how to transform the text from the sources into their own text in order to write clearly enough for younger children. The work was done in pairs so that the pupils would learn to cooperate and to share their knowledge. Group discussions at the beginning of the project aimed to activate interaction and collaboration between pupils. The pupils were guided to use inquiry logs for keeping track of information sources.

Guided Inquiry. The Teacher borrowed the idea of inquiry logs from GI. As recommended in GI, she chose a project theme that she felt was familiar to the pupils and she let the pupils choose their subtopics. The thinking here was to engage pupils in their work. GI also emphasizes that pupils should be prepared to seek information by stimulating their curiosity and interests, and sharing what is already known. The Teacher aimed to achieve this by letting pupils discuss the theme, firstly in inquiry circles and then working together in an inquiry community.

Experiences. The Teacher reported that most pupils seemed to enjoy the project. She thought that the pupils had learned about seeking and using information, as well as about working in pairs. However, the Teacher saw huge differences in how well pupils sought and then used information. The Teacher reported that a common problem was that many inquiry logs were not filled in completely and some others were lost. Most of

the pupils finished the project in a hurry. Incomplete bibliographies were one indicator of this hurry. The use of information sources was somewhat problematic. The Teacher saw copying and pasting from Wikipedia. Some pupils used low quality websites as their sources.

All things considered, the Teacher thought that the assignment was probably too complicated. Several things were calling for the pupils' attention at the same time. The Teacher concluded that simpler assignments would be more useful. She suggested that a more concrete example of the end product should have been shown to the pupils. The observations confirmed that the pupils seemed to wait for specific instructions on what and how they should do. The Teacher was not satisfied with the inactive use of inquiry logs (on paper). She argued that an electronic log might have been more effective.

4.2   Module 2

The Teacher cooperated with two history teachers for the second module. It was carried out during the Spring term. In the history course, pupils gave a presentation about the Finnish Civil War. In the Finnish course, the pupils wrote a fictive text which they based on facts learned during the history lessons. The teacher team hoped that pupils would learn to seek and use diverse information sources and to present justified opinions. The Teacher wanted the pupils to learn that seeking information contributes to fictive writing and is a part of it. Learning criticism of sources was set as an important goal by the history teachers. From the pedagogical point of view, the Teacher expected joint teaching units to give more time to the first phases of inquiry and the pupils could then concentrate more thoroughly on the theme.

Design. Pupils' orientation to the theme was emphasized in the design of the unit. The pupils paid a visit to a museum to see an exhibition of the Finnish Civil War before the project started. The visit was expected to perform as a cognitive and emotional trigger encouraging the pupils to think about the theme and inspire them in their work.

The teacher team wanted pupils to learn to manage their sources more systematically and continued to guide them in the use of inquiry logs. The logs were in electronic format. In order to offer diverse information sources to the pupils, the history teachers brought books from their own collections and also gave the pupils tips about useful internet sites. The assignments were done individually for both subjects, but some activities were also done in inquiry circles. In history, the pupils had group discussions about their themes and about how to outline the topics. In Finnish, the pupils gave written feedback to their classmates in the middle of the writing process as well as afterwards. In history, the pupils got feedback from the others at the end.

Guided Inquiry. Some pedagogical designs used in the module were similar to GI. The pupils' curiosity was stimulated by a museum visit, the pupils were free to choose their topics within the main theme, and inquiry logs were used. The pupils wrote their own texts individually but worked at some point in inquiry circles. More time and attention was devoted to the first phases of the inquiry process: open, immerse, explore. The three teachers formed a learning team – as emphasized in GI. GI also encourages the team to offer the pupils a variety of sources as the history teachers did.

Experiences. The Teacher noted that the work done in history influenced the pupils' activities in her class. The pupils chose topics that they knew about and got ideas from the history class. The Teacher felt that the pupils made progress in process writing. The fictional writing process did not require much information seeking as the pupils used information that they had already found for their history work. However, the Teacher saw that some learned about acquiring information for writing fiction.

According to the history teachers, the pupils were positive about the assignment and seemed to find and choose topics of their own interest. The museum visit motivated pupils for the learning task. The history teachers felt that even those who were not initially interested in history showed some signs of engagement. They also argued that pupils paid more attention to the language of their presentations than they usually do. The history teachers reported that pupils learned about subject content, information seeking and evaluation. The pupils who had used the inquiry log managed to synthesize information across sources better than those who had not used it. The history teachers experienced that most pupils' problems dealt with finding and analyzing information. They did not use eagerly the sources offered by the teachers.

The teacher team also noticed that some pupils had difficulties getting started and choosing the topic and some changed their topic if they did not find information at once. Copying and pasting caused a minor problem. Although the inquiry logs were in electronic format this time, they were not actively used.

All of the teachers were quite satisfied with the second assignment apart from the fact that there was too little time for shared activities between subjects at the end. They suggested that a shared launch of the module would have been useful, too. The Teacher expressed that organizing the project in one class at a time instead of in parallel in three classes would be one way to enhance collaboration.

4.3   Module 3

The third module was again a one-subject course in Finnish language and it was carried out in the Fall term of the second school year with pupils who were now 8th graders. Each pupil gave a five-minute speech about a theme of their choice. The aim was to convince the audience of one's message, and to learn to justify one's opinions. The Teacher's aim was that the pupils recognize what they already know about the subject matter and to analyze what kind of further information they need. The Teacher emphasized that seeking information was not the main issue but that it would help to complete the task. The pupils needed information to justify their opinions.

Design. Before handing out the assignment, the Teacher asked pupils to think about what could be improved at their own school, in their hometown and in Finland. She wrote some of the pupils' answers on the blackboard and then explained the assignment. She emphasized that pupils need to seek information in order to justify their message. She prepared worksheets for the pupils to write down what they know about the subject in advance. In addition, pupils were asked to plan what kind of further information they would need and where to find it. Inquiry logs were again used in printed form.

Guided Inquiry. Pupils' own choice, inquiry logs and emphasis of the first phases of inquiry associated the designs with GI. The Teacher wanted pupils to concentrate especially on what they already know and thus emphasized the immerse phase of GI.

Experiences. According to the Teacher, the third module went as planned. Most pupils managed to perform at their own level. They learned about giving a speech but only a few had searched for information for their speeches. The observations revealed that some pupils pondered their topic selection for a very long time. Some thought that they did not need any information or could not search for it. Not all filled in the worksheet. Again, the inquiry logs were incomplete. The Teacher reported that pupils had problems when choosing a topic for their speech, when seeking information and when justifying their opinions. Some pupils had not prepared their speeches at all.

The Teacher felt that she should have emphasized more the importance of seeking information and provided more personal guidance for pupils. She argued that the pupils failed to see seeking information as a learning goal. She suspected that there were too much content in the worksheets. She thought that it might have been better to seek information separately, before pupils began planning the speech. On the other hand, she hesitated to make seeking information a separate part of the process.

5   Discussion and Conclusions

The current study explored how inquiry-oriented teachers develop information literacy instruction as part of their everyday school practices. The practices of information literacy instruction are typically studied in the context of a single teaching unit. We adopted a wider perspective by monitoring how the Teacher taught her three classes during two school years. Data were collected by taking a sample of three assignments, each from a different course. The advantage of this approach is that we could study pedagogical practices in varying curricular contexts. However, all three assignments were part of the same curricular track both for the Teacher and for pupils. We may think that this increases the validity of our data since varying modules and courses shed light on the Teacher's pedagogical ideas and practices from varying angles.

Findings. The results show that the teachers are ready to apply diverse assignments in IL instruction. The teachers implemented four assignments. None of them was a traditional essay. The formats were a brochure, a presentation, a fictive text and a speech. Diverse assignments lead to diverse inquiry processes, activities and guidance.

Guided Inquiry emphasizes similar issues as the Finnish curriculum. Thus, the teachers were partly familiar with them. They devoted attention to the first phases of the inquiry process (open, immerse, explore, identify) and introduced various designs for how to do this. They also gave more space for pupils to choose topics that interested them. Inquiry logs were introduced to the pupils. The pupils worked in different groups and the teachers also worked partly as a team. But, apart from Guided Inquiry, the librarian was not involved. In Finland, different professions tend to be quite territorial and cooperation is not always self-evident.

The teachers experienced that investment of their time in the first phases of inquiry paid off: the pupils seemed to find topics that interested them. They also seemed to gain

from cooperation between the two subjects. The teachers saw that pupils who used inquiry logs managed to synthesize information across sources more effectively than those who did not use them. Choosing the topic, finding and analyzing information was difficult for some pupils. Sometimes it was difficult to strike a balance between phases. For example, emphasizing the pupils' own knowledge (immerse) could lead to passivity when seeking information (explore, identify, gather). Technical problems and a lack of IT-skills occasionally steered pupils' attention towards technical issues instead of working on information and writing.

It seemed that not all pupils are attuned to working in a learner-centered way and are waiting for clear instructions. This may affect motivation and cause indifference to the assignments which was evident with some pupils. But, all in all, the teachers felt that inquiry-based learning is a fruitful approach and that the meaning of information seeking is something that should be emphasized to the pupils.

Future Research. The work reported here is part of a broader study. We also collected survey data in the classroom of pupils' online inquiry attitudes, self-efficacy and practices. In addition, the pupils completed online tests which measured their skills in searching the web and evaluation of sources. The surveys and competence tests were carried out at the beginning, in the middle and at the end of the research period both in the three classes taught by the Teacher and in two control classes at the same school. Thus, we can analyse the long-term changes in various variables among the pupil population and compare them with the Teacher's experiences.

Limitations of the Study. The case study focused on one teacher and her two colleagues at a teacher training school. Subsequently, the results cannot be generalized to Finnish lower secondary schools or other schools. However, we may expect that the ecological validity is good since the teachers were planning and implementing their pedagogical ideas as part of their regular work in the framework of the national and local curriculum.

Conclusions. Our concluding remarks are the following: We have introduced a novel approach for case studies on the practices of IL instruction in schools. Our longitudinal approach enables teachers to concentrate on development of the instruction across a long period of time. For the researcher, it helps to dig deeper into teachers' pedagogical practices by exploring IL instruction in varying curricular contexts. The empirical findings suggest that teachers use various types of assignments and instructional activities for IL instruction.

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PUBLICATION
II

How does information literacy instruction in secondary education affect students' self-efficacy beliefs and attitudes?

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How Does Information Literacy Instruction in Secondary Education Affect Students' Self-Efficacy Beliefs and Attitudes?

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Abstract. This paper reports the findings of a study on how students' self-efficacy in and attitudes to online research develop in a two-year information literacy intervention in the lower secondary school. The data was collected by a questionnaire administered before, in the middle of, and after the intervention. A repeated measures ANOVA was used to reveal the effect of the intervention. The teaching intervention changed students' behavioral intentions in the evaluation of search results and in source-based writing. No intervention effect was observed in other attitude factors or in self-efficacy beliefs. The authors suggest that self-efficacy and attitudes should be considered as explicit learning goals in pedagogical practices in order to develop them more effectively.

Keywords: Information literacy instruction, online research, intervention.

1   Introduction

Information literacy (IL) is defined as 'a set of abilities individuals require to recognise the information need and to locate, evaluate and use the needed information effectively' [1]. IL instruction typically aims to improve students' IL skills, and learning outcomes are assessed accordingly [2]. As argued by Pinto and Fernandez-Pascual [3], the concept of IL can be extended beyond knowledge and skills to include attitudes and motivations of individuals for searching, evaluating, processing, and communicating information. The aim of this study is to examine how long-term inquiry-based curriculum-embedded IL instruction affects students' self-efficacy beliefs and attitudes.

Bandura [4] defined *self-efficacy* as individuals' confidence in their own capabilities to organize and execute the course of actions required to perform a task or attain a goal. Previous research suggests that individuals with high self-efficacy use their skills [5] and develop their skills [6]. Individuals with low self-efficacy tend to avoid challenging activities [7] and are less likely to develop their competencies [8]. Aesaert et al. [6] found that competent primary school students had quite realistic ICT-related self-efficacy beliefs, but less competent students overestimated their ability severely. The researchers suggested that realistic but slightly overoptimistic beliefs have a positive effect on students' acquisition of competences.

Eagly and Chaiken [9] defined attitude as 'a psychological tendency that is

expressed by evaluating a particular entity with some degree of favour or disfavour'.

