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A Mixed-Methods Study of the Conditions Related to Finnish Home Economics Teachers' Use of Information and Communication Technologies

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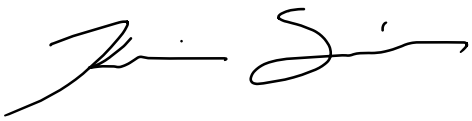

Abstract

In Finnish lower secondary education, home economics (HE) is one of the smallest school subjects in terms of teaching hours, yet, its central task is quite comprehensive. Especially in today's digitised society, HE has a significant mission to support students in developing skills, knowledge, attitudes, and readiness needed for managing digitalised daily life. However, previous research has shown that development of these skills, including digital competence, among students relies on whether the teacher provides students with sufficient opportunities to use information and communication technologies (ICTs).

A limited amount of research has highlighted the conditions that influence how HE teachers use ICTs as well as the challenges they need to overcome to use the same. Both national and international reports have shown little use of ICT by teachers in artistic and practical school subjects.

To fill this research gap, this doctoral thesis aims to investigate Finnish HE teachers' use of ICT in teaching and supporting students' learning in lower secondary education. In addition, the theory of reciprocal determinism by Bandura (1986) is applied in this study to gain a deeper insight into how different conditions at the environmental and individual levels interact with each other to influence HE teachers' use of ICT.

This thesis consists of three publications and an extended summary. The publications are, in turn, based on two separate empirical studies: (1) a survey study and (2) an interview study. A sequential mixed-method explanatory design with elements of convergent mixed methods enabled a two-phase data collection procedure in which quantitative survey data were first collected (Publications I and II), followed by collection of qualitative interview data (Publication III). The sample for the survey study (Publications I and II) consisted of 161 HE teachers working at both Swedish and Finnish language schools in lower secondary education in Finland. Of these participants, 12 HE teachers were selected to participate in the interview study (Publication III).

Three research questions have been formulated in relation to the three publications of this thesis; however, to achieve the overarching aim of this thesis, the findings from these three publications have been integrated and discussed through the lens of Bandura's triadic theory of reciprocal determinism.

Publication I explores patterns in HE teachers' (n = 161) use of ICT by identifying ICT user profiles. The preliminary exploratory factor analysis identified three dimensions of ICT use: for cooperation, facilitation of pupils' learning and administration and lesson planning. The main K-means cluster analysis revealed three recognisable ICT user profiles: frequent (n = 58), specific (n = 43), and infrequent ICT users (n = 60).

In Publication II, structural equation modelling (SEM) was used to examine the direct and indirect effects of teacher-level (perceived usefulness of ICT in

HE, digital competence, age) and school-level (ICT infrastructure, support) factors on HE teachers' (n = 161) three different dimensions of ICT use that were identified in Publication I. Based on total effects, digital competence, perceived usefulness of ICT in HE as well as perceived access to support (i.e. technical and pedagogical support, school, administrative and colleague support, ICT teacher training) were the most important pre-requisites that influenced HE teachers' use of ICT for facilitating student learning.

Publication III was a qualitative interview study conducted to gain a deeper understanding of HE teachers' use of ICT and get an idea of other conditions that enable or hinder HE teachers' use of ICT. From the participants in the survey study, 12 HE teachers were selected (Publications I and II). Using content analysis, the findings showed that ICT was used in different ways using both teacher- and student-centred approaches to promote both affective (attention, motivation, interest) and cognitive outcomes (conceptual knowledge, engagement, self-awareness). It is somewhat worrying that the development of students' digital competence was not included in the goals of their ICT use. Publication III revealed several hindering and enabling conditions for their ICT use, both at the personal (e.g. digital skills, interest and motivation, domain-specific epistemological beliefs, teacher characteristics) and environmental levels (e.g. ICT infrastructure, support, organisational factors, subject culture).

Finally, to achieve the overarching aim of this thesis, the findings are discussed based on Bandura's theory of reciprocal determinism. The most obvious findings that emerged in this thesis are the variety of conditions at the personal and environmental levels that hindered and those that facilitated the use of ICT by HE teachers as well as the role that HE teachers' human agency plays in influencing ICT behaviour and responding to environmental conditions and challenges.

Based on Bandura's model, HE teachers cannot be regulated solely by enabling and constraining conditions, as revealed in separate publications. Confirming the reciprocal determinism, Publications II and III found that different environmental conditions (support, ICT infrastructure) were only indirectly related to HE teachers' use of ICT through personal conditions (perceived digital competence, perceived usefulness, motivation, and interest).

From a socio-cognitive point of view, HE teachers can also influence their own motivation through self-regulatory mechanisms, such as perceived usefulness (i.e. as part of forethought capacity) and high levels of ICT self-efficacy (i.e. as part of self-reflective capacity). These mechanisms appeared to play a key role in influencing how HE teachers use ICT and how often they do so (Publications I and II). Teachers' perceived benefits of ICT use were also related to whether teachers engaged in environments and activities that supported their ICT use, such as developing their own digital skills, by taking advantage of the available support and ICT infrastructure (Publication III).

Personal agency also plays a key role in overcoming challenges (Bandura, 2001). A range of conditions were also identified as barriers to HE teachers' use of ICT, such as insufficient digital skills, lack of support, lack of interest, feelings of lack of time and effort, domain-specific epistemological beliefs, students' expectations of the subject, low status of HE, limited time allocated to the subject, broad curriculum, impractical instructional facilities, lack of other financial resources, time constraints, technical issues related to management of digital devices, ethical safety issues related to students' integrity and privacy, dysfunctional devices, poor internet connection, lack of teacher training programmes, students' poor digital skills and ICT behaviour involving surfing other websites without teachers' permission. Some of these challenges may emerge as more dominant than others, such as the breadth of the curricula, time allocation, subject culture and teachers' long-standing expectations of and subject-specific epistemic beliefs about HE as a school subject (Ricardson, 1996).

Based on the results of the three publications and theoretical reasoning, it can be concluded that it is vital to provide HE teachers with various forms of support to increase their motivation to use ICT and strengthen their agency to face and overcome potential challenges.

Various forms of support, both technical and pedagogical, should be made as accessible as possible at the school and classroom levels so teachers can resolve challenges they face in teaching without much delay. Ideally, support should be arranged with an ongoing strategy, especially when it comes to teaching training programmes and support aimed at the development of HE teachers' digital competence. The findings also underline the importance of supporting HE teachers in building collegial networks to exchange best practices in ICT integration. Drawing on Bandura's model of reciprocal determinism and human agency, these forms of support can provide opportunities for HE teachers to gain positive experiences in overcoming actual challenges in their ICT use, strengthen their beliefs in their own ability to use ICT and create positive outcome expectations. This, in turn, makes it easier for teachers to set clear goals to strive for and increases their motivation to overcome future and potential challenges (Bandura, 1989, 1997).

Keywords: Information and communication technology, Home Economics teachers, digital competence, mixed-methods, reciprocal determinism

Abstrakt

Huslig ekonomi är ett av de minsta läroämnena i årskurserna 7–9 inom den grundläggande utbildningen i Finland, sett till antalet undervisningstimmar. Trots detta är husliga ekonomins centrala uppdrag mycket omfattande. Huslig ekonomi har i synnerhet i dagens digitaliserade samhälle ett viktigt uppdrag att stöda eleverna att utveckla de färdigheter, kunskaper, attityder och den beredskap som behövs för att kunna hantera den allt mer digitaliserade vardagen. Däremot visar tidigare studier att elevens utveckling av dessa färdigheter, såsom digital kompetens, är beroende av huruvida eleven ges tillräckliga möjligheter att använda informations- och kommunikationsteknik i undervisningen. Få studier har undersökt de faktorer som påverkar lärarnas användning av IKT i huslig ekonomi, liksom de utmaningar som lärarna står inför. Däremot visar både nationella och internationella rapporter att ämneslärare i konst- och färdighetsämnen använder IKT i en ganska låg utsträckning.

För att fylla forskningsluckan, syftar denna avhandling till att undersöka ämneslärarnas användning av IKT i huslig ekonomi för att främja elevens lärande. Därtill tillämpas Banduras teori om ömsesidig determinism för att få en djupare insyn i hur olika omständigheter på miljö- och individnivå interagerar med varandra för att påverka lärarnas användning av IKT.

Avhandlingen består av tre publikationer och en inledande sammanfattning (kappa). Publikationerna bygger vidare på två separata empiriska studier, 1) en enkätstudie och 2) en intervjustudie. Forskningsdesignen tar sitt utgångsläge i blandade metoder och är av typen förklarande sekventiell design med element från den konvergenta forskningsdesignen. En dylik kombination har möjliggjort en datainsamling i två olika faser. Insamling av kvantitativ enkätdata (Publikation I, II) har således följts av insamling av kvalitativ intervjudata (Publikation III).

Det slutliga urvalet i enkätundersökningen (Publikation I och II) bestod av 161 lärare i huslig ekonomi från både svensk- och finskspråkiga skolor i årskurserna 7–9 inom den grundläggande utbildningen i Finland. Av dessa 161 ämneslärare valdes 12 lärare ut till intervjustudien. Tre konkreta forskningsfrågor har formulerats i relation till avhandlingens tre publikationer, men för att kunna besvara avhandlingens övergripande syfte har resultaten från publikationerna också kopplats samman och diskuterats utifrån Banduras triadiska modell om ömsesidig determinism.

Publikation I går ut på att identifiera IKT-användarprofiler och undersöka mönster bland ämneslärarnas (n = 161) användning av IKT i huslig ekonomi. Den explorativa faktoranalysen resulterade i att följande tre dimensioner av IKT-användning kunde identifieras: för samarbete, för att främja elevens lärande och för utförande av administrativa uppgifter och lektionsplanering. Med hjälp av klusteranalys, kunde i sin tur urskiljas tre olika IKT-användarprofiler bland ämneslärarna i huslig ekonomi: frekventa IKT-användare (n = 58), specifika IKT-användare (n = 43) och icke-frekventa IKT användare (n = 60).

I publikation II analyserades i vilken utsträckning olika lärar- och skolfaktorer påverkar direkt och indirekt ämneslärarnas användning av IKT i huslig ekonomi. Analysen gjordes med hjälp av strukturell ekvationsmodellering (SEM). Lärarfaktorer hänvisar till upplevd nytta, digital kompetens och ålder, medan faktorer på skolnivå syftar på IKT-infrastruktur och stöd. Resultaten visar att lärarnas digitala kompetens, upplevd nytta med IKT och upplevt stöd (tekniskt och pedagogiskt stöd, stöd från skolan, administrativt stöd, kollegialt stöd, tillgång till fortbildningar) utgör de viktigaste faktorerna som påverkar lärarnas användning av IKT.

Publikation III bygger på en kvalitativ intervjustudie, vars syfte var att skapa en djupare förståelse för lärarnas användning av IKT, samt att få en bild av andra faktorer eller omständigheter som hindrar eller främjar lärarnas användning av IKT i huslig ekonomi. Totalt 12 ämneslärare i huslig ekonomi valdes ut bland de lärare som också deltog i enkätstudien (Publikation I, II). Det insamlade materialet analyserades med hjälp av kvalitativ innehållsanalys. Sammantaget visar resultaten att lärarna använder IKT på olika sätt med hjälp av både lärarstyrda och elevcentrerade metoder, för att främja elevens affektiva (uppmärksamhet, motivation, intresse) och kognitiva (konceptuell kunskap, engagemang, självmedvetenhet) lärande. Att främjande av elevens digitala kompetens inte alls nämndes, kan däremot anses som något oroväckande. Framförallt visar resultaten (Publikation III) att det finns ett flertal faktorer, som på både individ- (t.ex. digitala färdigheter, intresse och motivation, domänspecifika epistemologiska övertygelser, personliga egenskaper) och miljönivå (t.ex. IKT-infrastruktur, stöd, organisatoriska faktorer, ämneskultur), upplevs antingen hindra eller främja lärarnas användning av IKT i huslig ekonomi.

I avhandlingen diskuteras resultaten utifrån Banduras triadiska teori om ömsesidig determinism för att kunna besvara det övergripande syftet. Det mest framträdande i resultaten från avhandlingen är att det har visat sig finnas faktorer som på både miljö- och individnivå fungerar som hindrande och främjande för lärarnas användning av IKT i huslig ekonomi. Resultaten understryker också vikten av lärarens aktörskap och självreglerande förmåga att själv påverka den egna IKT-användningen samt bemötande av utmaningar.

Sett ur Banduras teori och något som också framkom i de separata publikationerna, påverkas inte läraren i huslig ekonomi direkt av olika hindrande och möjliggörande omständigheter. Resultaten i Publikation II och III visar till exempel att olika miljöfaktorer har tendens att först påverka faktorer eller omständigheter på individnivå (upplevd digital kompetens, upplevd nytta, motivation, intresse), vilket också bekräftar Banduras teori om ömsesidig determinism.

Sett ur ett socio kognitivt perspektiv, anses lärarna i huslig ekonomi också kunna påverka den egna motivationen att använda IKT med hjälp av olika självreglerande mekanismer. Två olika självreglerande mekanismer identifierades i resultaten. Upplevd nytta med IKT (förtänksamhet) och

upplevd självförmåga för IKT användning (självreflekterande kapacitet) visade sig påverka hur ofta lärarna använde IKT, samt för vilka ändamål IKT tillämpades (Publikation I, II). Lärarnas syn på nyttan med IKT spelade också en avgörande roll huruvida de såg till att upprätthålla eller utveckla den egna digitala kompetensen, utnyttja tillgängligt stöd samt skolans IKT-infrastruktur (Publikation III).

Lärarnas individuella aktörskap har också en nyckelroll när det gäller att övervinna potentiella utmaningar (Bandura, 2001). I publikationerna kunde ett flertal hindrande faktorer eller utmaningar för lärarnas IKT-användning identifieras, bland annat följande: lärarnas otillräckliga digitala färdigheter, brist på tillgängligt stöd, svagt intresse, brist på tid och energi, domänspecifika epistemologiska övertygelser om lärande i huslig ekonomi, elevernas förväntningar på huslig ekonomi som läroämne, läroämnets låga status, undervisningstid avsatt för huslig ekonomi, läroplanens omfattning, opraktiska undervisningsutrymmen, brist på ekonomiska resurser, tekniska problem i klassrummet, etiska säkerhetsfrågor vad gäller elevens integritet och privatliv, dåligt fungerande digitala verktyg, dålig internetuppkoppling, brist på fortbildningar, elevernas bristfälliga digitala färdigheter och elevers olämpliga beteenden på nätet. De uppräknade utmaningarna, till exempel läroplanens omfattning, tidsallokeringen, ämnets kultur och lärarnas förväntningar och epistemologiska uppfattningar om huslig ekonomi som läroämne, kan framstå som mer dominerande än andra.

De slutsatser som kan dras utifrån resultaten och ur ett teoretiskt resonemang, är att lärarna i huslig ekonomi är i behov av olika former av stöd i syfte att öka på motivationen att använda IKT, samt stärka sitt aktörskap och sin styrka att övervinna potentiella utmaningar.

Tillgång till olika former av stöd, både tekniskt och pedagogiskt stöd, bör förbättras på både skol- och klassrumsnivå, så att lärarna har bättre förutsättningar att tackla utmaningar som de ställs inför i undervisningen. Stödet får med fördel arrangeras med en uppföljande strategi, så att det finns möjligheter till återkoppling. Denna återkoppling är särskilt viktig i sammanhang när det handlar om stödformer, som syftar till att stöda lärarnas utveckling av den digitala kompetensen, såsom vid fortbildningar men också andra stödinsatser. Resultaten understryker också vikten av att stöda lärarna i huslig ekonomi i skapande av kollegiala nätverk. Dylika nätverk kan ge lärarna möjligheter till utbyte av bästa praxis när det kommer till IKT användning.