We adopt here the three-component model of attitudes widely used in social psychology to define the construct of attitudes [10]. The three components are 1) *affect* (feelings, likes, or dislikes about the attitude object), 2) *cognition* (ideas and beliefs about the attitude object), and 3) *behavioral intention* (the intention to act a certain way with regard to the attitude object).

Our literature review did not reveal any previous studies on how IL instruction changes students' self-efficacy beliefs and attitudes in primary or lower secondary schools. Pinto and Fernandez-Pascual [11] conducted a study having the same elements but university students as subjects. They carried out an intervention study on the first-year library and information science students and measured students' attitudes and self-efficacy before and after the intervention. Students' self-efficacy increased in relation to 23 IL skills, but attitudes improved only in nine skills.

Some studies in science education suggest that guided-inquiry approaches have positive effects on both the young students' cognitive and affective characteristics. For example, Gibson and Chase [12] found that learners' attitudes toward science can be improved through teaching interventions. Koksal and Berberoglu [13] found that a guided-inquiry teaching intervention improved sixth graders' attitude toward science.

Our literature review indicates that we lack studies on how IL instruction affects students' self-efficacy beliefs and attitudes in primary or lower secondary schools. However, studies in other fields, such as ICT education, indicate that self-efficacy beliefs and attitudes may influence how students acquire new competences and skills. Hence we should understand better how the various ways of teaching IL and online research affect these traits. Another poorly studied area is how teaching affects students' conceptions of good practices in online research.

We argue that although it is important that instruction develops students' skills, there are other factors, such as attitudes and self-efficacy beliefs, which should also be considered as learning goals. Attitudes and self-efficacy beliefs have a role in how students engage with the task at hand and use their skills. A wide range of research in psychology gives evidence that attitudes affect individuals' behavior [14-15]. The same mechanism can be concluded to hold for information practices, see [16]. Enhanced self-efficacy beliefs in and attitudes to online research provide the potential to encourage students to actively practice and exploit their IL skills.

The study focuses on the following research questions:
1. How does the teaching intervention change students' self-efficacy beliefs in online research?
2. How does the teaching intervention change students' attitudes to online research?

2   Methods

The nature of this study was quasi-experimental using a non-equivalent groups design. The selection of groups was based on a convenience sample. Quasi-experiments are

useful in cases where the random assignment of subjects into test and control groups is difficult, for example, in intervention studies conducted in schools [17–18].

2.1 Participants and procedure

The study was conducted in a lower secondary school located in a medium-sized city in southern Finland. The total number of students in the school is about 300, and they all are from the neighbouring area. All students have access to the school without entrance examinations. The school serves as a teacher training school.

Data collection was started in the autumn term 2015 when the students entered seventh grade (13–14 years old) and was completed in the spring term 2017 when the students completed their eighth grade (14–15 years old). The intervention group consisted of three parallel classes (35 girls and 23 boys). Two other classes not exposed to the intervention performed as a control group (19 girls and 17 boys). Thus, the number of students was 58 in the intervention group and 36 in the control group.

The intervention was integrated into three courses held in autumn term 2015 (Course 1), spring term 2016 (Course 2), and autumn term 2016 (Course 3). The intervention was designed and implemented by a Finnish language teacher. The second course combined Finnish language and history, and two history teachers collaborated to organize it. All teachers had years of experience and were also training student teachers. The control group was taught by teachers working independently from the intervention.

The courses were within the regular curriculum of the school, but the teachers redesigned them to emphasize information literacy skills as an important learning goal. In the beginning, Guided Inquiry [19] was introduced to the teachers, but they were free to embed it into their pedagogical practices as extensively as they thought appropriate. The key instructional principles of Guided Inquiry that the teachers aimed to follow were: to devote attention to the first phases of the inquiry process and to give more space for students to choose topics that interested them. In order to keep track of information sources, inquiry logs were introduced to the students.

In course 1, students made a brochure about good practices in social media. In course 2, students worked on a source-based presentation and a fictional text, both about the Finnish Civil War. In course 3, each student prepared and presented an argumentative speech. The main learning goals were that the students learn to search information on the Web, evaluate sources critically, and use information meaningfully in a given task. The details of the teaching intervention are reported in [20]. The control group received standard instruction based on the curriculum.

2.2 Materials

The survey tool to measure self-reported attitudes and self-efficacy beliefs was designed by using the validated SORAB (Survey of Online Reading Attitudes and Behaviours) instrument by Putman [21] as a framework. Because the SORAB survey is designed only for online research, we added a set of items to cover library aspects of information

searching and use.

To develop a survey of self-efficacy beliefs, we first modelled the online research process into three subtasks: 'Web searching', 'evaluation of sources', and 'use of Web sources' and designed new candidate items for each subtask. A set of items was adopted from the SORAB's Efficacy for Online Reading factor, and included in the subtask model. Further, three items of library use were added. The resulting scale included one generic item for online research, five for Web searching, four for the use of the library, six for evaluation, and six for writing. All items started with the phrase 'I am able to …'. A 5-point Likert scale from 'Very well' to 'Not at all' was used.

A set of items for the attitude components affect and cognition were adopted from the SORAB's factors F3 (Anxiety) and F5 (Value/Interest). The core set was extended by items about traditional learning materials and their use. Eight items were related to positive and four items to negative attitudes toward online research. Four items contrasted Web and printed sources, six related to traditional forms of learning and use of learning materials, and two dealt with use of the library - 24 items in total. A 5-point Likert scale from 'Fully agree' to 'Fully disagree' was also used here.

The third attitude component was designed to measure behavioural intentions in online research. It was based on a careful analysis of good practices for analysing information needs, formulating search statements, evaluating and reading search results, and writing texts based on selected sources. Ten items were related to the planning and searching stage, fifteen to the reading, evaluation, and selection stage, and eight to the use of sources in writing the end-product (33 items in total). A 5-point Likert scale ranged from 'I always do this way' to 'I never do this way'.

2.3 Data Collection

The questionnaire was administered before the intervention, after the second course, and after the intervention. The items on self-efficacy beliefs and attitudes regarding behavioural intentions were included in all three data collections. The affect and cognition components of attitudes were surveyed only two times (pre and post) to avoid students' overloading.

The total number of students participating in the survey was 94. Two outliers, whose answers showed that they had filled in the questionnaires without consideration, dropped the number of students to 92. Some students were absent in one of the data collections or failed to answer some individual items. Because SPSS applied listwise deletion of subjects in case of missing data, the number of students in the statistical analysis varied from 78 to 82.

The first step was to conduct an exploratory factor analysis (EFA) to find reliable scales for the measurement of students' self-efficacy beliefs and attitudes. The number of students in the study was quite small compared to the number of items [see 22, p. 683-685]. The problem was solved by grouping the items into five theoretically consistent subsets and applying EFA to these subsets.

Table 1. The summary of the factor analysis and reliability tests

Factors	Number of items	Loadings	Cronbach's alpha	Test-retest reliability *)	Examples of representative items (translated)
Attitudes: Searching intentions	7	-	.779	.506 - .661	Before a search, I think carefully which keywords I will use.
Attitudes: Evaluation intentions	5	-	.785	.500 - .581	I try to find out who is the author of the webpage.
Attitudes: Writing intentions	4	-	.736	.560 - .680	I prepare myself for writing by taking notes from sources.
Attitudes: Online Learning	4	.645 - .803	.774	.408	It is important for me to be good at searching information on the Web.
Attitudes: Traditional Learning	4	.572 - .730	.739	.562	I like to search information in the library (books, journals).
Self-efficacy: Searching	3	.622 - .825	.746	.424 - .525	I am able to choose the best link from the search engine's result page.
Self-efficacy: Writing	3	.620 -.748	.727	.504 - .570	I am able to make notes of what I have read.

*) all statistically significant p<0.01

Data distributions for ten items deviated seriously from normality (|kurtosis| or |skewness| >1) and were removed before EFA. Principal axis factoring was used as the extraction method with oblique rotation (Direct oblimin) with requirements: communalities >0.3, loadings >0.4, cross-loadings <0.3, and Kaiser-Meyer-Olkin measure (KMO) >0.5. Eigenvalues (>1) and scree plots were analyzed to find a good estimate for the number of factors searched [see 22, p.665–706]. The EFA results are summarized in Table 1.

The reliability of psychometric scales are typically estimated by Cronbach's alpha. All scales meet the requirement for α >0.7 [see 22, p.709]. In addition, we could estimate the test-retest reliability by analysing correlations (Pearson's r) of data collected by the same scale three times (only two for the attitude components affect and cognition). All correlations were statistically significant (p<0.01) and mostly higher than .5. Although scores as high as .8 are desirable, in practice such high scores are difficult to achieve in scales for behaviour, beliefs, and attitudes [23]. We argue that we had enough evidence of the stability of our scales to be used in this study.

2.4 Statistical Analysis

Statistical analyses were performed using SPSS version 25. Normality checks were carried out numerically by the Shapiro-Wilk Test because our data set is relatively small. The sets of data which did not pass the Shapiro-Wilk Test were evaluated graphically using the normal Q-Q Plots. All data was at least approximately normally distributed.

A mixed between-within subjects ANOVA was conducted to assess the impact of

the teaching intervention. A mixed between-within subjects ANOVA is an extension of a repeated measures ANOVA and can be used in a study with two independent variables: one is a between-subjects variable (e.g., group: intervention/control) and the other a within-subjects variable (e.g. time: pre/post). [24, p.284-292.]

3   Results

The key results are presented in Table 2. The results suggest that the students in the intervention group adopted more positive behavioural intentions in the evaluation of search results ($F(2, 154) = 4.05$, $p = .019$, partial $\eta^2 = .050$). The effect size was nearly medium (suggested norms for partial eta-squared: small = .01; medium = .06; large = .14 [24, p.217-218]). Within-subjects contrasts revealed that the differences were statistically significant between pre- and post-measurements ($p = .004$, partial $\eta^2 = .103$), and between pre- and mid-measurements ($p = .048$, partial $\eta^2 = .050$). No learning effect was observed after the midpoint ($p = .575$).

Table 2. The scores of attitudes and self-efficacy beliefs measured before (PRE), in the middle of (MID), and after (POST) the intervention.

ITEM	GROUP	N	PRE M	PRE SD	MID M	MID SD	POST M	POST SD	F	p*	η^2
Attitudes: Searching intentions	Interv.	48	3.59	0.60	3.64	0.62	3.39	0.69	.324	.724	.004
	Control	31	3.60	0.61	3.54	0.69	3.31	0.59			
	Total	79	3.59	0.60	3.60	0.64	3.36	0.65	8.532	**.000¹**	.100
Attitudes: Evaluation intentions	Interv.	48	3.29	0.72	3.40	0.73	3.42	0.74	4.050	**.019²**	.050
	Control	31	3.44	0.73	3.21	0.80	3.13	0.63			
	Total	79	3.35	0.72	3.32	0.76	3.31	0.71	.656	.521	.008
Attitudes: Writing intentions	Interv.	47	3.61	0.91	3.79	0.77	3.81	0.75	3.533	**.032³**	.044
	Control	31	3.74	0.63	3.51	0.83	3.70	0.57			
	Total		3.66	0.81	3.68	0.80	3.77	0.68	1.028	.360	.013
Attitides: Online learning	Interv.	50	3.67	0.55	-	-	3.55	0.70	.198	.657	.002
	Control	32	3.87	0.79	-	-	3.82	0.59			
	Total	82	3.74	0.66	-	-	3.65	0.67	1.033	.313	.013
Attitudes: Traditional learning	Interv.	50	3.41	0.74	-	-	3.17	0.81	.009	.926	.000
	Control	32	3.67	0.71	-	-	3.41	0.55			
	Total	82	3.51	0.74	-	-	3.26	0.73	10.308	**.002⁴**	.114
Self-efficacy: Searching	Interv.	48	4.08	0.52	4.11	0.49	4.12	0.55	.510	.602	.007
	Control	31	4.10	0.52	4.12	0.54	4.24	0.39			
	Total	79	4.09	0.52	4.12	0.51	4.16	0.49	.997	.371	.013
Self-efficacy: Writing	Interv.	48	4.20	0.63	4.09	0.56	4.08	0.61	.586	.558	.008
	Control	31	4.15	0.48	4.14	0.60	4.16	0.43			
	Total	79	4.18	0.57	4.11	0.57	4.11	0.54	.566	.569	.007

* statistically significant p<0.05

1) pre > post ($p = .000$, $\eta^2 = .184$), mid > post ($p = .002$, $\eta^2 = .123$)
2) pre < post ($p = .004$, $\eta^2 = .103$), mid < post ($p = .048$, $\eta^2 = .050$)
3) pre < mid ($p = .021$, $\eta^2 = .069$)
4) pre > post

The results also indicate that the intervention had an effect on the students'

behavioural intentions in writing ($F_{(2, 152)}$ = 3.533, p = .032, partial η^2 = .044). The effect size was again nearly medium. Within-subjects contrasts showed that there was a statistically significant difference between pre- and mid-measurements (p = .021, partial η^2 = .069). No difference was observed between the pre- and post-measurements (p = .085), or mid- and post-measurements (p = .270). Figure 1 shows the change in the test scores over time in the intervention and control group regarding behavioural intentions in evaluation and writing.
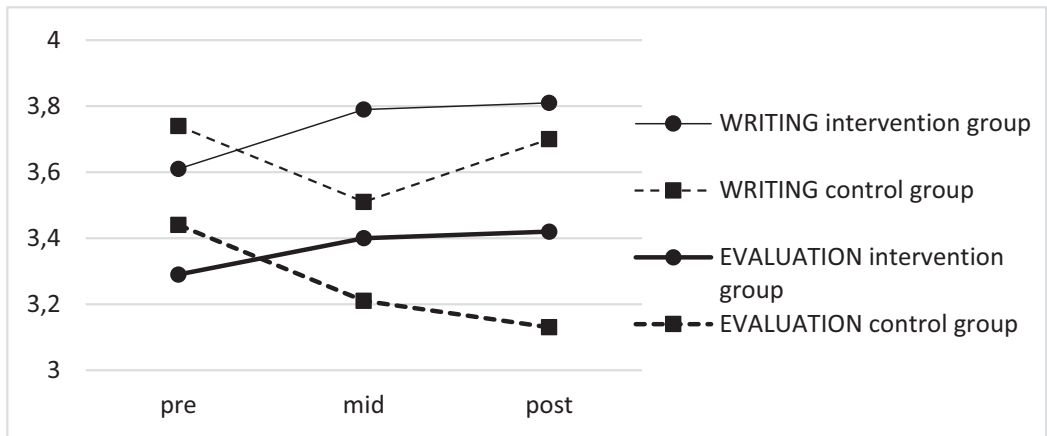
Figure 1. The effects of the intervention on students' behavioural intentions in evaluation and writing.

No statistically significant difference was found between the intervention and control group regarding the development of students' searching intentions ($F_{(2, 154)}$ = .324, p = .724). The intervention had no effect on the affective and cognitive attitudes measured by the factors online learning ($F_{(2, 80)}$ = .198, p = .657) and traditional learning ($F_{(1, 80)}$ = .009, p = .926).The teaching intervention had no effect on students' self-efficacy beliefs in searching for information ($F_{(2, 154)}$ = .510, p = .602) or in writing ($F_{(2, 154)}$ = .586, p = .558).

4   Discussion

The aim of this study was to investigate the effect of long-term, inquiry-based, curriculum-embedded information literacy instruction on students' self-efficacy beliefs and attitudes. The results show that the teaching intervention had a positive effect on students' behavioural intentions regarding the evaluation of search results and writing. No effect was observed in other attitude factors or self-efficacy beliefs.

The students in the intervention group adopted more developed behavioural intentions in the evaluation of search results. Most of the development happened during the first year. It can be explained by the fact that the first two courses explicitly required the students to practice evaluation. Source criticism was emphasized, especially in the second course. Learning to evaluate the trustworthiness of sources was set as an

important learning goal by the history teachers. [20.] The last course was more focused on finding arguments for a speech.

The results also suggest that the intervention group adopted more advanced intentions in source-based writing. Again, the change took place during the first year and can be explained by the type of assignments. In the first two courses, students wrote a lot, but not in the last one where the end product was a speech. Especially the second course required a lot of writing in two subjects. Also the teachers reported that the students made progress in writing. [20.]

One of the learning goals of the intervention was to learn to search on the Web and other information channels. However, no difference was found between the groups regarding the development of students' behavioural intentions in searching. This unfortunate result requires further consideration: during the whole research period, the teachers for the intervention group reported that the students had problems in searching for information. The short instruction that the school librarian offered in the beginning of the seventh grade was obviously not enough. The teachers did not design any concrete activities to practice Web searching. For example, the importance of finding a personal viewpoint on the topic was emphasized but not demonstrated regarding how to apply these ideas in searching. After the third course, the teacher argued that she should have emphasized searching practices more. [20.]

The results suggested that the teaching intervention had no effect on students' self-efficacy beliefs because no change took place in self-efficacy scores either in the intervention or in the control group. However, this result is difficult to interpret alone because the development of skills and self-efficacy beliefs might interact. As Bellini et al. [25] and Aesaert et al. [6] argued, the self-efficacy beliefs of inexperienced individuals are typically inaccurate and unrealistically high, and when they get more experienced, their self-evaluations become more accurate and less biased. This means that if students' skills are improved in the intervention (students get more experienced), their estimates of self-efficacy will become more accurate. Yet, the scores of self-efficacy belief might go up, remain the same, or go down. All depends on what was the original level of their beliefs and how much their skills developed in the intervention. Our preliminary results of students' performance tests show that skills improved in the intervention group [26, forthcoming]. Thus, we may make a paradoxical conclusion that the intervention might have an effect on students' self-efficacy belief although they remained at the same level. This will be further elaborated on in the forthcoming paper.

Unlike in the research of Koksal and Berberoglu [13] and Gibson and Chase [12], our results suggest that the intervention did not affect students' attitudes, except behavioural intentions in evaluation and writing. Similarly to our findings, the intervention in Pinto and Fernandez-Pascual [11] did not lead to substantial progress in university students' attitudes.

The two-year period from the seventh grade to the eighth grade is an exceptionally long time to collect data about the effects of a teaching intervention. Other factors external to the intervention may affect the development of students' attitudes. We found two examples of this type of change in our data. Firstly, in the whole sample (intervention and control group together), the scores changed to favour less traditional forms of teaching and learning ($F(1, 80) = 10.308$, $p = .002$, partial $\eta^2 = .114$). This

trend was not connected to the intervention, nor to any change in the attitudes to online learning, suggesting that some other factors external to the study might be behind this trend. Secondly, the analysis revealed that the scores across the groups in behavioural intentions in searching ($F(2, 154) = 8.532$, $p = .000$, partial $\eta^2 = .100$) showed a declining trend. This means that the students as eighth graders were less likely to follow good searching practices presented in the questionnaire items.

5 Conclusions

This study generated new knowledge about information literacy instruction and its effect on students beyond procedural knowledge and skills. Results revealed that the teaching intervention changed students' attitudes positively in terms of behavioural intention in the evaluation of search results and source-based writing, but no effect was observed in other factors.

The results demonstrate the importance of the type of the activities and especially the training that they offer to the students. When students were more engaged in certain aspects of IL and online research, their behavioural intentions regarding these aspects improved. In other words, through training, students become aware of good practices - and hopefully will use them in real life, as well. However, the results imply that in lower secondary school, students seems to need continuous training in order to acquire and maintain good information literacy and online research practices.

All in all, it seems to be a challenge to develop self-efficacy beliefs or attitudes through IL instruction. They should be considered as explicit learning goals and explicit attention should be given to them.

The case study focused on students at one single school. Subsequently, the results cannot be generalized to Finnish lower secondary schools or other schools.

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The effect of a teaching intervention on students' online research skills in lower secondary education

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Contents |
- Author index |
- Subject index |
- Search |
- Home

The effect of a teaching intervention on students' online research skills in lower secondary education

Tuulikki Alamettälä and Eero Sormunen.

Introduction. Information literacy skills are crucial in today's world. But teaching these skills is challenging and calls for new pedagogical approaches. This paper reports the results of a teaching intervention designed by practicing teachers in a lower secondary school.
Method. A quasi-experimental pre-test/post-test design was used to investigate the effect of the intervention. Students' learning outcomes were measured in four component skills of online research: search planning and query formulation, Web searching, critical evaluation, and argumentative use of Web information.
Analysis. A mixed between-within subjects ANOVA (analysis of variance) was conducted to investigate the impact of the intervention on students' online research skills.
Results. The intervention group outperformed the control group in an online research performance test. The intervention effect was most powerful among the students who were less active Web searchers or social media users or among those with lower self-efficacy in online research. Surprisingly, the students who had a positive attitude towards traditional teacher-centred learning improved their skills, but the attitude towards independent online learning did not make a difference in learning outcomes.
Conclusions. Even individual teachers may draw inspiration and ideas from research-based pedagogies, develop their professional practice effectively, and create effects in students.

Introduction

In today's Internet-centred information environment, people need online research skills to make sense of controversial issues typical of public debates and everyday life. Online research skills refer to the competences of searching, evaluating, and synthesising information on the Internet. In information sciences, these skills are traditionally referred to as information literacy (Limberg et al. 2008; Kuhlthau et al., 2015). In this paper, we focus solely on students' work on the Web, and we call these competences online research skills. This is in line with the conceptualisation adopted in the study of online reading and comprehension (Leu et al., 2015).

Student-centred learning, including learning by searching, evaluating and integrating information from multiple sources, has become a common practice in schools (Alexandersson and Limberg, 2012; Lundh, 2011; Rouet and Britt, 2011). Yet, recent research shows that students' skills are underdeveloped (Kaarakainen et al., 2018; Coiro et al., 2015; Kiili and Leu, 2019). Students' and teachers' blind trust in the search engines and their unawareness of the biases caused by the search algorithms are also fundamental aspects of the problem (Haider and Sundin, 2019; Sundin and Carlsson, 2016). All in all, we are talking about a complex set of skills that is not easy to acquire (Brand-Gruwel et al., 2005).

Teaching online skills is a challenge for teachers. Information literacy (including online research skills) earns little explicit attention in teacher education (Duke and Ward, 2009; Tanni, 2013). Practicing teachers are uncertain about effective teaching practices (e.g., Colwell et al., 2013). Studies suggest that information literacy instruction is often weakly designed and technically oriented, and it leaves the learning process without sufficient attention (Limberg et al., 2008). However, some studies show that there are individual teachers who actively develop their professional practice in information literacy instruction (Sormunen and Alamettälä, 2014).

Research-based pedagogical models have been developed for information literacy instruction in library and information science. Guided inquiry design is one of the most established frameworks (Kuhlthau et al., 2015). This framework is based on extensive studies of students learning through research assignments. It provides a framework to help schools develop their curricula and detailed guidelines for teachers to guide students through the inquiry process. It is grounded in the idea that information literacy is developed by training information practices in a collaborative inquiry process. In the process, the teacher identifies the crucial points at which students need support and offers targeted guidance. (Kuhlthau et al., 2015)

Although novel pedagogical frameworks have been developed, it is not easy for an individual teacher or teacher team to implement them in the classroom. The suggested models, for example guided inquiry design, assume that the renewal of the pedagogical practice is a school-wide process. Overall, we have little research-based evidence of the effects of novel pedagogies in online research. Some researcher-designed teaching interventions, especially those that are curriculum-embedded, have been shown to be helpful for students (Macedo-Rouet et al., 2013; Chu et al., 2011). However, we lack studies in which a pioneering teacher or teacher team designs an intervention to improve their professional practice of teaching online research skills. Another problem is that most studies deal with short-term interventions in which a reliable measurement of development in complex competences is difficult. Studies on the long-term effects of teaching interventions on online research skills are urgently needed (Bråten et al., 2011).

This study aims to fill the gap in research regarding teacher-designed interventions to develop students' online research skills. In a previous paper (Alamettälä and Sormunen, 2018), we reported how teachers designed and experienced a teaching intervention informed by guided inquiry design. We have also reported the effect of the intervention on students' self-efficacy and attitudes (Alamettälä et al., 2019). In the present study, the goal is to show its effect on students' online research skills. We are also interested in seeing how students' success in the pre-test, information and communication technologies activity, self-efficacy beliefs and behavioural intentions in online research, attitudes towards learning and sex predict their learning outcomes in the intervention.