Utgående från Banduras teori för ömsesidig determinism och aktörsperspektivet, kan dessa ovannämnda stödformer ge lärarna i huslig ekonomi en möjlighet att samla på sig positiva erfarenheter av att hantera faktiska utmaningar i sin IKT-användning. Genom positiva erfarenheter kan läraren bygga upp sin egen tilltro till sin förmåga att använda IKT, och skapa positiva förväntningar för sin IKT-användning. Det här kan i sin tur stöda lärarna att sätta upp tydliga mål för sin IKT-användning och stärka deras

motivation att övervinna aktuella och framtida utmaningar (Bandura, 1989, 1997).

Nyckelord: Informations- och kommunikationsteknik, ämneslärare i huslig ekonomi, digital kompetens, blandade metoder, ömsesidig determinism

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List of Original Publications

This thesis consists of the following three publications (also referred to as Publication I, Publication II, and Publication III):

Publication I: Sundqvist, K., Korhonen, J. & Eklund, G. (2020). Finnish subject teachers' beliefs and use of information and communication technology in Home Economics. Nordic Journal of Digital Literacy, 15(3):202–222. 10.18261/issn.1891-943x-2020-03-06

Publication II: Sundqvist, K., Korhonen, J. & Eklund, G. (2020). Predicting Finnish subject-teachers' ICT use in Home Economics based on teacher- and school-level factors. Education Inquiry, 12(1), 1–21. 10.1080/20004508.2020.1778609

Publication III: Sundqvist, K. & Eklund, G. (2021). Home Economic teachers' ICT use in Finland seen from a lens of reciprocal determinism. International Journal of Home Economics, 14(2), 116–129.

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1. Introduction

We live in a rapidly changing world, in which information and communication technologies (ICTs) are thoroughly embedded in the way we live and manage our everyday lives. Digitalisation has changed almost all areas of daily life, including modes of communication, consumption patterns and the way we carry out our daily household tasks (Cochoy et al., 2017; Meier & Reinecke, 2021; OECD, 2019a; Rainie & Wellman, 2019). The internet has enabled individuals to engage in new forms of technology-mediated interactions. Consumption patterns are also changing, making it easier to purchase, compare and evaluate goods (Cochoy et al., 2017).

In this introductory chapter, I will present the background, aim, research questions and structure of the thesis. In addition, I will discuss the nature of home economics (HE) as a field of study and school subject and describe the two key concepts in this thesis: ICT and digital competence.

1.1 Background

ICT has become a fundamental part of young people's lives, with its increasing use year by year. In Finland, 100% of young people (16–29 years) in 2021 and 85% of children (9–16 years) in 2020 used the internet daily, and the majority of them owned smartphones (Eurostat statistics, 2023; London School of Economics and Political, 2023.). ICT is used in this thesis as an umbrella term for all hardware, software, digital learning content and networks used to transmit, store, create, share, present, exchange information or otherwise support communication (OECD, 2012; UNESCO, 2009). Although ICT is widely used by young people, not all children are sophisticated users. According to the EU kids online 2020 report, one concern is that young people have difficulty navigating and identifying valid information (Smahel et al., 2020). Another concern is the extensive and inappropriate use of ICT by children and young people (Thulin & Vilhelmson, 2019). In adulthood, frequent use of ICT can lead to an increased pace of life and feelings of time pressure (Santarius & Bergener, 2020).

To benefit from ICT, manage risks and problems encountered in everyday life and participate in society in a rapidly changing world, it is vital to develop digital competence from an early age (Ala-Mutka, 2011; European Commission, Directorate-General for Education, Youth, Sport and Culture, 2019; Smahel et al., 2020). Digitalisation and the increased availability and use of ICT have brought about fundamental changes in the education system and in teachers' pedagogical practices. From a Finnish perspective, ICT, digital competence, and other twenty-first century skills have become a crucial part of education policy, curricula and school subjects (Erstad et al., 2021; Finnish National Agency of Education, 2014; Olofsson et al., 2021; Tanhua-Piiroinen et al., 2020). Digital competence refers to the "confident, critical and responsible use of, and engagement with, digital technologies for learning, at

work, and for participation in society" (*Council Recommendation of 22 May 2018 on Key Competences for Lifelong Learning 2018/C189/01*, 2018).

Thus, to prepare students for life in a digitalised society, opportunities must be given to them to develop the necessary skills and systematically use different types of ICT for different purposes in the context of all school subjects. According to the Finnish national core curricula, students should develop digital competence[1] as well as other related transversal competences during all school years and in all school subjects (Finnish National Agency of Education, 2014). I see HE as a school subject that, under the right conditions, can support students in developing several of the skills needed to manage daily life in today's digitalised society, including digital competence. However, studies and reports have shown that ICT is least used in artistic and practical subjects, including HE (Fraillon et al., 2020; Kaarakainen & Saikkonen, 2021; Tanhua-Piiroinen et al., 2016). This is also confirmed by other international studies that have shown that different subject areas respond differently to the integration of ICT in teaching and learning (Erixon, 2010; Howard et al., 2015).

HE is important in supporting students in developing the skills to cope with everyday life. The Finnish core curriculum for basic education defines HE as an artistic and practical school subject with the task of "developing the knowledge, skills, attitudes and readiness to master everyday life and to adopt a sustainable way of living that promotes well-being" (Finnish National Agency of Education, 2014, p. 470). As a school subject, HE is directly related to the management of everyday life. The subject covers a variety of content, including practical skills, nutrition and health, consumer and household matters, planning and organisational skills, information management and critical thinking skills, collaboration and interaction skills and living and environmental matters (Finnish National Agency of Education, 2014).

1.1.1 The Value of Using ICT in Home Economics

Although studies have reported contradictory results on the outcomes of using ICT for student learning (Fernández-Gutiérrez et al., 2020), teachers' use of ICT in education has been shown to have the potential to support students' affective outcomes, cognitive outcomes, digital competence and other twenty-first century skills (Fraillon et al., 2020; Sha et al., 2012; Sung et al., 2016; Tingir et al., 2017; Trabelsi et al., 2022).

In Finland, HE is a compulsory school subject in Grade 7 and is further offered as an optional subject in Grades 8 and 9 of lower secondary education. The compulsory teaching hours for HE are three annual weekly hours of 45 minutes each (Statsrådets förordning om riksomfattande mål för utbildning enligt lagen om grundläggande utbildning och om timfördelning i den grundläggande utbildningen 422/2012, 2012)

Using ICT in HE to promote students' digital competence and other twenty-first century skills is considered increasingly important (Dixon, 2017;

[1] referred to as ICT competence in the national core curricula.

Elorinne et al., 2017; Kuusisaari et al., 2021), especially given how integrated ICT is in our daily lives (Cochoy et al., 2017; Rainie & Wellman, 2019). Twenty-first century skills, including competencies in communication, collaboration, digital competence, creativity and problem solving (van Laar et al., 2020; Voogt & Roblin, 2012), have already been argued to be closely aligned with the core purposes of teaching and learning in HE. Both Kuusisaari et al. (2021), Taar and Palojoki, (2022), and Turkki and Vincenti (2008) recognised the potential of HE to support students in developing the skills needed to manage everyday life in today's rapidly changing world.

The role of ICT in HE can be discussed in relation to different aims, tasks and content areas of the HE curricula. The potential benefits of using ICT are discussed in relation to *practical working skills*, *information and management skills*, and *cooperation and interaction skills*. Within *practical working skills*, students are encouraged to plan, organise and evaluate their use of time, work and actions in relation to all key content areas related to food knowledge and skills, food culture, housing and living together and consumer and financial skills (Finnish National Agency of Education, 2014). Time management, planning, goal setting and evaluating one's work and performance are important elements of self-regulation (Pintrich, 2005). Moreover, self-regulation occurs in all kinds of problem-solving situations in daily life (e.g. food preparation, shopping) and has an important value for well-being, life balance, and school success (Brownlee et al., 2005; Duckworth & Carlson, 2013; Kuhnle et al., 2012; Zimmerman, 2000). Several studies describe how different types of ICT, such as e-portfolios and podcasts, can be used as a medium to support different stages of self-regulation, such as motivation, goal setting, strategy planning, self-observation, self-reflection, self-instruction and self-evaluation (Abrami et al., 2013; Kay, 2012; Kongsgården & Krumsvik, 2016; Meyer et al., 2010).

In the context of *practical working skills*, students will also be guided on how to use ICT in a way that supports both health and sustainable consumption. This is closely linked to the objectives of *information management skills*, in which students are encouraged to acquire and evaluate information and make cost-conscious decisions based on reliable information and sources (Finnish National Agency of Education, 2014). Students practice making conscious, sustainable and responsible decisions related to food preparation, consumption, living and spending (Autio et al., 2021; Finnish National Agency of Education, 2014; Uitto & Saloranta, 2017). Overall, HE has the potential to address some of the economic, social and environmental challenges of the future (Autio et al., 2021; Kortesalmi & Autio, 2019). Consumption is about not only satisfying needs and wants but also ensuring sustainable consumption (Brečko & Ferrari, 2016). Thus, advances in ICT have drastically changed individuals' consumption patterns and their ability to contribute to a sustainable and responsible society through consumption decisions and actions (Cochoy et al., 2017; Gazzola et al., 2017).

In today's digital world, an adequate level of digital competence and critical thinking are required to make informed decisions. Digital competence is the basis for retrieving and evaluating information, making informed decisions, weighing benefits and risks, protecting one's privacy, operating safely in digital markets, managing online financial transactions and evaluating the environmental impact of one's actions (Brečko & Ferrari, 2016; OECD, 2009). Critical thinking skills, that is the ability to analyse, synthesise and evaluate information, are also needed to cope with excessive 'information overload (IO)' online (Koltay, 2017). Both the inefficient use of information and an oversupply of online information can easily lead to poor outcomes in decision-making (Vogrincic-Haselbacher et al., 2021). Consumer awareness has also been shown to be positively linked to responsible consumer behaviour (Lubowiecki-Vikuk et al., 2021). Moreover, making conscious, responsible, financial and sustainable decisions requires self-regulatory skills, particularly self-control.[2] Consumers with higher levels of self-control can respond more consciously to environmental and sustainability issues when consuming and reduce their risk of over-indebtedness (Gathergood, 2012; Nguyen et al., 2019). Different types of ICT are also seen as tools that can be used to support both students' digital competence (European Commission, 2019c; Redecker, 2017), twenty-first century skills (e.g. critical thinking, creativity) (Qian & Clark, 2016; Voogt et al., 2013) and self-regulation skills (Kay, 2012; Meyer et al., 2010).

HE also aims to develop students' *cooperation and interaction skills* to promote their ability to live together with others. These skills are developed in HE by, for example, practicing listening to others, having meaningful conversations, practicing time management and acting both independently and in groups (Finnish National Agency of Education, 2014). Thus far, little attention has been paid to the role of ICT in supporting these skills. Previous studies suggest that different types of ICT can increase students' collaboration and communication (Kongsgården & Krumsvik, 2016; Strømman, 2022), support shared regulation (Järvenoja et al., 2020) and improve students' learning outcomes, skill acquisition and social interaction (Chen et al., 2018; Chou et al., 2012; Fernández-Gutiérrez et al., 2020). However, neither all forms of computer-supported collaborative learning activities necessarily lead to positive outcomes (Labonté & Smith, 2022; Sung et al., 2016) nor collaborative learning activities without computers. In a study by Lindblom et al. (2016), which analysed different types of group work in HE in Sweden, half of the group work carried out neither provided the best conditions for learning nor supported social interaction. Thus, in terms of the positive effects on subjective well-being, quality of life and maintenance of meaningful relationships (Webster et al., 2021), computer-mediated interactions cannot replace face-to-face interactions (Lee et al., 2011).

[2] Self-control refers to the ability to resist temptations and direct one's behaviour towards a desired goal (Baumeister et al., 2007; Gillebaart, 2018).

To sum up, a systematic understanding of the role of ICT in teaching and learning in HE is still lacking. Although ICT has had a fundamental impact on our daily lives and digital competence is considered an essential competence for coping with everyday life, very little scholarly attention has been paid to ICT as a tool for learning in HE so far. In a recent project (Taar et al., 2021, 2022) involving all Nordic–Baltic countries, online learning material was published with several methods for implementing digital tools in HE lessons. The material was also tested in a number of schools. The developed material mostly received positive feedback. Most teachers found the material very useful in supporting the meaningful use of digital tools in the classroom.

It is important that students in HE develop deeper insights into the challenges and opportunities that ICT brings to our daily lives and that they have the opportunity to develop the life skills that support their ability to manage their lives in a healthy and sustainable way (Hölttä, 2014). This includes not only the development of digital competence but also other life skills, such as critical thinking, problem solving and collaboration. As mentioned previously, these are closely aligned with the core skills of HE (Kuusisaari et al., 2021).

1.1.2 The Key Role of Teachers in ICT Integration

This thesis focuses specifically on HE teachers' use of ICT in Finnish lower secondary education, with the overall aim of understanding the conditions related to their use of ICT. Teachers play a key role in the integration of ICT in teaching and learning (Ertmer & Ottenbreit-Leftwich, 2010; Fransson et al., 2018; Hernández-Sellés et al., 2019; Sipilä, 2014).

In the Finnish educational context in particular, teachers play a vital and autonomous role associated with a high level of responsibility for implementing the curriculum. Although teachers have to follow the national core curricula, they are given a large amount of flexibility to make various decisions at the classroom level, such as the choice of content, teaching materials, learning activities and teaching methods (Lavonen, 2020; Sahlberg, 2015; Salokangas et al., 2020). Teachers are also seen as significant curriculum developers, as they are highly involved in the design of local curricula (Heikkilä, 2021; Lavonen, 2020). Understanding teachers' use of ICT is a challenging and multifaceted issue. The changing demands on teachers, and students' development of new skills, put pressure on creating the conditions essential for ICT integration. This has led to a growing research interest in identifying the conditions that influence teachers' use of ICT.

Appropriate indicators and information are needed to design and support the conditions for successful ICT integration. Kikis et al. (2010) listed three main types of ICT indicators: input, utilisation and output indicators. Input indicators, which are the most used indicators, refer to information on ICT infrastructure, teacher training and the integration of ICT into the curriculum. Utilisation indicators refer to the actual use of ICT by teachers and students, while outcome indicators focus more on teachers' and students' attitudes

towards ICT as well as their skills and confidence in using ICT. The three publications included in this thesis cover indicators from all three of these core indicators to gain a deeper understanding of HE teachers' use of ICT. Thus, it is important to note that the publications included in this thesis were conducted before the outbreak of COVID-19, which most likely accelerated the digital development in the field of education (Lavonen & Salmela-Aro, 2022; United Nations, 2020). However, the digitalisation of education was a policy initiative worldwide before the outbreak of COVID-19 (Zancajo et al., 2022), and it does not change the conditions that are vital for successful ICT integration.