We build our study on the constructive approach to learning (Phillips, 2000). In this theoretical framework, the student is seen as an active participant in the learning process, actively creating his/her own knowledge and skills based on his/her prior knowledge and experiences. We build on the task-based information interaction framework in which information interaction is understood and examined as cognitive and behavioural activities throughout the stages of task performance (Järvelin et al., 2015). The study assumes (as most intervention studies, e.g., Argelagós and Pifarré, 2012; Chen et al., 2014) that the effect of teaching on students' skills can be measured in a pre- and post-test design simulating a realistic online research process.

Previous research

Quite a few studies have been published on online research teaching interventions in lower (or upper) secondary education. Online research skills have been approached from two angles: some studies have focused on online research skills and how they have been changed by the intervention (Argelagós and Pifarré, 2012; Baji et al., 2018). In other studies, online research has had only an instrumental role, and learning has been measured as a change in subject content knowledge and problem-solving skills (Chen et al., 2014; Chen et al., 2017).

Both Argelagós and Pifarré (2012) and Baji et al. (2018) carried out quasi-experimental studies with a pre- and post-test control group design. Argelagós and Pifarré worked with 7th and 8th graders for two academic years, and Baji et al. studied 6th graders for six weeks. Argelagós and Pifarré utilised a Web-based learning environment in their intervention, and Baji et al. used the Big6 model (Eisenberg and Berkowitz, 1990) as the framework for their intervention. Both studies showed an intervention effect.

Argelagós and Pifarré (2012) measured students' skills in defining the problem and searching for information, scanning and processing information and organizing and presenting information. The experimental students outperformed the controls in defining the problem and searching the Web. As the experimental group searched more effectively, they could also devote more time to scanning and processing information, which also helped them organize and present information; their task performance scores were higher and Pi. The researchers concluded that it is important to support students as they develop their searching skills.

Baji et al. (2018) concluded that the Big6 model, integrated into the curriculum, improved the students' information literacy skills and helped them assimilate a deeper understanding of the research process. To perform the test, they used a modified version of the tool for real-time assessment of information literacy skills (TRAILS) for the 6th-grade students, which includes multiple-choice questions.

Chen et al. (2014) also conducted a quasi-experimental pre-post study with an experimental group and a control. Chen et al. (2017) used students' academic achievements as the moderating factor in their study instead – there was not a control group. Chen et al. (2014) conducted their three-week study among 7th graders, and Chen et al. (2017) studied elementary school students for six years, following them from grade 1 to grade 6. Both studies applied the Big6 framework in their interventions and found an intervention effect.

Chen et al. (2014) measured students' memory of the learned subject content, their comprehension of scientific concepts and problem-solving skills. Their results showed that the experimental group outperformed the controls on comprehension and problem-solving tests but not on the subject content (memory) test.

Chen et al. (2017) examined students' memory and comprehension of subject contents. Regardless of prior academic success, students' fact memorisation and conceptual understanding of subject content improved. In general, the progress level in comprehension was higher than in memory learning. Low-achieving students progressed most in both memory and comprehension learning compared to the medium- and high-achievers.

There are plenty of studies on how different student-related factors explain differences in higher-level Internet skills, i.e., online research skills. For example, it is suggested that students' digital skills benefit from active use of information technology at home (Fraillon et al., 2014). There is also empirical evidence that self-efficacy beliefs (Rohatgi et al., 2016) and attitudes towards information technology (Petko et al., 2017) are associated with the students' skill level. Sex has been related to computer competences, but no consensus has been reached on sex differences in online research skills (Fraillon et al., 2014; Kaarakainen et al., 2018).

We did not find any empirical studies on how the above-mentioned student-related factors predict how students benefit from online research teaching interventions. Aesaert et al. (2017) speculated that slightly overoptimistic self-efficacy judgements could be ideal for effective learning of competencies. The authors argue that moderate overestimation motivates students to persist in their efforts. It seems that discussions on the association among attitudes towards online research, active free-time use of the Internet, and sex, and the effect of online research teaching interventions is even more rare in the research literature.

To summarise, only a few longitudinal teaching intervention studies have been conducted on online research skills in secondary education. Some have measured the effect of the intervention with performance tests (e.g., Argelagós and Pifarré, 2012). Most studies do not elaborate on their findings of how different student groups are affected by the interventions. One exception is Chen et al. (2017), who used students' academic achievement as a moderating factor for their learning benefits in an intervention, concluding that low-achieving students displayed the most progression. Three studies (Baji et al., 2018; Chen et al., 2014; 2017) applied a specified pedagogical framework (Big6), but we lack studies on other frameworks. For example, the guided inquiry design (Kuhlthau et al., 2015) has been assessed only in studies that lack a rigorous design of measuring learning outcomes (e.g., Scott, 2017; Chu et al., 2008; Chu et al., 2011). Further, we found only two studies that had adopted a longitudinal approach to follow students' progress in a scale of school years (Argelagós and Pifarré, 2012; Chen et al., 2017). Finally, we observed that previous research has neglected the viewpoint of an individual teacher who wants to adjust some ideas of the research-based pedagogical frameworks into the everyday professional practice in the school.

Research questions

The aim of this study is to find out how students' online research skills develop in a teaching intervention informed by guided inquiry design in the 7th grade and how the development of skills is associated with various student-related factors. The research questions are:

1. Does the teaching intervention improve students' online research skills?
2. In the teaching intervention on online research skills, are students' benefits associated with their success in the pre-test of online research skills, information technology- and Internet-related activity, self-efficacy beliefs and behavioural intentions in online research, attitudes towards learning or sex?

Methods

The research was conducted as a pre-post intervention study with a control group. The study was quasi-experimental and used a non-equivalent groups design. The groups were selected based on a convenience sample without randomisation. Quasi-experiments are useful when random allocation is difficult, for example, in educational field interventions (Bryman, 2008, p. 40-41; Price et al., 2015).

Participants

The study was conducted in an urban school in a medium-sized city in southern Finland. The school serves as a teacher training school and has about 300 students who come from the neighbouring area without entrance examinations.

Data were collected during the 2015–2016 school year when the students were 7th graders, aged 12–14 years. The intervention group was comprised of three parallel classes of 58 students in total (35 girls, 23 boys). Two classes not exposed to the interventions were studied as a control group, which consisted of 36 students (19 girls, 17 boys).

Procedure

The teaching intervention was integrated into two courses: autumn 2015 and spring 2016. A Finnish language teacher designed and implemented the intervention, and two history teachers were involved in the second course. All were experienced teachers and also taught student teachers. Teachers of the control group were not involved in the study.

Guided inquiry design was introduced to the teachers, but they had the right to decide how to apply it in their pedagogical practices based on the requirements of the curriculum. Therefore, some features of the framework were incorporated by teachers into school practices. The teachers aimed to follow two instructional principles of the framework: to emphasise the first stages of the inquiry process (open, immerse, explore, identify) and to let students choose their own topics of interest. To keep track of information sources, inquiry logs were introduced to the students. In addition, the students worked in groups (shared knowledge building), and the teachers also worked as a team.

Course 1 was part of the Finnish language curriculum, and course 2 was a joint project of Finnish language and history. In course 1 (September 2015), students made a brochure about

recommended practices in social media. The theme of course 2 (April–May 2016) was the Finnish Civil War. The students worked on two end-products: a source-based presentation in history and a fictive text in the Finnish language. The main learning goals were that the students learn to search information on the Internet, evaluate the information and use it appropriately in a given task. The teaching intervention is described in more detail in Alamettälä and Sormunen (2018). The control group remained compliant with the school's curriculum.

Before the intervention, the school librarian briefly introduced information searching to all students, including controls. The lesson dealt with the school library and information searching on the Web (e.g., how to use search engines and formulate queries). Then, the teachers continued with another lesson with textbooks to familiarise students further with the basics of information searching (including planning and defining the search, evaluating sources and listing references). Thus, all students were able to learn the basics of information searching, but the intervention group was exposed to extra activities informed by guided inquiry design.

Materials

Evidence of students' skills in online research can be collected in various ways, for example, by knowledge tests, self-assessments (including self-efficacy scales) and performance tests. The biggest limitation of knowledge tests is that they measure factual knowledge rather than practical skills (Sparks et al., 2016). The problem with self-assessments is that the students easily underestimate or overestimate their skills (Bussert and Pouliet, 2010, pp. 136–137). Authentic tests or exercises have shown to be the most effective way to document actual applied skills (Schilling and Applegate, 2012). Integrated performance tests such as ORCA (online reading comprehension assessment) (Kennedy et al., 2016) and NEURONE (oNlinE inqUiRy experimentatiON systEm) (Sormunen et al., 2017) seek to expose the participants to the challenges of an online research process.

The test used in this study applied the ideas of integrated performance tests. Pre- and post-tests covered four competence dimensions: 1) search planning and query formulation skills, 2) search performance skills, 3) critical evaluation skills, and 4) argumentation skills. The pre- and post-tests had the same form but different themes in order to prevent memorisation. In the first test, the students were asked to find an answer to the following question: "*Can shopkeepers refuse to sell energy drinks to schoolchildren?*" In the second test, the question was: "*In which school subjects might computer gaming have positive effects?*" The students performed the test assignment online but wrote the answers on paper. Neither task was only a simple fact-finding task; they both required information searching and interpretation. However, they were formulated so that it was possible to find straightforward, justified answers.

Before seeking information, the students were asked to think up various search terms. Next, they were allowed to use laptops and search with the help of online search engines. Students were required to list the search terms they used, name two of the best sources and justify their choices. At the end, they were asked to give a well-justified answer to the question. The search plans, queries, sources and their justifications and the answers were assessed and scored.

The basic data on students' backgrounds, including their computer and Internet use, attitudes towards learning, behavioural intentions and self-efficacy beliefs in online research were surveyed by a questionnaire reported in a previous publication (see Alamettälä et al., 2019). Students' information technology activity was measured in three dimensions: school-related technology activity (two items), free time information-seeking activity (two items) and social

media activity (two items). Two sets of items measured attitudes towards independent online learning (four items) and traditional teacher-centred learning (four items). The third attitude component measured behavioural intentions (intent to act a certain way with regard to the attitude object) in online research, including searching (seven items), evaluation (five items) and writing (four items). Self-efficacy beliefs were targeted to information searching (three items) and writing (three items).

Data collection

The tests were carried out before the first intervention course and after the second. The total number of students was 94, 87 of which completed both tests. The tests took about 30 minutes each. The students were tested in their regular classrooms during their Finnish language lessons. The questionnaire regarding self-efficacy and attitudes was administered two times: before and after the intervention. The background information was collected between the first and the second intervention course.

Scoring

The scoring of search plans aimed to assess students' abilities to identify the core and auxiliary concepts of the search topic and find appropriate search terms to represent those concepts. Any string-level word form was accepted (various inflectional and derivational forms). The student could earn 0–6 points by

- identifying the core concept of the topic and presenting it in meaningful search terms (0–2 p)
- identifying auxiliary search concepts and presenting them in meaningful search terms (0–2 p)
- suggesting optional search plans (0–2 p)

The quality of queries used in searches was assessed similarly to search plans. The student could earn 0–4 points by

- formulating a query in which the core concept of the topic is represented with a meaningful search term (0–2 p)
- applying auxiliary search concepts by representing them with meaningful search terms (0–2 p)

The meaningfulness of search terms to represent a search concept was estimated using a three-category classification: strong (1 point), weak (0.5 points) and off-topic (0 points). Altogether, one could earn a maximum of 10 points in search planning (scaled by a factor of 0.2 in the overall test score).

The first author assessed the sources (2) selected by the student based on their relevance in the task completion. The source was relevant if it correctly answered the question from the test task. The student earned one point for each relevant source. The maximum number of points for search performance was 2.

The students were also asked to justify the chosen sources, and the justifications were evaluated. The criteria for evaluation were relevance (factual content) and reliability (Borlund,

2003). The student earned 1 point by justifying the chosen information source based on its relevance and 1 point based on its reliability. The maximum was 2 points regardless of whether the student evaluated one or two sources.

Measuring the use of information was simplified, and the evaluation was based on whether the student was able to give the correct answer (max 1 point) and justify it (max 1 point). The researcher assessed the relevance the same way as above (see search performance skills). The student could earn one point by giving the correct answer and another point by presenting a source-based argument to support the answer (for example, by referencing to authorities).

The overall test score was a sum of component scores all equalised to a maximum of 2 points. It is noteworthy that, in this kind of test, the search performance component dominates the two last components. Without relevant search results, it is difficult to achieve high scores in the evaluation and use of sources.

Data analysis

SPSS version 25 was used for statistical analyses. A mixed between-within subjects ANOVA (analysis of variance) was conducted to investigate the impact of the teaching intervention on students' online research skills. A mixed between-within subjects ANOVA is an extension of the repeated measures ANOVA and can be used in a study with two independent variables: one is a between-subjects variable (e.g., group: intervention or control) and the other a within-subjects variable (e.g., time: pre or post). (Pallant, 2013, pp. 284–292)

Prior to the analysis, assumptions of normality were tested using the Kolmogorov-Smirnov test and the Shapiro-Wilk test (Field, 2009, pp. 145–148). Data in both groups were normally distributed ($p > 0.05$). There were no outliers, as assessed by box-plot. The homogeneity assumption of variances and covariances in the data sets was verified by Levene's test of homogeneity of variances ($p > 0.05$) and Box's M test ($p > 0.05$), respectively (Field, 2009, pp. 150–152, 604).

Students from the intervention group were divided into the subgroups High and Low based on their pre-test scores, information technology activity, self-efficacy, attitudes and behavioural intentions to examine if these factors are related to the measured intervention benefits. The division was based on the mean values of each variable as a cut-off point. The relationships were analysed by applying one variable at a time. The effect of sex was also analysed.

Results

Does the teaching intervention improve students' online research skills?

The mean of the overall test score rose from 3.93 to 4.73 in the intervention group while staying around 3.7 in the control group $F(1, 85) = 6.43$, $p = 0.013$, partial $\eta^2 = 0.070$. The results of the mixed between-within subjects ANOVA (Table 1) show that the intervention had a measurable effect on students' learning. The effect size was medium (partial eta-squared thresholds: small = 0.01; medium = 0.06; large = 0.14, see Pallant, 2013, pp. 217–218).

Examining one test component at a time reveals that the intervention effect was most remarkable in *search planning and query formulation skills* ($p = 0.023$, $\eta_p^2 = 0.059$).

Argumentative use of Web information was near significance ($p = 0.087$). However, the scores improved in both groups, suggesting that the change is related to learning external to the intervention (for example, an effect of the school's regular curriculum, or an easier topic to build valid arguments in the post-test). In Web searching and critical evaluation, the measured difference between pre- and post-tests indicated a weak intervention effect, but the results were not statistically significant. It is worth noting that Web searching scores dropped in the control group by 0.33 points and in the intervention group by 0.08. This suggests that the relevant sources were more difficult to find in the post-test topic than in the pre-test topic. No change was observed in the scores of critical evaluation, indicating that in this sub-task, the intervention was ineffective.

	Intervention group (n=55)				Control group (n=32)				repeated ANOVA		
	Pre-test M (SD)	Post-test M (SD)	t	p	Pre-test M (SD)	Post-test M (SD)	t	p	F	p	η_p^2
Search planning and query formulation	1.37 (0.2)	1.46 (0.3)	-2.35	**0.022***	1.44 (0.2)	1.36 (0.4)	1.14	0.264	5.36	**0.023***	0.059
Web searching	1.02 (0.5)	0.94 (0.7)	0.74	0.463	0.89 (0.4)	0.56 (0.7)	2.32	**0.027***	1.86	0.177	0.021
Critical evaluation	0.80 (0.4)	0.92 (0.5)	-1.66	0.102	0.73 (0.5)	0.6 (0.4)	0.50	0.620	1.98	0.163	0.023
Argumentative use of Web information	0.74 (0.6)	1.42 (0.6)	-7.56	**0.000***	0.67 (0.6)	1.09 (0.6)	-3.48	**0.002***	3.00	0.087	0.034
Overall score	3.93 (1.1)	4.73 (1.4)	-4.20	**0.000***	3.74 (1.1)	3.71 (1.5)	0.11	0.915	6.43	**0.013***	0.070
* statistically significant p < 0.05											

Table 1: Overview of test results of students' online research skills

What kind of student-related factors explain students' learning benefits?

Table 2 presents a comparison of intervention benefits achieved in subgroups formed on the basis of students' pre-test scores, information technology activity, self-efficacy and behavioural intentions in online research, attitudes towards learning and sex. Column set A presents the comparison of online research scores between the high/low and male/female subgroups in the pre-test, and column set B the corresponding comparison in the post-test. Column sets C and D present the measured improvement of scores from the pre-test to the post-test within high/low and male/female subgroups.

	A. Between subgroups comparison Pre-test				B. Between subgroups comparison Post-test				C. Within subgroup high improvement			D. Within subgroup low improvement		
	High M (SD)	Low M (SD)	t	p	High M (SD)	Low M (SD)	t	p	M (SD)	t	p	M (SD)	t	p
Pre-test score n_{high}=26, n_{low}=29	4.9 (0.6)	3.1 (0.8)	10.17	**0.000***	5.5 (1.1)	4.1 (1.4)	4.07	**0.000***	0.6 (1.2)	2.29	**0.031***	1.0 (1.6)	3.56	**0.001***
School-related information technology activity n_{high}=32, n_{low}=23	4.3 (0.1)	3.4 (1.2)	3.06	**0.004***	4.9 (1.4)	4.5 (1.5)	0.94	0.352	0.6 (1.2)	2.67	**0.012***	1.1 (1.6)	3.28	**0.003***
Free time-related information-seeking activity n_{high}=33, n_{low}=22	3.9 (1.2)	3.9 (1.1)	0.13	0.898	4.7 (1.5)	4.8 (1.3)	-0.43	0.667	0.8 (1.5)	2.72	**0.010***	0.9 (1.3)	3.39	**0.003***
Social media activity n_{high}=23, n_{low}=32	4.4 (1.2)	3.6 (1.0)	2.56	**0.013***	4.8 (1.5)	4.7 (1.4)	0.17	0.864	0.4 (1.1)	1.68	0.107	1.1 (1.5)	4.01	**0.000***
Self-efficacy n_{high}=27, n_{low}=26	4.4 (0.9)	3.5 (1.1)	3.16	**0.003***	5.0 (1.3)	4.5 (1.5)	1.3	0.199	0.6 (1.2)	2.55	**0.017***	1.0 (1.5)	3.28	**0.003***
Attitude towards online learning n_{high}=27, n_{low}=26	4.1 (1.0)	3.8 (1.2)	0.93	0.358	4.7 (1.3)	4.8 (1.9)	-0.16	0.871	0.7 (1.3)	2.38	**0.025***	1.0 (1.4)	3.46	**0.002***
Attitude towards traditional learning n_{high}=28, n_{low}=25	4.1 (1.2)	3.9 (0.9)	0.52	0.605	5.2 (1.5)	4.3 (1.2)	2.14	**0.037***	1.1 (1.5)	1.21	**0.001***	0.4 (1.1)	1.93	0.066
Behavioural intentions n_{high}=27, n_{low}=26	4.2 (0.8)	3.8 (1.3)	1.14	0.256	5.0 (1.4)	4.5 (1.4)	1.38	0.173	0.8 (1.3)	3.61	**0.001***	0.7 (1.5)	2.34	**0.028***
	Female M (SD)	Male M (SD)	t	p	Female M (SD)	Male M (SD)	t	p	M (SD)	t	p	M (SD)	t	p
Sex n_{female}=34, n_{male}=21	4.2 (1.1)	3.5 (1.1)	2.19	**0.033***	5.0 (1.5)	4.3 (1.1)	1.71	0.094	0.8 (1.3)	3.46	**0.002***	0.8 (1.6)	2.38	**0.027***

*statistically significant p < 0.05

Table 2: Overview of subgroup comparisons

The *high* subgroup in the *pre-test scores* scored 1.8 points higher than the *low* subgroup (4.9 vs. 3.1, $p = 0.000$). In the post-test, the difference was 1.3 points (5.5 vs. 4.1, $p = 0.000$). Both groups learned, and the difference between the groups levelled out a bit (improvement 0.6 vs. 1.0). Still, the difference remained clear after the intervention.

The *high* subgroup in *school-related information technology activity* scored 0.9 points higher in the pre-test than the *low* subgroup (4.3 vs. 3.4, $p = 0.004$). In the post-test, the difference levelled out (4.9 vs. 4.5, $p = 0.352$). In other words, students actively using the technology for schoolwork at home did better in the pre-test, but the difference faded during the intervention. Both groups learned, but the mean measured improvement was higher for the *low* subgroup (0.6 vs. 1.1).

The *free time information-seeking activity* variable was not connected with intervention benefits. No difference was found between the active and passive free time information seekers in the pre-test (3.9 vs. 3.9) or in the post-test (4.7 vs. 4.8). Students' skills developed equally in both subgroups.

The *high* subgroup in *social media activity* scored 0.8 points higher in the pre-test than the *low* subgroup (4.4 vs. 3.6, $p = 0.013$). In the post-test, the difference levelled out (4.8 vs. 4.7, $p = 0.864$). Thus, the results provided evidence that students who are less active on social media improved their online research skills (difference 1.1, $p = 0.000$), but those who were more active on social media made hardly any progress (difference 0.4, $p = 0.107$).

The *high* subgroup in *self-efficacy in online research* scored 0.9 points higher in the pre-test than the Low subgroup (4.4 vs. 3.5, $p = 0.003$). In the post-test, the difference levelled out (5.0 vs. 4.5, $p = 0.199$). Both groups learned, but the *low* subgroup seemed to benefit more from the intervention.

Surprisingly, an *attitude towards online learning* did not predict an intervention effect. Both the *high* and *low* subgroups were approximately at the same level in the pre-test (4.1 vs. 3.8, $p = 0.358$) and post-tests (4.7 vs. 4.8, $p = 0.871$). Contrary to what was expected, an attitude towards traditional teacher-centred learning seemed to be a more likely predictor of effective learning. Both the *high* and *low* subgroups succeeded similarly in the pre-test (4.1 vs. 3.9, $p = 0.605$), but in the post-test, the *high* subgroup scored 0.9 points higher than the *low* subgroup (5.2 vs. 4.3, $p = 0.037$). The improvement in test results in the High subgroup was evident (1.1, $p = 0.001$) but remained speculative in the *low* subgroup (0.4, $p = 0.066$).

No difference in learning was observed between the subgroups based on *behavioural intentions* in online research. No difference was found between the subgroups in the pre-test (4.2 vs. 3.8, $p = 0.256$) nor in the post-test scores (5.0 vs. 4.5, $p = 0.173$). The subgroups improved test scores about equally (0.8, $p = 0.001$ vs. 0.7, $p = 0.028$).

Regarding sex, girls outperformed boys in the pre-test, but in the post-test, the measured difference was not conclusive. Girls scored 0.7 points higher in the pre-test than boys (4.2 vs. 3.5, $p = 0.033$). The measured difference remained the same in the post-test, but the result did not pass the t-test (5.0 vs. 4.3, $p = 0.094$). The problem in achieving statistical significance may be caused by the relatively low number of boys in the sample (n-males=21), and the higher standard deviation in the girls' post-test test scores (SD $= 1.53$).

Discussion

The aim of our case study was to investigate the effect of a long-term inquiry-based information literacy intervention designed and implemented by a teacher and her colleagues in a lower secondary school. The teachers were informed of the guided inquiry design framework (Kuhlthau et al., 2015), and they applied some aspects of it to their pedagogical practice (see Alamettälä and Sormunen, 2018). We also examined how student-related factors such as pre-test success (online research skills before the intervention), information technology related and Internet related activity, self-efficacy and behavioural intentions in online research, attitudes towards learning and sex explain the benefits gained by students from the intervention.

Our first finding was that the teaching intervention improved students' performance in online research. The sum of the test scores developed more in the intervention group than in the control group. The results are in line with the findings of Argelagós and Pifarré (2012) and Baji et al. (2018). In all studies, the intervention group outperformed the control group in the post-test. A closer examination of one component skill at a time showed that the intervention effect was most powerful in *search planning and query formulation*. The substantial progress in this sub-task can be explained by factors related to the pedagogical design of the intervention (Alamettälä and Sormunen, 2018):

1. All students including controls participated in the information searching unit arranged by the school librarian and the teacher at the beginning of the first semester just after the pre-test. All students were expected to learn the basics of information searching. However, the practical skills seemed to be developed and sustained only in the intervention group, which practised these skills during the intervention.
2. The teachers paid attention to the first phases of the inquiry process as recommended in the guided inquiry framework. They were obviously supported to conceptualise the topic of the task at hand and formulate their personal focus on it before the searches were done, that is, before the technical part. Past research has shown that practising teachers tend to teach searching as a technical skill (Limberg et al., 2008). The application of the guided inquiry framework helped to overcome this limitation in the professional practice.