Apart from some studies done in Nigeria (Ejinkeonye & Usoroh, 2016), the Philippines (Limon, 2015), Hong Kong (Ho & Albion, 2010) and Malaysia (Phua et al., 2012), no previous studies have investigated the conditions of ICT use by HE teachers in lower secondary education in Finland. In terms of analysing these conditions from a Finnish perspective, the country has reported high access to technology-related resources for teaching and learning, including both software resources and technical facilities. Students' access to ICT tools is also higher compared to many other countries. Hence, when it comes to providing teachers with incentives to facilitate the implementation of ICT in their teaching, Finland reports low figures (European Commission, 2019a, 2019b; Fraillon et al., 2020). Although school-level conditions, such as support and ICT infrastructure, are important conditions for teachers' use of ICT, teacher-level factors, such as beliefs and digital competence, seem to play an even more important role in determining teachers' use of ICT (Kaarakainen & Saikkonen, 2021).

Previous research and reports on Finnish teachers' ICT use also show that teachers encounter several barriers, including low levels of digital competence, lack of support, ICT infrastructure and ICT teacher training programmes (European Commission, 2019b; Tanhua-Piiroinen et al., 2020; Vuorio et al., 2021). The full use of ICT potential in education sector still seems to be a challenge for Finnish teachers (Fraillon et al., 2020).

A variety of approaches and technological models have been proposed to understand the conditions related to teachers' use of ICT. While quantitative studies (Atman Uslu & Usluel, 2019; Gerick et al., 2017; Hatlevik, 2017; Inan & Lowther, 2010a; Kreijns et al., 2013) often use causal models to investigate the relationships between different factors and teachers' ICT use, qualitative studies focus on qualitative data to gain a more nuanced and deeper understanding of the phenomenon (Lindberg et al., 2017; Razak et al., 2018; Tallvid, 2016). By using a mixed-methods research design and drawing on three publications based on two separate datasets, this thesis contributes to the research on understanding the conditions that enable and those that hinder subject teachers' use of ICT in HE.

1.2 Aim, Research Questions and Structure of the Thesis

Against the previously outlined background, this thesis focuses on HE teachers' use of ICT. The overarching aim is to investigate Finnish HE teachers' use of ICT in teaching and for supporting students' learning in lower secondary education and deepen the understanding of the conditions related to HE teachers' use of ICT by applying the theoretical lens of reciprocal determinism of Bandura (1986). To answer this overarching aim, the following research questions were formulated:

1. What are the dimensions of HE teachers' use of ICT and how do they relate to teachers' beliefs (perceived usefulness, ICT self-efficacy)? (Publication I)
2. How can teacher-level (digital competence, age, perceived usefulness) and school-level (support, ICT infrastructure) factors explain HE teachers' use of ICT in teaching and learning? (Publication II)
3. How can HE teachers' use of ICT in teaching and student learning be understood through their ICT integration practices, goals of use and related conditions? (Publication III)

In addition to these research questions, the findings from the three included publications are discussed through the lens of Bandura's reciprocal determinism to enhance the understanding of HE teachers' use of ICT. Research in this field is nationally and internationally scarce; therefore, this thesis addresses this gap and strengthens the research base in this area. Understanding the conditions associated with HE teachers' use of ICT will also provide better insights into how HE teachers can best be supported to integrate ICT into teaching and learning. This thesis consists of an extended summary and three publications based on two separate studies: (1) a survey study and (2) an interview study. The three publications are presented as follows.

Publication I: Finnish subject teachers' beliefs and use of information and communication technology in Home Economics.

Publication II: Predicting Finnish subject-teachers' ICT use in home economics based on teacher and school-level factors.

Publication III: Home economics teachers' ICT use in Finland seen from a lens of reciprocal determinism.

The thesis is divided into the following five chapters: *Introduction, Previous Research and Theoretical Framework, Research Philosophy and Methodology, Summary of the Publications, and Concluding Discussion.* Chapter I is the introductory chapter and presents the background, aim, research questions and structure of the thesis, the nature of home economics as a field of study

and school subject, and a description of two central concepts, ICT, and digital competence.

Chapter 2 *Previous Research and Theoretical Framework* is divided into three sub-chapters covering the following topics: facilitating students' learning using ICT; conditions related to teachers' use of ICT; and Bandura's model of reciprocal determinism. The theory of reciprocal determinism is used to frame the findings from Publications I–III.

Chapter 3, *Research Philosophy and Methodology*, describes the philosophical positioning of the thesis, the methodology employed and the methods of all three publications. Within this chapter I also discuss the quality of the publications based on a list of quality criteria, considering both the quantitative, qualitative, and mixed-methods research phases. Finally, I look at ethical consideration.

Chapter 4, *Summary of the Publications,* provides a summary of the findings and contribution of the three included publications.

Chapter 5, *Concluding Discussion,* discusses the overall findings of the three publications based on the research questions of this thesis and through the lens of Bandura's reciprocal determinism. Limitations and strengths, implications and suggestions for further research are also discussed. Finally, the main points are summarized in the conclusions.

1.3 The Nature of Home Economics

In order to fully appreciate and understand the true nature of HE education and HE as a school subject, scholars (Benn, 2012; Nickols & Collier, 2015; Turkki & Vincenti, 2008) emphasise the importance of understanding its origins and history. History gives rise to elements that continue to influence and inform HE practice to this day. In this chapter, I will discuss and summarize some essential features of HE to provide a basic understanding of the fundamentals underpinning HE as a field of study, but also as a school subject.

1.3.1 Understanding Home Economics Through its History

First, there is a need for conceptual clarification. Home economics has two root words: "home" and "economics". Home is defined by Cambridge Dictionary (2022) as "the house, apartment, etc. where you live, especially with your family". This brief definition sees "home" as a physical place, but also emphasises that home is made up of people, such as a family. Given that home is a multidimensional and complex concept, this is a very narrow view of home. Korvela (2003) points out that "home" does not necessarily have to be a fixed place. Although house and home are often used interchangeably, there are significant differences between the two. While a house includes a building and serves as shelter (Barrie, 2017), the home is seen more as a space of caring for human nature and a place where we can be accepted for who we are (Argandoña, 2018). Korvela (2003, p. 16) further describes the home as "a system of family social relations". However, Mallett (2004) concludes that the home does not necessarily have to include the family, but can be formed by other important people, belongings, or activities. Barrie (2017) states that both the house and the home are places of action, such as habitual actions and important life events, which in turn create meaning in life. The home often has emotional significance and is associated with feelings of comfort, relaxation, security, and intimacy (Mallett, 2004). According to Brown and Paolucci (1979, p.51), home provides "a sense of continuity in one's personal life, in one's culture, and in the world."

The term "economics" or "economy", on the other hand, comes from the ancient Greek word "oikonomia", which contains two different words: "oikos" (household) and "nemein" (management and dispensation), which often refers to the management of households. (Leshem, 2016) According to Allon (2011), oikonomia is referred to as "wise management of the goods, wealth and welfare in the household". Here it is clear that the household was seen primarily as an economic institution aimed at satisfying human material needs and ensuring a good life (Allon, 2011). The name "home economics" was adopted internationally as an umbrella term for HE as a profession and field of study. However, not all home economists agreed with the choice of name. (Philippy, 2021; Stage, 1997b). As a school subject, HE is now taught under different names in different countries, which is said to be due to different interpretations of the central ideas of HE (Turkki, 1999).

HE is a field of study that originally developed in the United States in the mid- 19th century, at a time of industrial revolution. This period was characterised by massive growth in productivity, mechanization, and technological advances, which also affected the home and, in particular, the status of women in society. (Lake Placid Conference Proceedings, 1902; Schwartz Cowan, 1976; Sysiharju, 1995; von Schweitzer, 2006). Throughout history until the 20th century, a women's key role was to take care for the home, but thanks to industrialization, women were provided opportunities to advance in their careers and to move out of the private sphere of the home (Stage, 1997a). A large part of household production of food, clothing, furniture, and housing also moved from the home sector to the market sector. This led to consumer issues and private finances being emphasised to a greater extent than before. (Schwartz Cowan, 1976; Sysiharju, 1995) However, the industrial revolution also brought negative effects in the form of malnutrition issues and poor living conditions. These were some of the concerns that created a need for development, especially women's knowledge and skills in household management. (Sysiharju, 1995)

In the 19th century, there were many pioneers who proved to be of great importance in the development of the field of home economics. Published books, writings, encyclopaedias, training programmes, cooking schools offered to the disadvantaged and women are just a few examples of initiatives that led to the development of the field of HE. (Nickols & Collier, 2015)

For example, HE was not systematized as a profession until Ellen Richards, the founder of HE in the USA, initiated the annual Lake Placid conference in New York (1899–1909) (Philippy, 2021; Turkki & Vincenti, 2008). Richard's primary agenda was to increase women's skills and knowledge in household management, which in turn was believed to both change women's roles and improve the living conditions and well-being of people in households (Dyball & Carlsson, 2017; Richardson, 2000; Tomes, 1997). The aim was also to increase women's opportunities for education and employment (Stage, 1997a; Sysiharju, 1995).

In Finland, HE education and HE profession grew out of similar social concerns and motives. The main ambition was to educate women in the application of new knowledge and science in the home, in order to increase the level of household knowledge. This, in turn was seen as having a positive impact on the well-being of both households and the nation. In the long run, this also contributed to the economic growth of the society. (Lindberg & Salomaa, 2022; Sysiharju, 1995; Turkki, 1990) Initially HE was defined as a female domain and was only taught to girls (Apple, 1997; Salomaa, 2021; Sysiharju, 1995). When reflecting on the history of HE, it is also clear that from its origins, HE has been concerned with the health and well-being of individuals and families (Brown & Paolucci, 1979).

The Lake Placid Conference provided a forum for leaders in the field to discuss the essentials of HE, the content, and aims of the curriculum, and the future of the field. Although there were strong disagreements and multiple

views on central concepts such as the human being, the home, society, and home economics put forward by different disciplines, a common definition of HE was reached. (Nickols & Collier, 2015; Turkki, 1999) At the Lake Placid Conference (1902, p.70), HE was defined as "a study of laws, conditions, principles and ideals which are concerned on the one hand with man's immediate physical environment and on the other hand with his nature as a social being, and is the study specifically of the relation between those two factors. "

This definition gave HE a wider meaning, as it was based on a human ecological perspective and recognised the interplay between individuals, families, and society. Ellen Richards was the first to use the term human ecology in relation to the home (Dyball & Carlsson, 2017). Although Richard's interpretation of the human ecological perspective has been criticized, human ecology theory is considered as one of the most developed conceptual frameworks for approaching HE and understanding household activities (McGregor, 2011; Turkki, 1995). HE has adopted a human ecological perspective since the 1970s in order to move away from a fragmented knowledge base and create a holistic view of HE (Bubolz & Sontag, 1988; McGregor, 2011). The best-known model of human ecology was provided and developed by Bubolz and Sontag (1988). They defined human ecology as "the study of humans as social, physical, biological beings in interaction with each other and with their physical, socio-cultural, aesthetic, and biological environments, and with the material and human resources of these environments" (p. 3). Within the human ecology model, the family is seen as the most important institution in society, where the basic needs of family members are met through the use creation of resources.

Although the human ecology model provided a broader framework for studying and analysing human behaviour, HE was criticized in its initial phase for its scientific position. In the definition presented in 1902, home economics was primarily viewed from an applied and empirical scientific perspective. The aim was to promote social change by increasing scientific awareness of various aspects, which was seen as a way of controlling the environment. (Yoo, 1997) The interest was in applying empirical findings to the home to find better ways of managing household tasks and solving practical problems. The empirical-scientific perspective on HE led to an overly narrow view of human life and human beings. (Brown, 1986; Richardson, 2000; Yoo, 1997)

Thus, human ecology is considered a very important theoretical basis for the school subject of HE, both internationally and in Finland (Hjälmeskog & Höijer, 2019; Turkki, 1990, 2008). Human ecological thinking places HE in a societal arena and emphasises the deeply intertwined relationship between individuals, the environment, and society. Furthermore, the theory emphasises the importance of individuals and households managing resources in a way that is in balance with nature, as well as the responsibility of the family to meet the needs of all family members and promote well-being. Consumer issues, but also sustainability and environmental issues, have long

been formed as an essential part of HE (Kyrk, 1930; Turkki, 2008, 2012). Consumer education and educating for sustainable and responsible living have also been an important part of HE curricula, especially in Finland (Finnish National Agency of Education, 1994, 2004, 2014; Wennonen & Palojoki, 2015).

To clarify the meaning of HE and to move away from the narrow interpretation of the human ecological perspective, Brown and Paolucci (1979) applied a critical science perspective to HE. These were ideas that had already been addressed by early leaders in the field. The critical theory perspective can be seen in the mission statement of HE, as presented by Brown and Paolucci (1979, p. 23)

> The mission of home economics is to enable families, both as individuals units and generally as a social institution, to build and maintain systems of action which lead (1) to maturing in individual self-formation and (2) to enlightened, cooperative participation in the critique and formulation of social goals and means for accomplishing them.

Brown and Paolucci (1979) further pointed out that although HE is concerned with actions and solving practical problems within the home and family, it would be morally irresponsible to focus only on action to satisfy one's own individual needs. An individual's actions affect other people. Solving practical problems therefore requires practical reasoning, reflective communication, and moral reflection. We need to be able to engage in dialogue and to communicate to better understand what lies behind human actions. We also need to engage in reflective thinking to develop as persons, to increase self-awareness and to develop a sense of moral responsibility.

Regardless of definition, the close interplay between human action in daily life and society is seen as the fundamental basis of HE. This also defines HE as a highly society-dependent subject. As society changes, so does the home, and vice versa. For HE to remain relevant as a school subject in the future, it is of great importance that HE can respond to megatrends in society, such as digitalization and globalization. Megatrends influence the way people live their lives and solve problems. (Pendergast, 2012, 2022) In this thesis, the megatrend digitalisation is in particularly addressed in relation to the school subject of HE in Finland.

HE is also unique in its multidisciplinary and holistic view of everyday life. Given that the complex challenges of everyday life can rarely be solved by one disciplinary base, HE depends on the creation, use, and integration of knowledge from different disciplinary bases (International Federation for Home Economics, 2008; Nickols & Collier, 2015; Turkki, 1999, 2008). According to McGregor (2008) this characteristic means that HE needs to apply content and knowledge from other disciplines, such as economics, psychology, sociology, law, philosophy, and business. The International Federation of Home Economics (IFHE) (2008, p.1) refers to content such as, "food, nutrition and health; textiles and clothing; shelter and housing; consumerism and consumer science; household management; design and

technology; food science and hospitality; human development and family studies; education and community services, and much more".

The content of home economics has gradually expanded in line with the developments in society and research. From cooking and household management, clothing and textile care, childcare, family relations and interior design, to human development, nutrition, economics, consumer affairs and sustainability issues. (Nickols & Collier, 2015)

This multidisciplinary background influences HE curricula and creates a need to gather and combine knowledge from different disciplines (Turkki, 1995). Different types of knowledge and insights are used to solve practical problems encountered in everyday life. This also reveals the problem-solving nature of HE teaching and learning. (Turkki, 1999)

The multidisciplinary, integrative, and holistic features of HE are also highlighted in the IFHE Position Statement, which in turn serves as a global model for describing the core elements and dimensions of HE (McGregor, 2014). IFHE is the only non-profit international organisation that represents HE as a profession (Dewhurst & Pendergast, 2011) According to IFHE (2008, p.1), HE as a curriculum area should "facilitate students to discover and further develop their own resources and capabilities to be used in their personal life, by directing their professional decisions and actions or preparing them for life". Connections are made to important outcomes such as wellbeing, lifelong learning, and human development. The well-being of individuals, families and communities, is thus something that permeates the HE profession as well as the school subject of HE (Finnish National Agency of Education, 2014; International Federation for Home Economics, 2008; Nickols & Collier, 2015).

As in many other places in Europe, HE is developed as a field of study in Finland in the mid-19th century (Sysiharju, 1995). The academisation of HE in Finland was an important milestone in the history of HE development. HE was officially academised, when the Teacher Education Act came into force and teacher education was transferred to the universities in 1975 (Lag om lärarutbildning 844/1971, 1971; Turkki, 1990). In 1979, HE started as a university subject at the University of Helsinki and later also at the University of Eastern Finland for Finnish-speaking students, at Åbo Akademi University for Swedish-speaking Finns (Haverinen, 2012; Lindberg & Salomaa, 2022).

Although the scientific approach of HE has not been entirely clear from the beginning, HE is currently positioned within the human sciences, drawing from a range of disciplines (Dewhurst & Pendergast, 2011; International Federation for Home Economics, 2008; Turkki et al., 2004). According to Turkki (1999), HE draws on perspectives from sciences such as the natural sciences, human sciences and social sciences. Turkki (1999) points out that this does not mean that HE should accept theories and concepts developed in these fields of science. On the contrary, HE should reflect on how these concepts and theories could be applied from an HE perspective to solve practical problems. This broad scientific base has also influenced HE

curricula in Finland, which include several content areas related to different disciplines (Finnish National Agency of Education, 2014).

1.3.2 Home Economics as a School Subject in Finland

The subject of HE was taught long before the discipline of HE was established in Finland. HE was included as a school subject when the Compulsory School Attendance Act was enacted and came into force in 1921 (Kommittébetänkande, 1927). However, it was not until comprehensive schools were established in Finland in 1970 that HE found its way into Finnish schools as a compulsory subject for both boys and girls (Kommittébetänkande, 1970: A5, 1970).

The education system in Finland currently includes early childhood education and care, pre-primary and basic education, general upper secondary education, vocational education, higher education, and adult education. Nine-year compulsory basic education (i.e. from ages 7 to 16) is further divided into primary education (Grades 1–6) and lower secondary education (Grades 7–9). (Ministry of Education and Culture, n.d.) To date, HE is a compulsory subject in lower secondary education for both boys and girls in Grade 7, however, it is optional in Grades 8 and 9. Compulsory teaching consists of three weekly lessons of 45 minutes each. (Statsrådets förordning om riksomfattande mål för utbildning enligt lagen om grundläggande utbildning och om timfördelning i den grundläggande utbildningen 422/2012, 2012) After the curriculum reform in 2014, HE can also be taught as an optional subject in the lower grades, from 1 to 6 (Finnish National Agency of Education, 2014).

HE is characterised in Finnish curricula as an artistic and practical subject that deals with the everyday life of individuals, families, households, the home and its interaction with society and the living environment. The central task of HE is "to develop the knowledge, skills, attitudes and readiness required to master everyday life and to adopt a sustainable way of living that promotes well-being" (Finnish National Agency of Education, 2014, p. 470).

Given the multidimensional challenges of everyday life and the multidisciplinary nature of HE, the content of HE is drawn from several disciplines. Students develop knowledge and skills related to food, meals and cooking, nutrition and health, consumerism and media, domestic work and hygiene, housing, sustainability, economics and much more. The current HE curricula cover a wide range of content divided into three sub-areas: food knowledge and skills and food culture, housing and living together and consumer and financial skills at home (Finnish National Agency of Education, 2014). The sub-area of *food knowledge, skills and food culture* supports students' development of knowledge and skills related to cooking, baking, and meal planning. In this area, students are guided to reflect on their food choices by searching for and using reliable sources of information on, for example, nutrition, food safety, economics, and ethics. Food culture, customs and festivities in the home are also highlighted. *Housing and living together*

includes developing the skills and knowledge needed to make sustainable, responsible, and conscious decisions related to housing, cleaning and textile care. The content also emphasises good manners, the use of resources and the development of responsibility within the family. Finally, a sub-area of c*onsumer and financial skills at home* has been a key content area in the Finnish HE curriculum since 1970 (Kommittébetänkande, 1970: A5, 1970). Within this sub-area, the focus is on consumer choices, rights and responsibilities and financial issues. The content also gives students the opportunity to practice using media and technology as tools in different everyday situations (Finnish National Agency of Education, 2014).

Each of these sub-areas is further related to different objectives, which also reflect the versatility of HE. The 13 educational objectives are broadly divided into and related to *practical working skills*, *cooperation and interaction skills*, and *information management skills* (Finnish National Agency of Education, 2014). Although practical working skills, cooperation and interaction skills, and information management skills are equally covered in the subject, it has been discussed that not all content is equally covered in HE education (Kuusisaari, 2014; Kuusisaari et al., 2021). According to Apple (1997), an unfortunate trend in HE has been observed throughout history, whereby HE has focused primarily on developing the technical skills of individuals to neglect other important life skills, such as critical thinking, problem solving and creativity. There are at least two reasons for this: the early influence of positivism on the scientific approach to HE and the breadth of HE, which, in turn, is considered a strength as well as weakness (Turkki, 1990; Yoo, 1997). As mentioned earlier, using only analytical science (cause and effect) to solve practical problems in everyday life leads to an overly narrow view of practice, reality, and human life (Brown & Paolucci, 1979; Brown, 1986; Richards, 2000; Yoo, 1997). In Finland, a concern has been growing that HE focuses mainly on practical technical skills, such as cooking, and neglects others (Kuusisaari, 2014; Turkki, 1990). A report by the Finnish Education Evaluation Centre indicates that students in HE have developed relatively good skills in cooking; however, their insights into consumer issues have simultaneously decreased (Venäläinen & Metsämuuronen, 2005). Tarsa (2014) argues for the importance of providing all students in HE the same right to acquire knowledge, skills and attitudes related to all content areas.

In HE, students learn how to solve practical problems related to everyday life. Therefore, problem-solving and practical skills remain highly valued. However, an ongoing debate remains about how best to combine theory and practice to solve practical problems in HE (Benn, 2012; Turkki, 1990). Turkki (1999) emphasised the importance of interpreting practice in a sufficiently diverse manner. She further pointed out that practical problems are defined as practical when they require practical action to resolve them. HE is seen as an action-oriented subject (McGregor et al., 2008); however, this does not mean that the outcome must always be a product, such as a dish or pastry. Instead, it can also mean a new perspective on something (Turkki, 1999). It

involves practical reasoning and a range of mental activities (Brown & Paolucci, 1979). Household practice is a wider concept than household tasks, and it is not limited to physical and technical activities, such as cooking and laundry. Only one of the 13 objectives in HE curricula specifically emphasises the manual skills needed to manage the household, and five objectives shed light on the development of practical skills (Finnish National Agency of Education, 1994). Practical problems differ from theoretical problems in the sense that they exist in a specific context and should be addressed by an individual or a group (Brown & Paolucci, 1979). Therefore, four out of the 13 objectives in HE curricula are related to the development of students' cooperation and interaction skills.

Several ways of conceptualising and defining practice exist. Brown and Paolucci (1979) presented three systems of action within a household, based on Habermas (1972/1968) three human interest and knowledge: technical or instrumental (hereafter technical), communicative and emancipatory. Brown and Paolucci (1979) saw actions as very closely related to practice or "praxis".

From an analytic–empirical perspective, HE practices can be seen as technical practices. A technical practice answers the questions "what" and "how" (Vaines, 1992). This type of practice refers to the development of technical skills; therefore, it is concerned with producing a particular product (e.g. baking a bread or cleaning a surface) or service for the benefit of the family or community (Brown, 1986; McGregor, 2008; Turkki, 1995). In HE education, technical practice involves students' development of particular facts and skills that support technical performance in accordance with pre-determined expectations and standards (Baldwin, 1984). It also involves scientific knowledge about actions and their consequences (Brown & Paolucci, 1979). This type of practice can be seen, for example, in cooking and baking in which certain technical rules should be followed to achieve a particular outcome (Hultgren & Wilkosz, 1986). This kind of practice can be indirectly seen in Finnish HE curricula. For example, students are supported in developing "manual skills" and "performing household tasks" (Finnish National Agency of Education, 2014, p. 470). However, to cope with everyday life, solve human problems and achieve well-being, it is not enough to focus on technical or physical practices. Given that theoretical knowledge is assumed to be value-free, applying only empirical knowledge neither provides an understanding of the context of practical problems nor reflection to provide insights into alternative solutions (Brown & Paolucci, 1979).

Communicative practice goes beyond technical practice and emphasises the importance of communicating about values, beliefs, attitudes, and feelings. This requires enquiry and communication skills (Brown & Paolucci, 1979). Dialogue and interaction with other family members provides clarity and supports individuals in understanding other people's points of view as well as their own values and ways of thinking. This type of practice improves individual self-development, self-awareness, and self-control (Brown & Paolucci, 1979; McGregor, 2008; Turkki, 1995). Interpretive practice is in line

with Haberma's practical knowledge interest, which sees language as deeply intertwined with practice, where the focus is on reaching consensus about the meaning people give to actions and communication (Habermas, 1972/1968; Hultgren & Wilcosz, 1986) Interpretive practice supports the development of interpretive reflection. Interpretive practice is also considered in Finnish HE curricula, the purpose of which is to support students' "readiness for interaction and living with others" and "acting together with others" (Finnish National Agency of Education, 2014, p. 470).

In contrast, emancipatory practice refers to self-reflection, self-determination and rational action (Baldwin, 1984; Brown & Paolucci, 1979). This type of practice supports people to critically reflect, question and evaluate actions, behaviours, norms, etc., which are taken for granted (Hultgren & Wilkosz, 1986) Through self-reflection, individuals learn to understand how external forces influence their lives, choices and interests (Baldwin, 1984). It is about achieving freedom from external constraints (Turkki, 1995). In HE, critical reflection can guide students to make better value-based decisions in the future and support the development of value knowledge (Haverinen, 2009; Wennonen & Palojoki, 2015). Emancipatory practice should also aim to support students' ability to self-reflect and act autonomously, ethically, morally, and responsibly. Therefore, students should be provided with the opportunity to evaluate different societal conditions and practice making moral and ethical decisions (Baldwin, 1984). In Finnish HE curricula (Finnish National Agency of Education, 2014), students are guided in planning, organising and evaluating their work and actions. Taking and developing a sense of responsibility is also an important element in HE and in dealing with everyday life (Haverinen, 1996; Turkki, 1995; Wennonen & Palojoki, 2015). McGregor (2015, p. 98) defined responsible living as "the ability to act independently and take decisions without authorization". Reflection on practice is considered a very important element in becoming a responsible and moral person (Heinilä, 2004). In teaching HE, teachers can promote responsibility in students by implementing learning activities in which students are encouraged to set goals, make decisions, and reflect on the underlying values and outcomes (Haverinen, 2009; Wennonen & Palojoki, 2015). Thus, responsible living also requires communication skills, decision-making skills, problem-solving skills, creativity and change management (Partnership for Education and Research about Responsible Living, 2023).

Practice in HE can also be analysed based on the Aristotelian two forms of action: *poiesis* and *praxis*. While poiesis (making) refers to the technical actions of production, praxis is seen as morally committed actions done for their own sake (Balaban, 1990; Renwick, 2015). These forms of practice are balanced by theory that is also included in the Aristotelian (Lobkowicz, 1967) forms of action (theoria[3]). In the HE context, theory refers to scientific

[3] Referred to as "contemplative life" by Aristotle (Lobkowicz, 1967).

knowledge and truths related to, for example, nutrition, chemistry, ecology, and hygiene (Renwick, 2015; Turkki, 1995).

In summary, all these forms of practice and ways of thinking about a practical problem in HE are necessary for individuals to achieve well-being and take responsibility for their own behaviours and actions in everyday life. Home is both a factory, a relationship, and a moral centre (Vaines, 1992). These forms of practice are also present in HE curricula; therefore, it remains vital to consider both technical, communicative, and emancipatory practice as well as poiesis and praxis, when trying to form an understanding of the core element and characteristics of HE as a school subject.

As already noted, the close interaction between individuals' actions in everyday life and the surrounding society makes it crucial for HE to provide students with opportunities to develop the skills needed to meet the demands of contemporary society. This, in turn, makes it important to understand the impact of societal changes on the skills, knowledge, attitudes and values needed to cope with everyday life (Bubolz et al., 1979; Kuusisaari, 2014; Pendergast, 2012). Although many household activities are based on routines (e.g., cooking, cleaning, hygiene), well-functioning routines may also need to be changed and reflected upon due to societal changes (Turkki, 1999). The Finnish core curriculum (Finnish National Agency of Education, 2014) has identified the following seven transversal competences to prepare Finnish students for the twenty-first century: (T1) thinking and learning to learn; (T2) cultural competence, interaction and self-expression; (T3) taking care of oneself and managing daily life; (T4) multi-literacy; (T5) ICT competence; (T6) working life competence and entrepreneurship and (T7) participation, involvement and building a sustainable future. These competencies are also an integral part of learning in HE in terms of content and objectives. In particular, digital technology has become increasingly important in curriculum guidelines, including in HE curricula (Finnish National Agency of Education, 2014). In HE, students should "form an understanding of the increasingly technological nature of daily life at home as well as cost-conscious actions and the use of information and communication technology in household activities" (Finnish National Agency of Education, 2014, p. 471). The development of students' digital competence is especially supported not only in relation to practical working skills but also indirectly in relation to other skills (Finnish National Agency of Education, 2014). The role of HE teachers' use of ICT to support students' digital competence and other learning outcomes in HE is discussed in more detail in Chapter 2.

1.4 ICT and Digital Competence: Concept Clarification

Two concepts are central to this thesis, namely, ICT and digital competence. ICT is a concept that permeates the whole thesis. Digital competence, is a slightly less central concept compared to ICT, but is discussed throughout the thesis in relation to both teachers and students.

1.4.1 Information and Communication Technology (ICT)

As connectivity came to be seen as more important than access to tools, it became necessary to expand the narrower term information technology (IT) into ICT (OECD, 2012). Thus, there is no general agreement on what should be included in the ICT acronym, partly because ICT is used differently in different contexts. For example, ICT has been described in relation to socio-economic development, the economy, business, and education (Zuppo, 2012).

Although there is no single universal definition of ICT, international organisations have provided some descriptions of ICT. In 2009, UNESCO (p. 120) defined ICT as "a diverse set of technological tools and resources used to transmit, store, create, share, create or exchange information. These technological tools and resources include computers, the Internet (websites, blogs, and emails), live broadcasting technologies (radio, television, webcasting), recorded broadcasting technologies (podcasting, audio, and video players, and storage devices) and telephony (fixed or mobile, satellite, visio/videoconferencing, etc.)". According to the International Organization for Economic Co-operation and Development (OECD) (2012, p. 16) ICT includes "all technologies and applications intended to support communication and provide access to digital information and media"… as well as everything from "computers, networks, mobile phones and all the hybrids or new technological developments such as smartphones, tablets, digital pads or netbooks as well as the applications that can be run by them". The possibility of connectivity is what unites all these devices and resources. Digital technology is another term used in research almost as a synonym for ICT, referring to both hardware, software, and the Internet (Kaarakainen & Saikkonen, 2021; Spiteri & Chang Rundgren, 2020). As the number of mobile devices and the various applications run on them are steadily increasing year by year (Ceci, 2023; Laricchia, 2023), the number of handheld tools included in mobile devices also increases. According to Pegrum et al. (2013) mobile devices include all types of handheld devices such as digital media players, smartphones, personal digital assistants, and tablet computers. Similarly, the Oxford English dictionary (Oxford University Press, 2023b) refers to mobile devices to include mobile phones, smartphones or portable computing devices or tablet computers.