Similarly, Argelagós and Pifarré (2012) found that the students in the intervention group outperformed the controls in the component skill *defining the problem*. Their study design supported activating prior knowledge and specifying the information needed.

We were not able to demonstrate an intervention effect in the other sub-tasks. Web searching scores (based on the relevance of the chosen documents) dropped in the control group and did not improve in the intervention group. This suggests that the relevant sources were more difficult to find in the post-test topic than in the pre-test topic. However, the difference in search task difficulty does not explain the failure to demonstrate the intervention effect. A likely explanation is that searching on the Web is always a trial-and-error process through which various details in the implementation of a search plan (e.g., choice of search words, writing mistakes) may lead the searcher to fail or succeed. Especially if there are only a few relevant sources available, the test measure suffers from low stability (see Soboroff, 2004). The additional random error component in a relatively small dataset makes it difficult to achieve statistically significant results.

No intervention effect was observed in the critical evaluation of sources (justifications for the relevance and reliability of sources used). This is a disappointing result since the team of teachers in the second unit emphasised the importance of critical evaluation skills as a learning goal. Teachers introduced the evaluation criteria and a sample of high-quality sources to the students. However, no organized activities or guidance were included in the intervention to practise these skills. Therefore, some students ignored the sources offered by the teachers and used low-quality Web sites as their sources. (Alamettälä and Sormunen, 2018). In the guided inquiry framework, the teacher team (including the school librarian) pays a lot of attention to the critical evaluation of sources. They actively guide students in locating and evaluating information sources. In this intervention, the teachers did not take such an active role, and the librarian was not involved at all. Nor did they look at the evaluation from the angle of search engine infrastructures (cf. Haider and Sundin, 2019, pp. 107-110).

The last sub-task measured how skilful students were at finding an answer to the assignment and presenting source-based arguments to support it. Here, we found only a weak indication that the intervention developed the skills of the argumentative use of Web sources. As reported in Alamettälä and Sormunen (2018), we observed that the teachers paid at least indirect attention to the use of sources. They instructed the students to use inquiry logs, and they reported that students who used the log seemed to synthesise information better across various sources than those who had not used it. However, we did not find active, teacher-guided activities to improve students' skills in the argumentative use of sources. For example, Argelagós and Pifarré (2012) argued that scaffolds related to scanning and processing information helped students in their study to construct knowledge in a more efficient way. In their study, the intervention improved students' task performance, i.e., to present a justified answer to a question.

We also wanted to find out how several student-related factors were connected to the intervention effects. The pre-test of online research skills indicated that various student-related variables are associated with the levels of online research performance. It is important that novel pedagogical approaches do not increase the gaps between high- and low-performing students. We followed the example of Chen et al. (2017), who found that the teaching intervention helped low-achieving (overall in studies) students improve their online skills more their medium- and high-achieving peers.

The pre-test revealed four factors, which are related to skill differences in online research: *using information technology for schoolwork at home*, *using social media*, *self-efficacy in online research* and *sex*. In each group, the post-test results indicated that the intervention decreased the gap between the groups in online research skills. The finding suggests that those who were less active Web searchers or social media users or those who were not convinced of their Web skills got a boost to learn new Internet skills. The evidence for gap reduction regarding sex was weakest; girls clearly outperformed boys in the pre-test, but in the post-test, the measured gap was still a borderline case in terms of statistical significance.

Free time information-seeking, behavioural intentions in online research, attitude towards online learning and *attitude towards traditional teacher-centred learning* were student-related variables that did not differentiate students in the pre-test. The *high* and *low* groups related to the first three variables performed in the post-test equally well. The *attitude towards traditional learning* made a difference and emerged as a variable that influenced learning outcomes. The *high* group for students preferring traditional teacher- and textbook-centred pedagogies outperformed the *low* group in the post-test. This finding is rather confusing, especially

because, at the same time, the *high* group for students that prefer independent learning with the help of the Internet did not improve their online research skills more than the *low* group.

The relationship between the intervention effect and a positive attitude towards traditional teacher-centred learning may indicate that our attitude scale also measures students' engagement and motivation to learn in school. It seems that their basic orientation did not change, although the learning object was now online research skills. Their motivation to learn might be greater than for those who preferred working online. The 7th-grade students do not have much experience with online research, and their conceptions of online learning might refer to the hope of easy learning on the Internet.

Conclusions

This study contributes to the pedagogy of online research skills. We lack intervention studies on teachers' professional practices in teaching online research skills. The results revealed that even individual teachers may draw inspiration and ideas from research-based pedagogies such as the guided inquiry framework. This kind of pioneering work helps to improve teaching practices in schools. However, as most of the pedagogical models emphasise, the renewal of pedagogical practices is a school-wide process (e.g., Kuhlthau et al., 2015). In an ideal situation, the whole school would be involved, including the school library.

The study demonstrated the importance of organized activities. The intervention was effective, but the effect was limited only to one sub-task of online research: search planning and query formulation. We expect that balanced progress in all sub-skills could be achieved by operationalising learning goals for each sub-task more concretely. Furthermore, the learning of complex skills requires that students come across each sub-task several times in different contexts during their school years. Obviously, the chances of an individual teacher or teacher team are limited in this respect.

The case intervention tended to decrease the gaps in students' online research skills. This might not happen in all teaching interventions. It might be that the guided inquiry framework helps students of lower-than-average performance to narrow some of the skill gaps. However, those who shared the attitude towards traditional teacher-centred learning seemed to increase their advantage over their less-engaged peers. Motivating all students in the learning process overall is a challenge in schools and needs further research in the context of online research.

We encourage teachers to collaborate and try out new pedagogical models such as guided inquiry, paying attention to every phase of the online research process, and researchers should report these experiments to get more research-based knowledge of online research instruction and its effects on students. Future research could be conducted among students from different age groups and could also take students' overall academic achievement into consideration.

This study shares the limitations of quasi-experiments. Intervention and control groups may not be comparable, and prior differences between the groups may affect the outcome of the study (Bryman, 2008, pp. 40-41). Our students came from the same neighbourhood and were not exposed to any entry exams or ability-based selection procedures. Therefore, we assume there were similar starting level distributions for both groups. In addition, the pre-test scores showed that students' online research skills were on the same level in the beginning. However, there might be other factors that are impossible to control that influence students' development

during and between the intervention units. On the other hand, the ecological validity of our quasi-experiment is expected to be high because it was conducted in a natural environment (cf. Bryman, 2008, pp. 40-41).

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PUBLICATION
IV

Learning online research skills in lower secondary school: Long-term intervention effects, skill profiles and background factors

Tuulikki Alamettälä & Eero Sormunen

Learning online research skills in lower secondary school: long-term intervention effects, skill profiles and background factors

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Abstract

Purpose: The aim of the study was to investigate the long-term development of online research skills among lower secondary school students and how various factors such as teaching interventions and students' self-efficacy, attitudes, ICT activity, and gender are associated with development.

Design/methodology/approach: Two intervention courses were implemented to improve online research skills among 7th-grade students. In the follow-up test in the 8th grade, students' skills were measured in Web searching, critical evaluation of sources, and argumentative use of Web information. Students' self-efficacy beliefs in online research, their attitudes toward learning, behavioral intentions in online research, and ICT activity were surveyed by questionnaires.

Findings: The main finding was that the effect observed immediately after the intervention in 7th grade did not last until the following year. A cluster analysis revealed six skill profiles characterizing strengths and weaknesses in students' performance in the subtasks of online research and indicated that many students suffer from poor evaluation skills. Self-efficacy beliefs stood out as a student-related factor associated with the development of online research skills.

Originality/value: This study contributed to the pedagogy of online research skills. It indicates that small-scale interventions are not enough to enhance 7th-graders' online research skills. Students need continuous practice in different contexts during their school years. It is important to support students' self-efficacy to motivate them to develop their skills in all the subtasks of online research. The study also demonstrated the importance of follow-up studies in online research skills, as they have been rare thus far.

1. Introduction

In today's Internet-centered information environment, we need advanced competences to *search*, *evaluate*, and *use* information on the Web. Traditionally, these competences have been the focus of information literacy research (e.g., Kuhlthau *et al.*, 2015). In our study, we prefer to call these *online research skills* because the Web has taken a dominant role in students' information behavior. The concept originates from studies of online reading and comprehension (e.g., Leu *et al*., 2015).

Primary and secondary school students have been exposed to digital media throughout their lives. Their Web-related skills develop along with their age and education levels (van Deursen and van Diepen, 2013; Kaarakainen *et al.*, 2018). However, there are remarkable differences in skill levels among students (e.g., Hatlevik and Christophersen, 2013). We do not have a clear picture how formal learning in schools or factors in students' backgrounds explain the differences in their skill levels. Further, past studies show that many students lack essential components of the online research skills required for school (e.g., Kaarakainen *et al*., 2018; Kiili and Leu, 2019). The competence gaps challenge the school to develop more effective pedagogies for online research skills.

Teaching interventions have been conducted in schools to improve pedagogical practice in online research instruction. Researchers have reported positive learning outcomes measured immediately after intervention (e.g. Argelagós and Pifarré, 2012; Baji *et al.*, 2018; Chen *et al*., 2017). However, it has remained unclear whether the learning outcomes are lasting. For example, Hsieh *et al*. (2005) urged researchers to conduct testing not only when the intervention ends but also later.

Another challenge in teaching online research skills is that we do not completely understand what skills are most likely learned informally in everyday life. Understanding the role of personal factors such as ICT (Information and Communication Technology) activity, self-efficacy in, and attitudes toward online research could help in finding more informed pedagogical designs. Further, identifying variations in students' skill profiles could improve the determination of their individual weaknesses and needs for support.

This paper reports a follow-up study of a teaching intervention (Alamettälä and Sormunen, 2020) that provided evidence of short-term learning outcomes similar to the studies

mentioned above (e.g., Argelagós and Pifarré, 2012; Baji *et al.*, 2018; Chen *et al.*, 2017). The teaching intervention was designed and implemented in a Finnish lower secondary school. In this follow-up study, we had three objectives. First, we wanted to find out, whether the intervention effect observed in the 7th grade remains in the 8th grade. Second, we wanted to reveal students' skill profiles across the subtasks of online research and to find out how common the identified skill profiles are. The third goal was to identify student-related factors that are associated with student groups that demonstrate high or low skills in online research performance test.

We explore the following research questions:

RQ1: Do the immediate effects of a teaching intervention on online research skills last across grades?

RQ2: What kinds of skill profiles emerge among lower secondary school students in terms of the information searching, evaluation, and use subtasks?

RQ3: Are self-efficacy beliefs in online research, attitudes toward learning, behavioral intentions in online research, ICT activity, or gender associated with students' development toward high or low performance in online research?

2. Literature review

The chances of achieving substantial learning outcomes depend on the intensity and length of a teaching intervention. For example, in education technology interventions, it has been noted that the duration of the intervention affects learning. Sung *et al*. (2016) conducted a meta-analysis of studies on mobile-integrated education and concluded that short-duration interventions tend to produce greater effects than those of a longer duration. This finding is confusing, but the phenomenon has a logical explanation: novelty factor (Cheung and Slavin, 2013). However, gains made in learning due to interventions' novelty value do not necessarily last (Higgins *et al*., 2012). Research in the field of education and psychology emphasizes long-term teaching interventions' importance for obtaining reliable and lasting results (Anderson, 1980; Hsieh *et al*., 2005). Lakkala and Ilomäki (2011) state that complex competences evolve only through extensive, repeated, and long-term practise in varying instructional contexts.

Follow-up studies are conducted to see whether the short-term effects continue after a certain period of time (Salkind, 2010). We did not find any follow-up studies on information literacy instruction interventions except the one by Baji *et al*. (2018). They conducted a six-week

teaching intervention on information literacy among Iranian 6th graders applying the Big6 model (Eisenberg and Berkowitz, 1990) as the framework. In their case, the follow-up test was done two months after the intervention, and it confirmed a positive intervention effect. The test tool used in their study was a knowledge test called TRAILS (http://www.trails-9.org/).

Previous research has focused on online research and related skills overall (Kennedy *et al.*, 2016; Sormunen *et al.*, 2017), specific subtasks of Web searching (e.g., Deursen and van Diepen, 2013), critical evaluation of sources (e.g., Paul *et al.*, 2017), and use of source information (e.g., Kiili and Leu, 2019). However, we did not find earlier research on skill profiles, that is, how students' skills in the subtasks are combined in their overall online research skills.

We assume that online research and related skills are learned both informally by practicing Web information interactions in everyday life, and formally in the school. Learning outcomes vary individually as the studies indicate (Hatlevik and Christophersen, 2013). Some student-related factors have been studied to explain the differences in achieved skill levels.

Kurbanoglu (2009) suggested that individuals with low self-efficacy – those who do not have confidence in their abilities and, thus avoid challenging activities – are less inclined to develop their information literacy skills, whereas individuals with high self-efficacy are more likely to do so. However, we did not find studies where the hypothesis had been empirically tested. Instead, the topic has been studied in a related research area: the study of ICT and internet competences, which, in many cases, includes some aspects of the online research skills. According to the ICILS (International Computer and Information Literacy Study) 2013 and 2018, ICT self-efficacy is positively related to computer and information literacy among 8th-grade students (Fraillon *et al.*, 2019; Hatlevik *et al.*, 2018). However, in Kaarakainen *et al.*'s (2018) study, self-efficacy was found to have a positive effect only on male students' information skills.

Psychology studies have shown that attitudes affect individuals' behavior (e.g., Olufemi, 2012), and previous studies suggest that attitude has an influence on content learning. For example, Petko *et al.* (2017) found that positive attitudes toward educational technology were associated with higher test scores in reading, math, and science among 15-year-olds. Consequently, it seems that attitudes influence learning subject content. Attitudes may also influence the development of online research skills. One dimension of attitudes is behavioral

intentions, which refers to the intent to act a certain way with regard to an object. In our previous study, we noticed that the intervention changed students' behavioral intentions in the evaluation of search results and source-based writing (Alamettälä *et al*., 2019).

The relationship between students' use of computers and their computer and information literacy is also somewhat unclear. Both Kaarakainen *et al*. (2018) and Fraillon *et al*. (2019) report that versatility of technology use and online activities are the most prominent predictors of students' computer and information literacy. Access to computers at home and experience using computers were positively associated with student computer and information literacy. However, the use of ICT in schools correlated negatively with achievement in a digital literacy test for Norwegian 9th graders (Hatlevik *et al*., 2015). In a more recent study, Hatlevik *et al*. (2018) suggested that the quality of ICT use (how it is used) in schools is more important for students' learning than its frequency (how often it is used).

Regarding the relationship between gender and information literacy skills, some studies suggest gender equivalence and others gender difference. In the ICILS 2018, female students demonstrated higher computer and information literacy achievement than male students (Fraillon *et al*., 2019). However, in a recent study conducted in Finland, there were no differences between genders in the total scores for information skills (Kaarakainen *et al*., 2018).

In short, earlier research indicates a lot of variation concerning association between students' background factors and online research skills.

3. Methodology

3.1. Participants and procedure

The study was conducted in a lower secondary school in an urban area in Southern Finland. The students come from the surrounding neighborhood and are admitted by the local school principle (that is, all students from the neighborhood can enter the school without entry exams). Altogether, 94 lower secondary school students participated in the study. The intervention group consisted of three parallel classes of 58 students in total (35 girls, 23 boys). 36 students (19 girls, 17 boys) in two other classes formed the control group. The intervention took place during the 2015–2016 school year when the students were in the 7th grade. Follow-up data were collected in the autumn term of 2016, when the students were 8th graders, aged 14–15 years. In all, 86 students took part in the follow-up test. Two students were excluded because

their answers indicated that they had not taken the test seriously (some answers included offensive language, and some tasks were left blank).

The teaching intervention was integrated into two regular courses of the school. Three teachers designed and implemented the intervention. The teachers were informed of the Guided Inquiry Design (Kuhlthau *et al.*, 2015), a research-based teaching model for information literacy, and they integrated some of its features into their teaching. The teachers' the main goals were that students learn to search for information on the Internet, evaluate the information found, and use it appropriately in a given task.

Course 1 was part of the Finnish language curriculum (September 2015). Students made a brochure about good practices on social media. Course 2 was a joint project in Finnish language and history (April–May 2016); its theme was the Finnish Civil War. The students worked on two end-products: a source-based presentation in history and a fictive text in the Finnish language. Originally, the intervention was to be integrated into three courses. However, the teacher's design for the third course deviated from the ideas of our research project. The oral presentation assignment did not encourage students to practice their online research skills. Thus, the third course was excluded from the intervention, and the last performance test was regarded as a delayed post-test. The control group was taught by teachers working independently of the study. The teaching intervention is described in more detail in Alamettälä and Sormunen (2018).

3.2.Data collection

A simulated online environment NEURONE (oNlinE inqUiRy experimentatiON system, https://www.neurone.info; see also González-Ibáñez *et al.*, 2017) was used to collect students' performance data in an online research assignment. The task was to compose an article entitled "Computer-gaming has both advantages and disadvantages" for a school magazine. NEURONE is a closed, fully controlled system simulating a Web-based learning and searching environment. The system guides the process, directing students to perform the task step by step through the subtasks of information searching, evaluation, and use.

The test environment contained 20 information sources, 3 of which were relevant and 17 nonrelevant. The content and layout of the relevant sources were designed to simulate authentic Web pages and approach the topic from different perspectives. For a full picture, and in order to complete the task, the students needed to integrate information from all the perspectives. Nonrelevant pages were copies of pages downloaded from the Web.

First, the students searched for three relevant sources. After that, they evaluated the credibility of each source. Finally, the students were asked to write an article of at least 50 words. The system collected versatile log data of students' actions.

The NEURONE workflow is designed so that students' performance can be independently assessed in each subtask (search, evaluation, use). The relevant sources are given to the student before the evaluation phase if the search has partly or totally failed. This guarantees that each student has an equal chance to succeed in the evaluation and information use subtasks and that the test scores are comparable in these subtasks.

The test took about 45 minutes. The students were tested in their regular classrooms during their Finnish language course. Before the students came to the class, computers were logged into the NEURONE system. A researcher read quick guidelines aloud to the students before they started the test. The students were advised to perform the test independently following the instructions given in the system. They were advised to ask the researcher for help if they experienced technical issues.

The basic data on students' self-efficacy beliefs in online research, their attitudes toward learning, and their behavioral intentions in online research were collected via a questionnaire developed for the study (see Alamettälä *et al*., 2019). Self-efficacy beliefs were targeted to information searching (three items, Cronbach's $\alpha = .746$) and writing (three items, $\alpha = .727$). Two sets of items measured attitudes toward independent online learning (four items, $\alpha = .774$) and traditional teacher-centered learning (four items, $\alpha = .739$). The third attitude component measured behavioral intentions (the intent to act a certain way with regard to an object) in online research, including searching (seven items, $\alpha = .779$), evaluation (five items, $\alpha = .785$) and writing (four items, $\alpha = .736$). All scales meet the requirement for Cronbach's $\alpha >0.7$ (see Field, 2013, p.709). The questionnaire was administered before the first course.

The background information regarding students' activity of computer and Internet use was collected between the first and second course. Students' computer and Internet activity were measured in three dimensions: school-related ICT activity (two items), free time information-seeking activity (two items) and social media activity (two items).

3.3. Scoring

Students' Web searches were assessed from two angles. The scoring of queries aimed to assess students' abilities to identify the core and auxiliary concepts of the search topic, and to

find appropriate search terms to represent those concepts. The student earned 1 point by formulating a query where both the core concept and at least one auxiliary concept of the topic was represented by meaningful search terms. Additional points were earned by suggesting optional queries and by expanding the terminology by using meaningful search terms outside the given assignment.

The effectiveness of searches was measured by the number of relevant documents bookmarked by the student. The scoring was based on automatic procedures in the search log data. The total number of relevant documents bookmarked was discounted by the total number of nonrelevant documents bookmarked. Many bookmarked nonrelevant documents revealed a cheating behavior adopted by some students in order to misuse NEURONE's feedback to find relevant documents (see Sormunen *et al*., 2017). The query scores and search effectiveness scores were totaled and normalized between 0 and 3 points.

A credibility evaluation was scored based on the justifications that students presented for each of the three relevant sources. The justifications were identified, categorized, and counted. The scoring was based on the diversity of the justifications. The student could earn points by referring to source features (expertise of the source or other source features) and the quality of the content (argumentation in the text or other aspects of the content) (see Hämäläinen *et al*., 2020). The students scored one point for each relevant justification. The total score was normalized between 0 and 3 points.

The scoring of information use was based on whether the student's article specified both positive and negative effects of playing computer games (based on the source materials) and whether the article also included a recommendation on how to use the games. Articles earned point as follows:

- one negative or one positive effect: 1 point
- either two negative or positive effects: 2 points
- one negative and one positive effect: 3 points
- two negative and one positive effects (or vice versa): 4 points
- two negative and two positive effects: 5 points
- a recommendation included: 1 extra point.

The total scores were normalized between 0 and 3 points. The overall test score was the sum of the component scores: search, evaluation, and use (each max 3 points).

The scoring was conducted by the first author. To ensure that the scoring was reliable and in line with the instructions, two other researchers scored around 20% of the responses from randomly selected participants for all variables except for search result, which was auto scored. Percent agreement was used to measure intercoder reliability (Stemler and Tsai, 2008). In general, above 75% is considered an acceptable level of agreement. The overall consistency was 76% in queries, 65%in evaluation, and 87% in information use. The evaluation value remained under the acceptable level. When examining the differing scores in evaluation, it turned out that there was one specific criterion where the coders' interpretations differed. However, it was found that both interpretations were justified, and had been applied consistently. The interpretation by the first author was used in the final scorings.

3.4. Data analysis

SPSS version 25 was used for statistical analyses. An independent samples t-test was conducted to compare the test score means between the two groups. An independent samples t-test is commonly used in experimental designs in which the participants have been divided into two groups. The t-test compares the means between the groups and determines whether there is statistical evidence that the means are significantly different. (Field, 2009, pp. 334–336.)

Prior to the analysis, assumptions of normality were tested using the Kolmogorov–Smirnov test. The sets of data that did not pass the test were evaluated graphically using the normal Q–Q Plots. All data were at least approximately normally distributed. There were a few outliers assessed by boxplot, mainly students that had failed the test. We ran the analysis both with and without the outliers. As removing the outliers did not change the results, they were included in the analysis to reduce an unnecessary turnout. The homogeneity assumption of variances was verified by Levene's test of homogeneity of variance ($p > .05$).

A two-step cluster analysis using the log-likelihood measure was used to reveal how the test divided students into groups based on their scores in Web searching, evaluation, and information use. Cluster analysis is an exploratory analysis that tries to identify structures within the data. More specifically, it tries to identify groups of cases that are similar to each other but different from other groups. Two-step cluster analysis is a combination of more traditional cluster methods: hierarchical and k-means. The first step divides the data set into small subclusters, while the second step groups the subclusters into the desired number of clusters. (Bittmann and Gelbard, 2007.)

The desired number of clusters can be determined automatically, or it can be a predetermined fixed number of clusters. An automatic selection of clusters is optional, but in this case, it resulted in only two clusters, which resulted in too rough and vague a distribution. Thus, the number of clusters was determined by exploring a range of solutions with different numbers of clusters (from 3 to 7). The solution (6) was based on the information value (distinguishing a cluster from the others) and the size of the clusters (not too small or different in size). A silhouette measure of cohesion and separation indicated that the cluster quality was fair, at almost 0.5. The obtained value must be above 0.0, suggesting the validity of the within- and between-cluster distances (Norusis, 2011).

An independent samples t-test was used to compare high performers and low performers concerning their self-efficacy beliefs, attitudes, and ICT activity.