Definition

In this thesis, ICT is defined in line with both UNESCO's (2009) and OECD's (2012) definitions of ICT. ICT is used as an umbrella term to describe a range of hardware (computers, mobile devices, and other devices), various forms of software applications and digital learning content and networks, that are used to transmit, store, create, share, present, exchange information or otherwise support communication. More specifically, ICT covers everything from various digital devices, games, blogs, online presentation programmes, social media, multimedia content, cloud storage sources, online assessment tools to virtual learning platforms. The term "computer" includes both

desktop and laptop computers. Even though the use of portable computers, laptops and tablets has intensified in recent years (OECD, 2020) desktop computers remained the most common form of computers in all countries in year 2012 (OECD, 2015). It should also be noted that the first data collection took place in 2016, and therefore includes ICTs typical of that period.

The terminology used has also shifted somewhat over the course of the thesis, for example in relation to mobile devices and digital learning materials. In this thesis, mobile devices are generally defined in line with Oxford English Dictionary definition (Oxford University Press, 2023b) and therefore refer to all types of handheld devices such as smartphones, mobile phones, and tablet computers.

Digital learning material is understood in a broad sense to refer to any type of digital resource that can be used by teachers or students for learning, including media elements (presentations, animations, videos, texts, images), webpages, software applications, video lectures, games, blogs, and other digital content that is used to deliver information (exposition), instruct, promote discovery, and exploration (Shepherd, 2017). This is in line with the definition proposed by Bilbalo–Osorio and Pedró (2010), and the classification of digital learning content by Ilomäki (2013).Thus, the term used for digital learning materials has also shifted somewhat in the course of the work.

1.4.2 Digital Competence

Digital competence can be described and interpreted in many ways depending on the context (Brečko & Ferrari, 2016; Vuorikari et al., 2022). In this thesis, it is necessary to distinguish between students' and teachers' digital competence. Both HE teachers' use of ICT to support students' digital competence and teachers' perceived digital competence are investigated in the publications. Hence, due to the rapid development of technologies, the different attempts, and terms used, it is difficult to provide a quick overview of the term (Ala-Mutka, 2011; Ilomäki et al., 2016).

Numerous studies have been published and frameworks have been developed to define and conceptualise digital competence (Ala-Mutka, 2011; Falloon, 2020; Ilomäki et al., 2011, 2016; Vuorikari et al., 2022). Digital competence can be broadly understood as the skills, knowledge and attitudes needed in today's knowledge society (Ilomäki et al., 2016; Mannila, 2018). However, the concept is much more complex. The multiple terms used, and the different definitions presented for digital competence can easily lead to confusion among readers and researchers (Spante et al., 2018). Several related concepts to digital competence have been introduced in the literature, including: computer literacy, network literacy, IT literacy, ICT literacy; information literacy, media literacy, and digital literacy (Bawden, 2001; Ilomäki et al., 2016). While digital competence has elements of several of these earlier literacies (Ilomäki et al., 2016), digital literacy is the concept

most closely associated with digital competence and is often used interchangeably (Gallardo-Echenique et al., 2015; Pangrazio et al., 2020).

In this thesis I have chosen to use the term digital competence instead of digital literacy, even though digital literacy is used more often from an international perspective (Ilomäki et al., 2016). There are three reasons for this choice. First, digital competence is a more common term compared to digital literacy in a Scandinavian context (Ilomäki et al., 2016; Pangrazio et al., 2020). Second, the use of the term "competence" instead of "literacy" is in line with the latest curriculum reform in Finland, which is characterised by a shift from a content-oriented to a more competence and goal-based curriculum. The concept of competence has become increasingly important in Finnish schools and educational institutions since the so-called transversal competences were introduces in the latest Finnish core curriculum, which was implemented in 2016. (Lavonen, 2020) Thirdly, in the light of policy documents, the competences presented in the Finnish core curriculum seem to be closely related to frameworks for lifelong learning, such as those provided by the European Union (European Commission, 2019b; Mannila, 2018).

It is difficult to establish a precise and standardized definition of digital competence. Hence, there have been some important contributions to the definition of digital competence (Ala-Mutka, 2011; Ferrari, 2012; Vuorikari et al., 2022). Digital competence has been described and defined at both *conceptual* and *operational* levels. A definition at the *conceptual level* is necessary to identify the main elements of digital competence (Ala-Mutka, 2011). One of the best known conceptual definition of digital competence, is the one provided by the European Parliament and the Council in 2006, which identified digital competence as one of eight key competences for lifelong learning (*Recommendation of the European Parliament and of the Council of 18 December 2006 on Key Competences for Lifelong Learning 2006/962/EC*, 2006) Following definition of digital competence was then presented:

> "Digital competence involves the confident and critical use of Information Society Technology (IST) for work, leisure, and communication. It is underpinned by basic skills in ICT: the use of computers to retrieve, assess, store, produce, present and exchange information, and to communicate and participate in collaborative networks via the Internet."

A reference framework was created to support policy makers, education providers, employers, and learners in developing the key competences needed throughout life (European Commission, 2007). This definition has been redefined to some extent in the updated version of the Council recommendation on key competence, adopted in 2018 (*Council Recommendation of 22 May 2018 on Key Competences for Lifelong Learning 2018/C189/01*, 2018). *Conceptual definitions* of digital competence are also provided by scholars, such as Ala-Mutka (2011) and Ferrari (2012). Ferrari (2012, p. 43) proposed the following definition of digital competence based on an analysis of 15 different frameworks:

> "Digital competence is the set of knowledge, skills, attitudes, strategies, values, and awareness that are required when using ICT and digital media to perform tasks; solve problems; communicate; manage information; collaborate; create and share content; and build knowledge effectively, efficiently, appropriately, critically, creatively, autonomously, flexibly, ethically, reflectively for work, leisure, participation, learning, socializing, consuming, and empowerment. "

Ferrari (2012) further identified key elements of digital competence, which he divided into seven competence areas: information management; collaboration, communication and sharing; creation of content and knowledge; ethics and responsibility; evaluation and problem solving; and technical operations. Furthermore, each of these areas combines knowledge, attitudes, and skills. In line with Ferrari (2012), Ala-Mutka (2011) structured digital competence into the following three core areas or building blocks: instrumental skills and knowledge; advanced skills and knowledge; and attitudes for skills and knowledge application. Instrumental skills and knowledge include both operational (e.g., using digital tools, software) and media-related skills (e.g., skills related to safety and multimedia), which are further considered as preconditions for the development of advanced skills. Advanced skills and knowledge include the ability to take advantage of the use of digital tools in areas such as communication and collaboration, information management, learning and problem solving, and meaningful participation. Attitudes include intercultural as well as collaborative, critical, creative, responsible, and autonomous attitudes.

Based on previously published definitions and frameworks (Ala-Mutka, 2011; *Council Recommendation of 22 May 2018 on Key Competences for Lifelong Learning 2018/C189/01*, 2018; Ferrari, 2012, 2013), an *operationalized approach* to describe digital competence was published in the form of a "Digital Competence Framework for Citizens" (DigComp 2.2) (Vuorikari et al., 2022). Within this framework, digital competence has been divided into five key competence areas: information and data literacy, communication and collaboration, digital content creation, safety and problem solving. For each of these, there are descriptions of what these competencies include and the level of proficiency. For example, problem solving includes skills of solving technical problems. While a person at proficiency level one "can identify simple solutions to solve them", a person at level six, "can solve them with the most appropriate solutions" (Vuorikari et al., 2022, p. 119).

The *conceptual* and *operational* definitions provided in the studies and frameworks mentioned earlier, contribute to understanding digital competence as a complex, broad, and multifaceted concept. However, when comparing different definitions, some shared elements can be identified. First, most conclude that digital competence is based on a combination of knowledge, skills, and attitudes. Second, scholars agree on the following key elements of digital competence: information

management, technical and instrumental skills and knowledge, communication and collaboration, problem solving, security, digital content creation, and reflective and critical attitudes. Ethics and responsibility were also emphasised, but not by all. Third, although technical skills are an important part of digital competence, they are only one element of many. Fourth, there is also general agreement that digital competence should be viewed as an essential life skill. (Ala-Mutka, 2011; European Commission, 2007, 2019c; Ferrari, 2012; Vuorikari et al., 2022) Finally, both the DigComp reference model (Vuorikari et al., 2022) and the study by Ala-Mutka (2011) emphasise that there are skills and knowledge that need to be developed as precondition for developing more advanced skills and knowledges.

When it comes to digital competence from the perspective of teachers, there are some important elements that need to be added to the previously outlined definitions of digital competence. Research has shown that the definition and conceptualisation of teachers' digital competence is rather controversial. There is no general agreement on what teachers' digital competence should include or how it should be evaluated. (Falloon, 2020; Johannesen et al., 2014; Markauskaite, 2007; Skantz-Åberg et al., 2022).

For example, Markauskaite (2007) suggested that teachers' digital competence should be understood as a combination of cognitive (e.g., problem solving and metacognition) and technological capabilities (e.g., basic ICT capabilities and production). On the other hand, based on a literature review, Skantz-Åberg et al. (2022) identified seven key elements of teachers' digital competence: technological competence (basic ICT skills); content knowledge (e.g., ability to use ICT to support students' development of subject knowledge); attitudes towards technology use; pedagogical competence (e.g., ability to integrate ICT into teaching to support students' learning); cultural awareness; critical approach (e.g., ability to use ICT critically and make critical judgements); and professional engagement (e.g., ability to manage tasks at a professional level).

Instefjord and Munthe (2016) proposed another model based on the work of Zhao et al (2002), Krumsvik (2008), and Mishra and Koehler (2006). According to this model, teachers' digital competence can be seen as a combination of technology proficiency, pedagogical compatibility, and social awareness. Teachers' digital competence has also been described by models such as Technological Pedagogical Content Knowledge, TPACK (Mishra & Koehler, 2006; Valtonen et al., 2023).

TPACK is a theoretical framework for describing and identifying how the three knowledge systems (pedagogy, content, and technology) interact to produce seven knowledge components that teachers need, for example, to use ICT meaningfully in their subject. These components include Technology Knowledge (TK), Content Knowledge (CK), Pedagogical knowledge (PK), Technological Content Knowledge (TCK), Technological Pedagogical Knowledge (TPK), Pedagogical Content Knowledge (PCK), and

Technological Pedagogical Content Knowledge (TPACK). Of these, TK, TCK, and TPK are all related to technology. According to this framework, a teacher needs knowledge of different technologies and the skills to use them (TK), knowledge of how to teach and present a particular subject matter using technology (TCK), and knowledge of how to use technology as part of the learning process. (Mishra & Koehler, 2006)

Digital competence has also been conceptualised and addressed by policy frameworks, such as the European Digital Competence Framework for Educators (DigCompEdu). According to this framework, teachers' digital competence is seen as a combination of professional, pedagogical and learner competences. The framework presents a total of 22 competencies divided into the following main areas: 1) professional engagement, 2) digital resources, 3) teaching and learning, 4) assessment, 5) empowering learners and 6) facilitating learners' digital competence. (Redecker, 2017)

Comparing these studies and definitions, teachers' digital competence can be summarized as including at least the following elements: technological competence (Instefjord & Munthe, 2016; Markauskaite, 2007; Mishra & Koehler, 2006; Skantz-Åberg et al., 2022), pedagogical competence (Instefjord & Munthe, 2016; Mishra & Koehler, 2006; Redecker, 2017), professional competence (Skantz-Åberg et al, 2022; Redecker, 2017), and social and cultural awareness (Instefjord & Munthe, 2016; Skantz-Åber et al., 2022). Although teachers' digital competence can be seen as a complex competence with different knowledge domains, teachers' competence has been assessed in rather limited ways, such as in Badia et al. (2014), who measured digital competence by asking teachers to report their competence in different internet practices.

Definition

In this thesis, digital competence is considered from both the teacher's and the student's points of view. Both teachers' and students' digital competence are defined in line with the conceptualisation of digital competence provided in the Recommendation on Key Competences for Lifelong Learning, adopted in 2006 (*Recommendation of the European Parliament and of the Council of 18 December 2006 on Key Competences for Lifelong Learning 2006/962/EC*, 2006). In this thesis, teachers' digital competence refers to their ability to: use different ICTs (basic ICT skills); use ICT creatively and innovatively; use ICT for problem solving; use ICT to search for, collect, process, produce and present information; evaluate the value of information; use ICT safely and manage potential risks online; understand ethical principles and the credibility and reliability of information; share information and communicate online. Given that this definition is not specifically aimed at defining teachers' digital competence, the term has been interpreted narrowly in this thesis when compared to the definitions of Instefjord and Munthe (2016) and Skantz-Åberg et al. (2022).

The definition used in this thesis still includes all the essential learning domains (knowledge, skills, attitudes) and competence areas (information and data literacy, communication and collaboration, digital content creation, safety and problem solving) needed to develop digital competence at the individual level (Vuorikari et al., 2022). In addition, the three publications included in this thesis use constructs that are closely related to digital competence, such as the perceived usefulness of ICT in teaching, which, in turn, has been shown to be related to and correlated with teachers' digital competence (Dogan et al., 2021). Beliefs and attitudes are also considered an essential component of teachers' digital competence (Instefjord & Munthe, 2016; Skantz-Åberg et al., 2022). It is suggested that teachers who are aware of their beliefs and use ICT in ways consistent with their beliefs are more likely to integrate ICT into teaching more successfully.

Similarly, students' digital competence is defined in line with the Recommendation on Key Competences for Lifelong Learning (Recommendation of the European Parliament and of the Council of 18 December on key competences for lifelong learning (2006/962/EC)) with some adaptations. According to this definition, students' digital competence includes: understanding of the potential role of ICT in everyday life, at home and at work; basic ICT skills; using ICT to develop problem solving, creativity, innovation and critical information processing skills; using ICT to search for, collect, process, produce, report, present and share information; using ICT safely and dealing with potential risks online; understanding ethical principles online and the credibility and reliability of information and using ICT for communication and collaboration. This definition also shares some similarities with Ferrari's definition, as both definitions include learning domains (knowledge, skills, attitudes), tools (ICTs), competence areas (e.g. content creation, communication), modes (attitudes towards how ICT should be used, for example, critically, ethically) and purposes (purposes and needs for digital competence, e.g. work, leisure).

Considering that digital competence is introduced as a transversal competence in the Finnish core curricula as an approach to include twenty-first-century skills, the definition in the Recommendation on Key Competences for Lifelong Learning is well suited to define students' digital competence in the context of this thesis (Finnish National Agency of Education. 2014).

2. Previous Research and Theoretical Framework

This thesis aims to examine HE teachers' use of ICT for teaching and for students' learning, as well as the conditions related to their ICT use. To understand these conditions, I will provide an insight into the research on teachers' use of ICT for students learning as well as dimensions of teachers' ICT use. In addition, I will touch upon the conditions that influence teachers' ICT use and outline the fundamental ideas of the theory of reciprocal determinism, which is used as a theoretical lens in this thesis.

2.1 Facilitating Students' Learning Using ICT

Teachers use ICT to support students' learning in various ways. Here I will highlight the potential role that teachers' use of ICT can have for student learning in HE. Due to the scarcity of research on how teachers' ICT use supports students learning in HE, studies on other subject areas are also included in this background. The role of ICT for students learning is discussed in relation to affective (e.g., motivation, interest, satisfaction), and cognitive outcomes (student acquisition of knowledge, skills, and self-regulated learning), as well as outcomes related to collaboration, interaction, and communication, and twenty-first century skills (e.g., digital competence). Note that the latter include both affective, cognitive, and social aspects (Ala-Mutka, 2011; Baker et al., 2013; Zimmerman, 2002).

Furthermore, I will refer to both quantitative and qualitative studies that report how teachers' ICT use can potentially benefit student learning based on both test scores, self-reported data, and observed behaviour change. Measuring and evaluating the impacts and benefits of ICT on student learning can be challenging and requires multiple measures, enough data, and discussions from different perspectives (Biagi & Loi, 2013).

2.1.1 Affective Outcomes

The role of ICT in learning is often discussed related to affective outcomes, such as students' feelings, emotions, attitudes, and values. (Hoque, 2017; Krathwohl et al., 1956; Wei et al., 2021). The focus here is on students' motivation and interest. Supporting students' interest and motivation is very important, considering they are both related concepts that has been identified as essential conditions for learning (Renninger & Hidi, 2015). Renninger and Hidi, (2015, p. 72) defines interest "the psychological state of a person during engagement as well as the cognitive and affective motivational disposition of the person to reengage with particular content over time" and motivation as a "desire or will to do something and may or may not be due to a developing interest". Interest is suggested to be an important source of motivation, but also engagement, given that motivation and engagement are claimed to be most fruitful when accompanied by interest (Renninger & Hidi, 2015; Ryan & Deci, 2000).

A qualitative study by Veeber et al. (2017) was conducted to examine Handicraft and Home economics (HHE[4]) teachers' understandings of how ICT can promote student learning in HHE. The findings show that the teachers see potential in using ICT for enhancing students' interest and motivation. A mixed-methods study (Ho & Albion, 2010) on HE teachers' use of ICT in Hong Kong also found that ICT was used to make HE more interesting.

Another study by Surgenor et al. (2016), found that implementing podcasts with video elements and recipes for meal preparation in HE, in six secondary schools in Ireland supported students' interest, curiosity, and motivation for practical skill development. The findings from the study were consistent with the literature review study by Kay (2012) who identified several benefits of using podcasts for teaching and learning in K-12[5] schools and higher educational levels. Another qualitative study by Lai and Lum (2012), which examined the implementation of wikis as a course platform in HE in a secondary school in Hong Kong, found that wikis[6] can be used to enhance students' interest in the subject and support engagement. A more recent study in Norway (Beinert et al., 2020) also reported that teachers in HE[7] use digital tools to increase students' motivation.

To sum up, based on these studies, it can be concluded that different types of ICT have potential in supporting students' motivation and interest in HE. These findings further accord with other quantitative (Kay, 2012; Sung et al., 2016; Tapingkae et al., 2020) and qualitative studies (Håkansson Lindqvist, 2015; Montrieux et al., 2015; Strømman, 2022) that have included other subject domains and levels of education, showing that mobile devices, podcasts, games with elements of formative assessment can foster students' interest and learning motivation.

2.1.2 Cognitive Outcomes

Cognitive outcomes are discussed in relation to the development of knowledge, skills, and self-regulation. Thus, I find it very difficult to analyse the role of ICT only in relation to knowledge and skill acquisition in HE, due to the holistic and integrative nature of HE (Bubolz & Sontag, 1988; McGregor, 2011). In HE, practical working skills, information, and management skills, and cooperation and interaction skills are strongly intertwined and consist of both cognitive, affective, and social dimensions (Finnish National Agency of Education, 2014).

A review of the literature on the use of ICT in HE yields only two studies, which discuss the role of ICT use in students' development. Surgenor et al.

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[4] In Estonia, Handicraft and Home Economics is taught as a single combined subject (Paas & Palojoki, 2019).

[5] K-12 is a term used in US, for example, and stands for education from kindergarten to 12th grade (Oxford University Press, 2023a). In Finland this would include pre-primary education, basic and upper secondary education (Finnish National Agency for Education, 2023).

[6] Wikis can be seen as a type of website where, if designed and implemented correctly, a number of students can interactively and collaboratively edit the content (Judd et al., 2010).

[7] Referred to as Food and Health in Norway

(2016) found that using podcasts in HE can enhance students' development of food skills by fostering their creativity and self-confidence. Another qualitative study conducted by Veeber et al. (2017) reported that teachers found using ICT as a potential tool to support students' creative thinking, which in turn is an important part of practical skills (Finnish National Agency of Education, 2014) and thought processes involved in everyday problem-solving situations (Haverinen, 1996; Vidal, 2009). Implementing laptops has also been shown to support creativity in other school subjects (Håkansson Lindqvist 2015).

Hence, to date, it is difficult to find studies that have analysed the impact of ICT use in developing students' skills in HE using numerically based data. The effectiveness of ICT on students' cognitive skill and knowledge development is usually evaluated using quantifiable key performance indicators, such as achievements (cf. Sung et al., 2016). Thus, international research, including literature review studies and studies based on large-scale survey data, has provided mixed results regarding the effects of ICT use on students' cognitive development, reporting both positive (Haßler et al., 2016; Sung et al., 2016; Tingir et al., 2017), and negative effects (Fernández-Gutiérrez et al., 2020; Hu et al., 2018; Huang et al., 2021; Mora et al., 2018). However, the positive effects seems to vary depending on the school subject (Fernández-Gutiérrez et al., 2020; Sung et al., 2016; Tingir et al., 2017) and primarily relate to the use of mobile devices (Haßler et al., 2016; Sung et al., 2016; Tingir et al., 2017), but also other ICT, such as educational games (Lamb et al., 2018) and podcasts (Kay, 2012).

As the learning outcomes in HE are difficult to quantify due to the integrative and broad nature of the subject, one way to understand the role of ICT in supporting students' cognitive outcomes, is to focus on the abilities that underpin these skills, such as self-regulated abilities. Self-regulation is described by Zimmerman (2000, p. 14) as "self-generated thoughts, feeling, and actions that are planned and cyclically adapted to the attainment of personal goals". From a social cognitive perspective, self-regulatory processes are divided into three cyclical stages: forethought, performance, and reflection. These stages includes for example goal setting, strategic planning, self-control, self-observation, self-reflection, self-judgement, and self-reaction (Zimmerman, 2000). The ability to self-regulate is seen as one of the most important qualities for succeeding in life (Baumeister et al., 2002; Zimmerman, 2000).

The abilities to self-regulate can be seen as underlying all three forms of practices in HE (Baldwin, 1984; Brown & Paolucci, 1979; Habermas, 1972/1968), including practical skills, cooperation and interactions skills and information management skills. In terms of practical skills, for example, students are supported to plan, organise, and evaluate their actions and decisions. They are also guided in planning both their time use and practical work. (Finnish National Agency of Education, 2014).

Various studies have examined the role of implementing ICT for supporting students' self-regulated and active learning in different subject areas and levels of education. Both e-portfolios, videos and mobile applications and software have been shown to support different phases of self-regulated learning (Abrami et al., 2013; Chang et al., 2016; Kongsgården & Krumsvik, 2016; Meyer et al., 2010; Sha, Looi, Chen, & Zhang, 2012; Trabelsi et al., 2022).There are also studies (Lai & Lum, 2012; Surgenor et al., 2016) in HE, indicating that ICT can support phases of students' self-regulated learning, although self-regulation skills were not the focus of the studies. For example, Surgenor et al. (2016) found that using podcasts with handheld devices when practicing cooking skills increased students' self-confidence, and independence by allowing them to watch videos repeatedly, experiment and make mistakes. Self-confidence, or self-efficacy is the most prominent construct in influencing self-regulated behaviour, and refers to "one's beliefs about their capabilities to exercise control over their own level of functioning and over events that affect their lives" (Bandura, 1991, p. 257). By believing in their own capabilities to do well and achieve their goals, students are also more likely to self-regulate their effort, motivation, action etcetera in order to achieve their goals (Bandura, 1997). Giving students some independency, autonomy, and freedom to control their learning process is another important element of self-regulated learning (Sha et al., 2012). Previous research (Håkansson Lindqvist, 2015; Haßler et al., 2016; Lindberg et al., 2017) indicates that ICT tools, especially mobile devices, have potential to provide students with greater freedom and flexibility. Experimentation, risk-taking and repeated watching of videos are also included in the strategies (rehears, memorize, self-reflect) of self-regulated learning (Zimmerman, 2002; Zimmerman & Martinez-Pons, 1986).

Another study by Lai and Lum (2012), who implemented wikis as a course platform in HE in a secondary school in Hong Kong, identified several benefits of using wikis, which contribute to students' self-regulation process. By using wikis, students were able to engage in self- and peer assessment activities. Recorded and uploaded videos and pictures from the learning process were used to support students' understanding of their learning progress in relation to practical food preparation skills. The implementation of wikis clearly supported students' self-awareness through self-learning, reflection, and feedback. Self-awareness is an important element of self-regulated learning and is needed for students to take correct actions in their learning (Zimmerman, 2002).

2.1.3 Collaboration, Interaction and Communication

Another potential impact of ICT on students' learning is the use of ICT to encourage collaboration, interaction, and communication (Chou et al., 2012; Kongsgården & Krumsvik, 2016; McKnight et al., 2016; Strømman, 2022) Both cooperative and interactive skills are at the core of teaching and learning in HE, therefore support for the development of these skills might be of

particular interest (Rantanen & Palojoki, 2015). However, only a few studies on ICT use in HE report positive attitudes towards using ICT to foster students' communication, interaction, collaboration, and cooperation. According to Veeber et al. (2017) Estonian HHE teacher see potential of using ICT to increase communication, both between teachers and students, and between students. This also accords with Lai and Lum (2012) who report that wikis in HE can function as a communication platform that supports student interactions, as well as student-teacher interactions. Conversely, a Norwegian study (Beinert et al., 2020) reports that digital tools are seldom used to promote students collaboration in HE in Norway[8].

There are also studies in other subject areas that report negative attitudes towards using ICT for student communication and collaboration. A study by Labonté and Smith (2022) on Canadian students' perceptions of their self-directed and collaborative learning, found that students participated less in collaborative activities when ICT was used. Another interview-based study (Midtlund et al., 2021) with six Norwegian secondary teachers found that using online-based collaboration and communication was problematic due to students' lack of digital skills, and privacy issues. A literature review study by Sung et al (2016) also reported negative effects of using mobile device on students' cooperative learning outcomes.

Teachers' use of ICT to support these skills in HE is not fully understood. Thus, interpretive practice, such as learning to communicate, negotiate and interact (Brown & Paolucci, 1979; Finnish National Agency of Education, 2014; Turkki, 1995) are core elements of HE practice. HE classroom includes different types of situations similar to those in everyday life (e.g. planning and preparing a menu; budget planning), where students work towards shared goals and practice listening to others, sharing information, ideas and understanding (Taar & Palojoki, 2022) Thus, research shows that good relationships, the development of good interactive and cooperative skills, and engagement in successful group works and social interactions require regulation at a cognitive, social, emotional, and motivational level (Berger, 2003; Cherniss et al., 2006; Järvelä et al., 2015). Computer-mediated interactions may not offer the same warmth, richness and feelings of togetherness as face-to-face interactions do (Hall, 2018; Lee et al., 2011), but ICT tools including scaffolding questions during the learning process can instead support students' self-regulation process on both individual and shared level (Järvenoja et al., 2020; Sha, Looi, Chen, & Zhang, 2012).

2.1.4 Digital Competence as Part of Twenty-first Century Skills

Finally, the use of ICT in education has been increasingly emphasised in relation to promoting students' development of twenty-first century skills and digital competence (Fraillon et al., 2019; Lavonen & Korhonen, 2017; Silber-Varod et al., 2019; van Laar et al., 2020; Voogt et al., 2013). There are

[8] It is noteworthy to point out that Norwegian HE curricula and school subject "Food and health" is strongly focused on food content and practical food skills (Tuomisto et al., 2017).

no clear definitions on twenty-first century skills. Voogt and Roblin (2010) presented them as an "overarching concept for the knowledge, skills and dispositions citizens need to be able to contribute to the knowledge society" (p.1). Binkley et al. (2012) referred to them as skills needed to work in teams, communicate, adapt quickly to change, use information to solve complex problems, harness the potential of ICT to produce new knowledge and support creativity and innovation. Voogt et al. (2013), on the other hand, suggested, based on a review of international frameworks describing twenty-first century skills, that the following competences would be vital: collaboration, communication, digital literacy, citizenship, problem solving, critical thinking, creativity, and productivity.

The potential of fostering lifelong learning attributes and twenty-first century skills in HE using ICT has also been discussed in HE literature and research (Kuusisaari et al., 2021; Ma & Pendergast, 2010). Both Kuusisaari et al., (2021), Taar and Palojoki (2022), as well as Turkki and Vincenti, (2008) have emphasised the potential of providing students in HE with the opportunity to develop the twenty-first century skills, referring to skills that students need to cope with everyday life in today's rapidly changing world. Supporting students' development of critical thinking, creativity and problem-solving skills has long been a key element of teaching and learning in HE (Turkki, 1990), as they are needed to reflect on and question their own actions and to face practical problems in daily life (Finnish National Agency of Education, 2014; Turkki, 1990; Turkki, 1999).

Teachers' use of ICT has also been emphasised in relation to supporting students' development of digital competence (Fraillon et al., 2020), which is furthermore an important component of twenty-first century skills (Voogt et al., 2013). Digital competence is also emphasised in HE curricula. The constant change in daily life due to the rise of ICT has made digital competence a necessary skill to develop in HE in order to manage life, solve problems, and make safe, responsible and cost-conscious decisions in everyday life (Brečko & Ferrari, 2016; Ferrari, 2012). A high level of digital competence is particularly for making responsible and conscious decisions in relation to money and consumption (Finnish National Agency of Education, 2014). To achieve this, students need to develop digital competence within different areas. Searching, filtering, evaluating, and comparing information; evaluating responsible purchasing decisions; managing one's digital identity online; developing awareness of hidden marketing, evaluating the impact of one's decisions on the environment; managing one's personal data and privacy are just a few examples of skills, knowledges and attitudes needed for a consumer to make responsible, safe, and conscious decisions. (Brečko & Ferrari, 2016) Information management skills are also needed for students to develop housing and textile care skills and HE literacy (Kuusisaari et al., 2020).

Thus, the relationship between teachers' use of ICT and the development of students' digital competence is not clearly understood. Implementing ICT

in teaching and learning is a seen as a prerequisite for supporting the development of students' digital competence (European Commission, 2019c; Heo & Kang, 2010). However, a growing use of teachers' ICT use do not automatically have a positive effect on students' learning (Leino & Nissinen, 2012). How teachers integrate ICT matters, as the teacher is the key agent in implementing ICT in a meaningful way to support student learning. (Fraillon et al., 2020; Gabriel et al., 2022) Thus, from a Finnish perspective, students' development of twenty-first century skills, as well as teachers' level of competence, digitalization, and integration of technology in learning has been a concern discussed in research (Lavonen, 2020; Lavonen & Korhonen, 2017). Therefore, next I will focus on the dimensions of ICT use and the ways in which teachers can integrate ICT into their teaching.

2.2 Teachers' Use of ICT

There are many ways in which teachers can employ ICT as part of their work. Considerable attention has been given to classifying purposes for which teachers use ICT (Howard et al., 2015; Meneses et al., 2012; van Braak et al., 2004). In research, teachers' dimensions of use, typology of ICT use (Mama & Hennessy, 2013; Tondeur et al., 2007), and technology practices (Howard et al., 2015) are used interchangeably to refer to the ways in which teachers use ICT to carry out tasks that support both teaching and learning. In this thesis I will use the term "dimensions of ICT use", as this is the term that has been used to describe the different ways in which HE teachers' use ICT in Publication I and Publication II.