4. Results

4.1. Long-term effects of the teaching intervention

An independent samples t-test was carried out to compare the test score means between the intervention and control groups. The test results indicated no difference in online research skills between the groups (Table 1). The measured mean overall score was 0.11 points higher for the control group, but the difference was not statistically significant, $t(82) = -.40, p = .694$. A two–sample Kolmogorov–Smirnov test showed that the distribution of the scores was also the same across the groups ($p = .85$). No differences were found between the groups in test components measuring skills in Web searching, evaluation, or information use. Thus, the teaching intervention did not seem to have a long-term effect on students' online research skills.

Table 1. Overview of test results

	Group	N	Mean	SD	t	Df	p	Cohen's d**
Web searching	Intervention	52	1.82	0.70	.03	82	.975	0.0
	Control	32	1.82	0.55				
Evaluation	Intervention	52	1.28	0.70	-.23	82	.822	0.0
	Control	32	1.31	0.59				
Use	Intervention	52	2.06	0.57	-.66	82	.509	0.1
	Control	32	2.14	0.53				

	Group	N	Mean	SD	t	Df	p	Cohen's d**
Overall score	Intervention	52	5.16	1.39	-.40	82	.694	0.1
	Control	32	5.27	1.00				

*statistically significant p < 0.05
**$d = 0.2$ small, $d = 0.5$ medium, $d = 0.8$ large (Cohen, 1990)

4.2. Students' skill profiles

Table 2 presents the results of the two-step cluster analysis. Six clusters of students were identified. The clusters were labeled with descriptive names, and the mean test scores overall and in each test component were categorized to represent either low, medium, or high performance. The category thresholds were based on a distance of 0.5 x standard deviation from the mean of all students. The clusters below the lower threshold were regarded to indicate low performance, clusters between the lower and higher thresholds medium performance, and clusters above the higher threshold high performance.

Following the same division with overall scores, the clusters can be divided into three: two clusters representing *high performers* (n = 36), one cluster *medium performers* (n = 17), and three clusters *low performers* (n = 31).

High performers consist of two kinds of student profiles. *Information-literate* are high achievers in evaluation and information use and medium achievers in searching, approaching high there, as well. Their information literacy skills seem to be good overall. *Fact finders* are high achievers in searching and information use, and medium achievers in evaluation. Their evaluation scores fall below the other components, indicating that they have developed good practices in finding relevant information and using the sources, but they may not pay much attention to the source's reliability. Medium performers represent students who are medium achievers in all three test components and thus do not have characterizing features in their component skills. Low performers are students who failed in one subtask and were medium achievers in others. *Weak searchers* failed in finding all relevant sources, but they demonstrated some skills in the evaluating the given sources and using them to write a reasonable answer. *Weak evaluators* achieved medium scores in Web searching and information use but failed in evaluation. *Weak information users* were medium achievers in Web searching and evaluation, but they failed in applying the information they found in the relevant sources.

The results show that over half of the students performed well, achieving medium or high scores in every component, and those who failed in one component managed to stay at an average level in others.

Table 2. Summary of cluster analysis

	information-literate	fact finders	medium achievers	weak searchers	weak evaluators	weak information users	mean	SD
searching (max 3)	2.06 medium	2.18 high	1.87 medium	0.53 low	1.93 medium	1.75 medium	1.82	0.64
evaluation (max 3)	2.25 high	1.15 medium	1.34 medium	1.05 medium	0.46 low	1.39 medium	1.29	0.66
use (max 3)	2.38 high	2.60 high	1.85 medium	2.05 medium	2.00 medium	0.79 low	2.09	0.56
overall score (max 9)	6.69 high	5.93 high	5.06 medium	3.63 low	4.39 low	3.93 low	5.20	1.25
N	16 (19%)	20 (24%)	17 (20%)	10 (12%)	14 (17%)	7 (8%)		

4.3. Factors associated with the development of online research skills

When comparing high and low performers' self-efficacy beliefs, attitudes, and ICT activity before the intervention, an independent-samples t-test showed that the groups differed in self-efficacy in online research (Table 3). The results suggest that the high performers (M = 4.21, SD = 0.41) had higher self-efficacy beliefs than the low performers (M = 3.96, SD = 0.49), t(61) = 2.22, p = .030. The effect size was medium, Cohen d = 0.6 (see Cohen, 1990). The difference between high and low performers was also near statistical significance in attitudes toward traditional teacher-centered learning (p = .079), representing a small, almost medium effect (d = 0.4). No difference was observed in other attitude components or in ICT activity. The results suggest that positive self-efficacy beliefs are connected to the development of online research skills. Positive attitudes toward traditional teacher-centered learning in schools might also have an effect on students' development in online research skills.

A Pearson's chi-squared test was conducted to find out the gender distribution in the groups. The results showed that the groups did not differ by gender, χ^2 (1) = 0.304, p = .581. Both females and males were equally represented as high and low performers.

Table 3. Overview of comparison between high and low performers

	Group	N***	Mean	SD	t	Df	p	Cohen's d**
SE online research	High	34	4.21	0.41	2.22	61	.030*	0.6
	Low	29	3.96	0.49				
ATT online learning	High	34	3.70	0.69	-0.84	61	.406	0.2
	Low	29	3.85	0.78				
ATT traditional learning	High	34	3.61	0.75	1.79	61	.079	0.4
	Low	29	3.27	0.79				
ATT behavioral intentions	High	34	3.63	0.62	1.26	61	.213	0.3
	Low	29	3.43	0.62				
ICT school-related	High	35	1.09	0.69	0.95	64	.346	0.2
	Low	31	0.90	0.87				
ICT free time	High	35	1.97	0.71	0.59	64	.559	0.1
	Low	31	1.84	1.11				
ICT social media	High	35	2.51	0.93	-0.75	64	.456	0.2
	Low	31	2.69	1.01				

*statistically significant p < 0.05
**d = 0.2 small, d = 0.5 medium, d = 0.8 large (Cohen, 1990)
*** ICT activity was surveyed at a different point of time than self-efficacy and attitudes which causes the difference in the number of the participants.

5. Discussion

The aim of this study was to find out whether the teaching intervention aiming to improve online research skills has long-term effects and whether the intervention effect observed in the 7th grade remains in the 8th grade. Follow-up test results showed that the effects of the intervention did not last. The test result showed no difference in the total scores or in the component test scores. Thus, the effects reported in Alamettälä and Sormunen (2020) were short-term and only observable immediately after the most intense instruction in the 7th grade.

We found only one prior follow-up study on information literacy instruction interventions. Baji *et al*. (2018) confirmed a positive intervention effect. Methodological issues may explain the difference from our results. The delayed test in Baji *et al*. (2018) followed only

two months after the intervention. In addition, learning outcomes were measured using a knowledge test with multiple-choice questions. It is possible that factual knowledge is easier to assimilate than it is to maintain good practices and skills learned in online research. Further intervention studies with delayed performance tests are needed to clarify the picture.

Quite often, the tests have focused on one subtask at a time or have reported students' performance subtask by subtask (e.g., Deursen and van Diepen, 2013; Kiili and Leu, 2019; Paul *et al.*, 2017). We took another approach and focused on students' skill profiles. The profiles help identify a small number of student groups that share similar strengths and weaknesses in the subtasks of online research. Further, the outcomes of the cluster analysis help to show that different student groups need support in different subtasks to achieve better online research skills. Based on the data, we cannot present justified claims on whether students were skillful or not but, instead, can reveal relative differences in the component skills between student groups.

The empirical results of the cluster analysis help to estimate how many students have relatively good skills in all subtasks and how many have difficulties in one or more specified subtask(s). In our sample, nearly 20% of 8th graders performed well in all three subtasks (labeled "information-literate"). It was only in this cluster that students got high scores in the evaluation subtask (see Table 2). This finding is in line with earlier studies reporting on students' poor performance in the evaluation of source trustworthiness (e.g., Paul *et al.*, 2017).

One-quarter of students belonged to the "fact finder" cluster and were good at searching and using Web sources; in the evaluation task, however, they were as weak as others. The findings also underline the lack of evaluation skills among lower secondary school students.

About 37% of 8th graders were categorized as low performers based on their low overall scores. Interestingly, each low-performing cluster had its own, distinct problem. About 10% of students had problems in searching, 17% failed in evaluation, and 8% had low scores in using the sources. The good news is that all students achieved medium or high scores in at least two subtasks of online research. There is some basis to build on in teaching online research skills.

Concerning student-related factors, only self-efficacy beliefs were found to associate with students' skills. The high performers had higher self-efficacy than the low performers. This is in line with prior research. Self-efficacy in related skills (such as ICT self-efficacy) has been associated with achievement level in computer and information literacy (Fraillon *et al.*, 2019).

Our results indicate that high performers might have a more positive attitude than low performers toward traditional teacher-centered learning. In our previous study (Alamettälä and Sormunen, 2020), attitudes toward traditional teacher-centered learning also emerged as a variable that influence learning outcomes in the post-test of the teaching intervention. We expect that our attitude measure correlates with students' engagement with the school's pedagogical practices in general. No difference was observed in attitudes toward online learning, which was also the case concerning learning outcomes in Alamettälä and Sormunen (2020). Based on the observations of students' reactions, we assume that some students may see online learning as an easy way to complete required assignments rather than as an engaging option to learn more effectively.

According to previous research, with respect to ICT use and online research skills, there is mixed evidence: some studies have identified positive relationships (Kaarakainen *et al*., 2018), whereas some have identified none (Hatlevik *et al*., 2015). Our results belong to the latter: no difference between high and low performers was observed in ICT activity. However, comparisons are difficult to make since the set of skills measured and how they are measured differ from study to study.

In recent literature, female students have demonstrated higher achievement in computer and information literacy (Fraillon *et al*., 2019). However, gender did not make a difference in our study. Both females and males were equally represented as high and low performers. This is in line with Kaarakainen *et al*. (2018), who found no differences between genders in the total scores for information skills.

6. Conclusion

Very little performance testing on online research skills has been done among lower secondary school students. This study gave a picture of their skill level and demonstrated the importance of follow-up studies on online research skills, which have been rare. It proved that short-term effects of teaching interventions do not necessarily last, which points out the need for long-term instruction and longitudinal follow-up studies.

The results showed that modifications in single courses aiming to improve online research skills hardly have long-term effects. An individual teacher's attempt to adjust some ideas about research-based pedagogical frameworks in everyday professional practice in the

school might not be enough to achieve long-term learning outcomes. Small-scale interventions are not enough to maintain complex skills as online research skills (cf. Lakkala *et al*., 2011). They need continuous, versatile practice in varied contexts throughout each school year – and preferably school-wide (cf. Kuhlthau *et al*., 2015). We encourage schools to tackle the matter by urging teachers to collaborate and work together to develop long-term instruction of online research skills.

Although the teaching intervention did not achieve its primary goals, the test results provided valuable information about students' skill profiles in online research. The study showed that there is room for improvement in students' skills. However, it also showed that so-called low-performing students usually failed in only one test component and managed the others relatively well. This indicates that a failure in one sub task does not necessarily mean that a student could not manage other tasks if given the possibility. Thus, it is important to identify each student's weak points and give targeted support, and vice versa, to identify students' strengths and give positive feedback.

Self-efficacy beliefs and attitudes toward traditional teacher-centered learning came to the fore when examining background factors associated with students' online research skills. Encouraging students to believe in themselves and motivating them to study seems to be a key factor when it comes to online research skills. As mentioned, identifying students' weak and strong points might be one option. Positive feedback on one component might motivate them to improve other components as well.

Of course, the development work cannot be left only for practitioners. Research-based knowledge of online research instruction and its effects on students is needed. In the future, more longitudinal studies with follow-up testing should be conducted. An interesting background factor that was not considered in this study is students' overall academic achievement which would be worth examining in the context of online research. Further research is also needed on how to develop students' self-efficacy and motivation.

This study was a case study focusing on students at one single school, and thus, the results should be applied and generalized with caution. It also shares common limitations concerning quasi-experiments. They do not eliminate the possibility of confounding variables, and because it is impossible to allocate subjects randomly to both intervention and control groups, the groups may not be equivalent. It weakens the internal validity of the research, and

thus, it is more contestable to deduce causality (Bryman, 2008). However, we may expect that the ecological validity of our quasi-experiment is high since it was conducted in a natural school environment (cf. Bryman, 2008, pp. 40–41). In addition, we may assume sufficient equivalence between the intervention and control group students, as they come from the surrounding neighborhood and are admitted by the local school principle without any entry exams or ability-based selection procedures.

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