2.2.1 Dimensions of Using ICT

Several scholars (Howard et al., 2015; Ibieta et al., 2017; Suárez-Rodríguez et al., 2018a; van Braak et al., 2004) have tried to explain teachers' dimensions of ICT use in education. For instance, van Braak et al. (2004) identified, through using a principal component analysis, two main dimensions of teachers' ICT use: supportive and class use. Supportive ICT use was explained as tasks related to teaching outside the school, such as administrative tasks, evaluation, and lesson preparation. Class use, on the other hand, included teachers' use of ICT to support the processes of teaching and learning, such as instruction, and differentiation. This distinguishment matches the study by Suárez-Rodríguez et al. (2018), who categorized teachers' ICT use into personal/professional use and use with students. While the first category referred mainly to administration and management, such as preparation and creation of didactic materials, the second category referred to students' ICT use in classroom with learning environments where ICT has been fully integrated.

Howard et al. (2015) separated between professional and instructional ICT practices by presenting a confirmatory factor analysis of a scale that measured teachers' use of ICT to perform tasks. Thus, compared to van Braak et al. (2004) and Suárez-Rodríguez et al. (2018) there are some slight

differences in how teachers' professional practice is conceptualised and defined. Teachers' professional use includes not only lesson preparation and delivery of instruction, but also collaborative tasks, such as sharing work online and communicating with parents. Instructional practices, on the other hand, refer to activities in which teachers provide students with the opportunities to use ICT to work with information, content, writing, data, and visualisation. In similar vein, Meneses et al. (2012) also included the dimension of communication and collaboration as part of teachers' professional use of ICT. Based on an explanatory factor analysis, it was found that teachers' professional use of ICT included both supportive use (i.e., lesson planning and preparation) and management of ICT use (i.e., collaborating with teaching staff and communicating with parents).

Ibieta et al. (2017) separated between teachers' ICT use outside and inside the classroom. Thus, in contrast to previously mentioned studies, the use of ICT outside the classroom was given a wider meaning with reference to both lesson preparation, searching for professional development opportunities, communication with students and parents, and online pedagogical support. Atman Uslu and Usluel (2019), on the other hand, classified teachers' educational ICT use into three forms of use: ICT use before teaching, ICT use for organising teaching, and ICT use for enhancing learning. The latter two were used as indicators of ICT integration in their study. Liu et al. (2017) distinguished between teachers' use of technology and classroom technology integration, where the former refers to the use of different software packages in the context of different school activities, and the latter refers to the use of technology to support instructional methods.

Although there are slight differences in how teachers' dimensions of ICT use are defined, these previous mentioned studies support the idea of dividing teachers' ICT use into two main dimensions: outside and inside the class. As mentioned, these are further referred to in various ways (e.g., supportive, and instructional use) Furthermore, these studies show that teachers' use outside the classroom is much greater that their use of ICT inside the classroom with students (Ibieta et al., 2017; Suárez-Rodríguez et al., 2018; van Braak et al., 2004). The referenced findings in the studies also indicate that teachers' use of ICT inside the classroom can both be teacher- and student-oriented.

In this thesis, ICT use refers to all dimensions of ICT use. Thus, when referring solely to HE teachers' ICT use inside the classroom for supporting students' learning (i.e., ICT integration), the dimension that is classified as supportive or professional use is excluded. Furthermore, the term ICT integration is used interchangeably to refer to the dimension of teachers' ICT use inside the classroom.

2.2.2 Teachers' ICT integration

There is no common standard definition of ICT integration. Thus, when comparing how prior studies have examined and understood ICT integration,

it can be considered as different types of ICT use inside the classroom. ICT integration therefore excludes the dimension of ICT use where teachers use ICT for supportive and professional tasks (e.g., administrative tasks). When looking more closely at this dimension of ICT use, several studies have attempted to describe this type of use. (Atman Uslu & Usluel, 2019; Blikstad-Balas & Klette, 2020; Comi et al., 2017; Tondeur et al., 2007) For example, Tondeur et al. (2007) identified three types or purposes of teachers' ICT use inside the classroom: learning basic digital skills, using technology as a learning tool, and using technology as an information tool. The first type of use refers to using ICT as a separate subject, where students learn basic technical digital skills (e.g., using a keyboard correctly). The second type of use involves using the technology to practice knowledge and skills in relation to learning content. In the third type of technology use, the emphasis is on accessing, storing, and processing information for various uses when it comes to the interaction between the student and the subject content.

Comi et al. (2017) have a slightly different categorization and separated between knowledge transmission practices (i.e., deliver information), media education (e.g., practice digital skills), and active involvement (e.g., students' active use of ICT for e.g. writing). Atman Uslu and Koçak Usluel (2019) distinguished between organising teaching (e.g., content delivery) and enhancing learning (e.g., problem solving), where the former is classified as teacher-driven and the latter as student-driven. The ICILS 2018 study (Fraillon et al., 2020) measured teachers' use of ICT for teaching and learning in relation to teachers' use of ICT for different teaching practices, in relation to students' engagement in different class activities, and in relation to the development of students' digital competence. The study by Liu et al. (2017, p. 802) defines teachers' ICT integration simply as "the frequency with which they use technology to support a variety of instructional methods".

Overall, there seems to be no clear consensus on teachers' ICT integration in the classroom. Thus, these studies clearly indicate that ICT can be implemented by teachers in at least two ways: in relation to their own teaching practices and in relation to students' learning activities for their active involvement. Students' active use can further support the development of either their digital competence or their achievement of learning outcomes in relation to the subject matter. The first area of use facilitates primarily the teachers and the second area primarily the students.

Studies further suggest that ICT is used differently in different school subjects (Erixon, 2010; Howard et al., 2015). Both national and international reports show that subjects that belongs to practical or vocational studies or artistic and practical subjects (e.g., home economics) report the lowest use of ICT use (Fraillon et al., 2020; Tanhua-Piiroinen et al., 2016).

In the case of Finnish secondary school teachers' use of ICT, the ICILS 2018 study (Fraillon et al., 2020) shows that the prevalence of teachers using ICT for school-related purposes is very low compared to other countries. This is

also supported by other international surveys, such as TALIS 2018[9] (OECD, 2019b). The findings of the ICILS 2018 study further indicate a rather limited and narrow use of ICT among Finnish teachers. When analysing the teacher-directed use of ICT for different teaching practices, it was found that ICT was often used to present information in class. This, in turn, can be seen as a traditional transmissive use of ICT. ICT was used significantly less for exam assessment, to provide feedback to students' learning, to support student inquiry learning, and to support collaboration (Fraillon et al., 2020).

When it comes to teachers' use of ICT in the context of classroom activities, findings show that teachers most often used ICT to enable students to access and search information for different class work and assignments (Fraillon et al., 2020). Thus, using ICT for information searching activities has been found to be positively related to higher literacy achievements (Leino & Nissinen, 2012). This was also partly consistent with that of Falck et al. (2018), who found that computers benefit students achievement if used for looking up ideas and information. However, using computers for practicing skills and procedures was associated with negative effects.

However, Finnish teachers' use of ICT was surprisingly low to enable students to carry out different fieldwork activities, discuss ideas with other students; reflect on their learning; communicate with other students; plan their own learning activities; analyse and evaluate data and information. (Fraillon et al., 2020) Overall, these findings indicate that Finnish teachers integrate ICT to a very small extent in teaching for students' active use. Leino et al., (2021) have also noted the low level of teachers' use of ICT to support students' share of information and to keep diaries.

There also seems to be little emphasis on teachers' use of ICT to develop students' digital competence. Compared to other countries, Finnish teachers reported the lowest level of emphasis in their teaching on developing ICT-based capabilities in their students. (Fraillon et al., 2020). Despite this, the level of Finnish students' digital competence is quite high in an international comparison (European Commission, 2019b; European Education and Culture Executive Agency, Eurydice, 2019). Nationally, on the other hand, a decline in Finnish students' level of digital competence has been reported between 2017 and 2019 (Tanhua-Piiroinen et al., 2020). Similarly, a prolonged decline in students' performance in PISA has also been a source of concerns during recent years (Ahonen, 2021).

Hence, these findings reflect teachers' ICT use prior to COVID-19 pandemic. Large-scale studies at both international and European level show that Finland has already before COVID-19 built a quite strong ICT infrastructure in education compared to other countries (European

[9] TALIS is a large-scale international survey where teachers and principals are asked questions about teaching, working, and learning environments, professional development, and beliefs and attitudes about teaching. The latest study (TALIS 2018) covers 260,000 teachers in 15,000 schools across 48 countries at three different school levels: primary, lower secondary and upper secondary.

Commission, 2019b; Fraillon et al., 2020; OECD, 2021). In addition, recent reports show that the coronavirus pandemic has fostered the development of both teachers' and students' digital competence in Finland (Vuorio et al., 2021). A follow-up ICILS teacher panel was designed and conducted in 2020 to examine the changes in teachers' use of ICT due to the coronavirus pandemic (Strietholt et al., 2021). A significant increase in teachers' use of ICT was reported for most of the teaching practices between 2018 and 2020. A statistically significant increase was also observed in relation to teachers' use of ICT for over half of the class activities. There has further been an increase in teachers' use of different ICT tools, such as applications for asking students questions, online games, learning management systems, collaboration software, and interactive digital learning resources. (Strietholt et al., 2021) In addition, Finland has been keen to move forward with the digitalization in policy documents, implement digital strategies, make investments to support the development of new teaching approaches and support the development of digital competence in both teachers and students (European Education and Culture Executive Agency, Eurydice, 2019; Lavonen & Salmela-Aro, 2022).

2.2.3 Teachers' Use of ICT in Home Economics

There are currently no published research studies on how Finnish HE teachers incorporate ICT into their teaching practices in lower secondary education. However, at least five international studies have been carried out in Nigeria, Philippines, Estonia, Hong Kong, which can be related to HE teachers' use of ICT (Ejinkeonye & Usoro, 2016, Lau & Albion, 2010; Limon, 2015; Ho & Albion, 2010; Veeber et al., 2017). Hence, the findings in the studies by Ejinkeonye and Usoro (2016) and Lau and Albion (2010) are mainly reported based on descriptive data. The study by Ho and Albion (2010) does not mention the type of analysis carried out, while the study by Limon (2015) uses a comparative analysis of different publications and documents, and Veeber et al. (2017) is based on teachers' views on the possibilities of using ICT in HHE classes.

Lau and Albion, (2010) examined Hong Kong HE teachers' use of ICT using a mixed methodology, combining questionnaires with interviews. Based on mainly descriptive statistics, ICT use was most reported for HE teachers' lesson planning and lecturing. ICT was less used for students' learning activities and communication purposes. This is in line with the studies by Ho and Albion (2010), Limon (2015), and Veeber et al. (2017) where ICT was mainly used as a tool to support teacher-centred practices, such as lecturing, demonstrations and illustrations of lessons. This finding reflects HHE teachers' desire to use ICT to facilitate their own work, although well-structured presentations with visual aids can indirectly support students' learning through better clarity (Fransson et al., 2018). Teachers also saw potential in using ICT to endorse more student-centred learning and therefore found using ICT as a tool for students to present their work, create content, carry out their task and communicate with their teachers. These

student-focused ICT practices were thus mentioned by significantly fewer teachers. (Veeber et al., 2017) Also in the study by Ho and Albion (2010), ICT was used significantly less for students learning activities and for communicative purposes.

In conclusion, teachers can implement ICT to perform tasks to support teaching and learning in different ways. Distinguishing the different dimensions of ICT use is further beneficial when trying to understand the conditions related to HE teachers' ICT integration inside the classroom in this thesis. In the next sub-chapter, the conditions that potentially hinder or promote teachers' use of ICT will be discussed.

2.3 Conditions Related to Teachers' Use of ICT

Teachers' implementation of ICT into teaching and learning has been found to depend on several different factors. As the aim of this study is to investigate HE teachers' use of ICT and deepen the understanding of the conditions related to their ICT use, I will next discuss the conditions at both teacher- and school/contextual level that have been found to either influence or be related to teachers' use of ICT.

The literature and research on teachers' ICT use is quite extensive. Considerable research has been conducted to understand the conditions or factors that influence teachers' use of ICT, using both quantitative (Gómez-Fernández & Mediavilla, 2022; Hatlevik, 2017; Inan & Lowther, 2010a; Liu et al., 2017; Ritzhaupt et al., 2012) and qualitative research approaches (Lindberg et al., 2017; Razak et al., 2018; Tondeur et al., 2012). While quantitative research tends to use statistical modelling approaches to discover relationships between variables related to teachers' ICT use, qualitative research commonly aims to gain a deeper understanding of the conditions that frame teachers' ICT use.

Some of the most popular models for uncovering the various factors that influence teachers' ICT use in quantitatively oriented studies are Theory of Reasoned Action (Fishbein & Ajzen, 1975), Theory of Planned Behaviour (Ajzen, 1991), Technology Acceptance Model (Davis, 1986), and Integrative Model of Behaviour Prediction (Fishbein & Yzer, 2003). Although studies have confirmed (Scherer & Teo, 2019; Teo et al., 2018), that these conceptual models address important factors that influence teachers ICT use, they are often limited to a few factors. To uncover the complex nature of teachers' use, I will therefore be referring to both quantitative and qualitative-oriented studies, as suggested by several scholars (Gómez-Fernández & Mediavilla, 2022; Hatlevik & Hatlevik, 2018; Tondeur et al., 2008). There are also studies in home economics that aim to identify barriers and facilitating factors that influence HE teachers ICT use, thus in Hong Kong (Ho & Albion, 2010; Lau & Albion, 2010), Philippines (Limon, 2015), Nigeria (Ejinkeonye & Usoroh, 2016) and Malaysia (Phua et al., 2012). However, due to major differences in context and use of mainly descriptive data, the findings of these studies are not in core focus here.

Furthermore, I will use the terms “factors” and “conditions” interchangeably as they are used as terms in both quantitative and qualitative research. Technical terms such as “influence”, “effect” and “predict” are also utilized as they are commonly used in quantitative oriented studies. For ease of reading, I have organised the content and the main headings according to teacher-level conditions and school- and contextual level conditions.

There have been several attempts to simplify the understanding of the conditions that influence teachers’ ICT use (Ertmer, 1999; Gerick et al., 2017; Gil-Flores et al., 2017; Gómez-Fernández & Mediavilla, 2022; Inan & Lowther, 2010a; Tawfik et al., 2021). However, I have chosen to discuss teachers’ ICT use in line with Liu et al (2017) who distinguish between teacher-level factors, school-level factors, and contextual factors.

When it comes to the object of the study, ICT use and ICT integration are used interchangeably to refer to teachers’ use of ICT in teaching both in a teacher-centred way to support teaching (e.g., delivery of content) and student-centred way to facilitate student learning (e.g., active use, problem solving).

2.3.1 Conditions on Teacher Level

Teachers play a key role in implementing ICT in teaching and learning. I will therefore initially focus on teacher-level factors and conditions, including: 1) perceived usefulness, 2) perceived ease of use, 3) self-efficacy, 4) educational beliefs, 5) teachers’ digital competence; 6) Feeling of lack of time and control; and 7) teacher and demographic characteristics.

Most of the conditions at the teacher-level are related to teachers’ beliefs. Research has shown that teachers’ ICT use is highly dependent on teachers’ beliefs (Gil-Flores et al., 2017; Inan & Lowther, 2010a; Petko, 2012; Petko et al., 2018; Teo, 2019), but also attitudes (van Braak et al., 2004). Beliefs and attitudes are key concepts in the most well-known theoretical models explaining human behaviour, including Theory of Reasoned Action, Theory of Planned Behavior, Technology Acceptance Model, and Integrative Model of Behavior Prediction (Ajzen & Fishbein, 1980; Davis et al., 1989; Fishbein & Ajzen, 1975; Fishbein & Yzer, 2003). Beliefs are even considered more powerful in influencing behaviour than knowledge (Ajzen et al., 2011), and as a result, scholars have begun to emphasise the importance of teachers’ educational beliefs as a crucial predictor for teachers’ ICT integration (Ertmer & Ottenbreit-Leftwich, 2010; Hermans et al., 2008; Kim et al., 2013; Richardson, 1996).

Beliefs are generally seen as a messy construct that is difficult to define, observe, and measure (Pajares, 1992; Richardson, 2003; Rokeach, 1986). Richardson (2003, p. 2) defines beliefs “as psychologically held understandings, premises, or propositions about the world that are felt to be true”. Rokeach (1986), on the other hand, defines beliefs as "any simple proposition, conscious or unconscious, inferred from what a person says or does, capable of being preceded by the phrase, 'I believe that . . . ' " (p. 113).

Rokeach (1986) further distinguishes between different types of beliefs and states that not all beliefs held by an individual are equally important or influence behaviour equally. Rokeach also concludes that the more central a belief is, the more resistant it is to change. Attitudes, on the other hand, are defined as "a relatively enduring organisation of beliefs around an object or situation predisposing one to respond in some preferential manner" (Rokeach, 1986, p. 112)". Beliefs can be part of an attitude, but not all beliefs necessarily belong to an attitude. In this thesis, the focus is mainly on beliefs rather than attitudes.

Given the diversity and quantity of teachers' beliefs, it has been important for scholars to narrow down the number of beliefs to the most central ones in understanding teachers' ICT use. For that reason, I have chosen to present and discuss beliefs that I have divided into four different categories: value beliefs, beliefs about technology, beliefs about the self, and educational beliefs. Value beliefs refer to beliefs about the role or value that ICT would have for students or teachers (Anderson & Maninger, 2007; Ottenbreit-Leftwich et al., 2010). Teachers' educational beliefs refer to beliefs that teachers have about teaching, learning and pedagogy, the nature of knowledge, the students, the subject matter, ethical, moral and social uses, and other beliefs about the students, as well as about themselves (Levin, 2015; Pajares, 1992). Educational beliefs often refer to fundamental beliefs such as conceptions of teaching and teachers' epistemological beliefs. Scholars also emphasise the importance of more domain-specific educational beliefs, such domain-specific epistemic beliefs (Urhahne & Kremer, 2023) and domain-specific curricular beliefs (Van Driel et al., 2007), the latter referring to beliefs about the importance of focusing on specific topics or curricular goals.

In this thesis, perceived usefulness (Scherer et al., 2015; Teo, 2019) is composed of two scales, one of which focuses of teachers' beliefs about the usefulness of using ICT in teaching and learning in general, and the other on more curricular beliefs about the usefulness of using ICT to achieve learning objectives in HE. Therefore, perceived usefulness in this thesis can be seen as both a value belief and a domain-specific curricular belief. Perceived ease of use is discussed as a technology belief (Teo, 2019). ICT self-efficacy is interpreted as a belief about self (Voet & De Wever, 2019), and refers to judgement of one's own ability to use ICT (Hatlevik, 2017; Kaarakainen & Saikkonen, 2021). Hence, these beliefs are only a fraction of all the beliefs that a teacher holds.

Perceived Usefulness

Empirical studies on teachers' ICT use provide evidence that perceived usefulness and equivalent terms used (e.g. utility value, teachers' beliefs) is a value belief and an important contributor to teachers' intentional and actual ICT use, either directly or indirectly (Backfisch, Scherer, et al., 2021; Dogan et al., 2021; Ibieta et al., 2017; Inan & Lowther, 2010a; Petko, 2012; Pynoo et al., 2011; Scherer et al., 2015; Teo, 2019). In terms of direct effects, this implies that the more value teachers perceive ICT to provide, the more likely they are

to integrate ICT into teaching and learning. When examining different types of ICT use, Ibieta et al. (2017) assume that these beliefs influence all forms of ICT use, both supportive ICT use before class, as well as ICT integration in class. The relationship between perceived usefulness and teachers' ICT integration is also confirmed by Backfish et al. (2021ab) and Inan and Lowther (2010). Atman Uslu and Koçak Usluel (2019), on the other hand, report that perceived usefulness directly affects ICT use pre-class, while having an indirect effect on teachers' ICT integration through pre-class ICT use.

Perceived usefulness has also been shown to have theoretical importance and is one of the two core constructs of the Technology Acceptance Model that predict the behavioural intention to use technology. Technology Acceptance Model, originally proposed by Davis (1986) assumes a mechanism whereby two primary constructs (i.e., perceived usefulness, perceived ease of use) influence an individual's attitude towards using technology, which in turn determines the individual's intention to use and the actual use of the technology. The Technology Acceptance Model has also been applied in HE research, where it was found that perceived usefulness correlated strongly with HE teachers' behavioural intention to use computer technology (Phua et al., 2012). In the study by Ejinkeonye and Usoro (2016), awareness of the benefits of ICT was something that could enhance HE teachers ICT use.

Perceived usefulness is thus measured and defined somewhat differently in different studies. In the Technology Acceptance Model, perceived usefulness is defined as "the degree to which an individual believes that using a particular system would enhance his or her job performance" (Davis, 1986, p. 26). To date, studies are still defining perceived usefulness closely aligned with this original definition and only emphasise the importance of ICT for teachers' performance (Dogan et al., 2021; Teo, 2019). Nevertheless, there are also studies (Ibieta et al., 2017; Inan & Lowther, 2010; Scherer et al., 2015) that have chosen to focus on the benefits of ICT for students, therefore emphasising the extent to which teacher believe that ICT has a positive influence on student learning.

Perceived usefulness has also an important mediating role, (Davis et al., 1989), and mediates the effects of perceived ease of use (Teo, 2009; Teo et al., 2018), perceived skills and computer proficiency[10] (Dogan et al., 2021; Inan & Lowther, 2010a), self-efficacy (Backfisch et al., 2021b; Teo, 2009), support (Teo, 2009) and computer availability (Inan & Lowther, 2010a) on teachers' ICT use. The important role of teachers' perceived usefulness of ICT has also been discussed in other types of studies. For example, Backfisch et al.2021a) show in a mixed-methods study that in-service teachers perceived usefulness

[10] Computer proficiency refers to "teachers' perception of their own computer ability level" (Inan & Lowther, 2010, p. 141)

of ICT was one of the most critical factors influencing the quality[11] of their ICT integration. This relationship was found to be reciprocal in nature. Teachers with higher perceived value integrated ICT more qualitatively. Conversely, positive experiences of ICT integration were related to higher perceived value of ICT use. The important role of teachers' perceived usefulness of ICT has also been reported in other qualitative studies (Abel et al., 2022; Hennessy et al., 2005; Tallvid, 2016). In an interview-based study, Hennessy et al. (2005) examined secondary teachers' use of ICT in the subjects of English, Mathematics, and Science. It was found that although teachers felt that the importance of using ICT underpinned their willingness to use ICT, there were several concerns about the added value of ICT. Resistance to using ICT in subject teaching and learning was related to their concerns about how ICT can facilitate student learning in the subject. On the other hand, a meta-ethnographic study (Abel et al., 2022), showed that teachers' perceptions of using technology (term similar to perceived usefulness) in class were shaped by various contextual factors, such as pro-technology zeitgeist[12], national policies, teacher training, and the pedagogical culture of the school. A qualitative exploratory study by Montrieux et al. (2015) showed that teachers' perceptions and beliefs about the role of using tablets in the classroom influenced their teaching practices and styles.

On the contrary, there are studies that do not support the positive relationship between perceived usefulness and teachers' ICT use. A study (Kwon et al., 2019) examining teachers' integration of mobile computing devices in middle schools in the United states, found that teachers' beliefs on the usefulness of mobile devices did not significantly influence their use of mobile devices. Due to the small sample size (n = 57) the findings should be interpreted with caution.

Perceived Ease of Use

Perceived ease of use is interpreted in this thesis as a technology belief-construct that has been shown to impact teachers' ICT use. Although both perceived usefulness and perceived ease of use are key constructs in the Technology Acceptance Model, the predictive power for perceived ease of use has been found to be much less than perceived usefulness (Teo, 2009). Studies have shown that perceived ease of use primarily has an indirect influence on ICT use through perceived usefulness and attitudes (Pynoo et al., 2011; Teo, 2009, 2019), as well as self-efficacy (Kwon et al., 2019). Perceived ease of use is defined by Davis (1986, p. 26) as "the degree to which an individual believes that using a particular system would be free of physical and mental effort". In a study by Phua et al. (2012), perceived ease of use was found to be strongly correlated with HE teachers' behavioural intention to use computers. A

[11] Quality of technology integration refers to how effectively technology is integrated into classroom practice in a way that enhances students learning through cognitive activation, individual support, and classroom management (Backfisch, Lachner, et al., 2021).

[12] Pro technology zeitgeist refers to "Innate positivism that has become an all-pervasive aspect of discourse around education technology use on a global scale" (Abel et al., 2022, p.8).

qualitative study by Tallvid (2016) also reported that teachers did not find it worthwhile to use laptops in classroom, which in turn was identified as a reason for their reluctance in using them.

Self-Efficacy

Next, we have the teacher-level factor of self-efficacy belief, which is interpreted as a belief about the self (Voet & De Wever, 2019) and has been shown in several studies to be a crucial determinant of teachers' ICT use (Backfisch, Scherer, et al., 2021; Drossel et al., 2017; Ertmer & Ottenbreit-Leftwich, 2010; Gerick et al., 2017; Gil-Flores et al., 2017; Hatlevik, 2017; Ibieta et al., 2017; Kaarakainen & Saikkonen, 2021; Kwon et al., 2019; Scherer et al., 2015; Teo, 2009). Self-efficacy has shown to have an effect on all types of ICT use, both for supportive use before class, as well as for ICT integration within class (Ibieta et al., 2017; Liu et al., 2017).

Self-efficacy also has theoretical importance and is one of the key constructs in the Integrative Model of Behaviour Prediction, which assumes that an individual's behaviour is determined by intention, attitude, perceived norm, and self-efficacy. These constructs are further grounded in underlying beliefs. (Fishbein & Yzer, 2003) For example, attitudes are seen as a function of one's behavioural beliefs and evaluation of desirability of the behavioural outcomes. Perceived norms are influenced by normative beliefs (beliefs about the extent to which other important people think they should perform) and motivation to comply. Self-efficacy, on the other hand, derives from efficacy beliefs (Fishbein & Yzer, 2003). By adding self-efficacy beliefs, skills, and environmental constraints, with the latter two directly affecting behaviour, they constitute the extensions made to Theory of Reasoned Action. Like perceived norm and attitude, self-efficacy indirectly affects a person's behaviour through the mediating variable of intention.

When discussing self-efficacy, reference is often made to Bandura's definition of self-efficacy (Hatlevik, 2017; Teo, 2019), which is quite natural given that self-efficacy is an important concept in Bandura's social cognitive theory. According to Bandura (1986, p. 391) self-efficacy refers to a "a judgement of one's capability to accomplish a certain level of performance. It is concerned not with the skills one has but with whatever skills one possesses." People tend to avoid performing tasks for which they believe they lack the capabilities. Hence, self-efficacy is defined and measured slightly differently in different studies. Most commonly, teachers' ICT self-efficacy is referred to their beliefs about their ability and confidence to perform tasks with technology (Dogan et al., 2021; Gerick et al., 2017; Inan & Lowther, 2010a; Liu et al., 2017; Scherer et al., 2015; Teo, 2019). Backfish et al. (2021b), Hatlevik (2017) and Hatlevik and Hatlevik (2018) use slightly different measures of teachers' self-efficacy. Backfish et al (2021b) measured teachers' self-efficacy in relation to the different knowledge for technology integration in the TPACK framework (Mishra & Koehler, 2006). Self-efficacy was therefore assessed differently for technological pedagogical content knowledge (TPCK), technological content knowledge (TCK), technological

pedagogical knowledge (TPK), and technological knowledge (TK, e.g., I can learn technology easily). Hatlevik (2017) on the other distinguished between teachers' self-efficacy to use ICT by themselves and self-efficacy in relation to using ICT for teaching purposes related to online collaboration. Liu et al. (2017) use a slightly different term, 'teacher confidence and comfort using technology', which is a term very similar to self-efficacy (Bandura, 2006).

There also seems to be some contradictory assumptions about the explanatory mechanism of the relation between self-efficacy, ICT use and different mediating variables. Backfish et al. (2021b) compared two mechanisms for self-efficacy and perceived usefulness. It was found that teachers' self-efficacy can both have a direct and indirect effect via perceived usefulness on teachers' frequency of ICT use. In addition to perceived usefulness (Teo, 2009), variables such as perceived ease of use (Teo, 2009, 2019), digital competence (Hatlevik, 2017) teachers' beliefs and readiness (Inan & Lowther, 2010) have also found to mediate the indirect effect of self-efficacy on teachers' ICT use.

Moreover, the importance of self-efficacy for teachers' use of ICT seems to vary by country and education systems (Gerick et al., 2017), as well as by contextual factors. Based on the studies discussed here, self-efficacy is positively predicted by support and computer availability (Inan & lowther, 2010; Liu et al., 2017), collegial collaboration (Hatlevik & Hatlevik, 2018), level of teacher education (Liu et al., 2017), ease of use, challenges, technical skills (Kwon et al., 2019), but negatively by age and years of teaching (Inan & Lowther, 2010; Liu et al., 2017).

That teachers' use of ICT is related to their self-efficacy beliefs is also reported in qualitative studies. Hennessy et al. (2005) found that lack of confidence in using ICT was seen as an barrier to ICT integration, particularly in English and science.

Educational Beliefs

Kim et al. (2013) further emphasise the importance of considering other underlying educational beliefs that are not directly related to technology when trying to understand teachers' use of ICT. These include, for example, teachers' conceptions of teaching and epistemological beliefs. The role of teachers' beliefs about effective ways of teaching (conceptions of teaching) on teachers' use of ICT has been explored and emphasised, for example by Hermans et al. (2008), Tondeur et al. (2008), Montrieux et al. (2015) and Gil-Flores et al. (2017), which show a consistent relationship. Conceptions of teaching are often divided into constructivist and traditional beliefs. While constructivist beliefs emphasise student-centred approaches to teaching and learning, traditional beliefs focus more on traditional teacher-centred approaches. Constructivist beliefs were found to have a positive impact on the frequency of teachers' use of ICT in the classroom. Traditional beliefs, on the other hand, have been found to have a negative impact on teachers' use of ICT in the classroom. (Hermans et al., 2008; Tondeur et al., 2008) This relationship is therefore quite complex and is further considered to be

undirect. Tondeur et al. (2008) examined the link between educational beliefs and different types of ICT use and found four different profiles. Surprisingly, teachers belonging to the profile with high constructivist beliefs and traditionalist beliefs, where the ones that integrated ICT the most.

In terms of epistemological beliefs, several theories have been offered to identify the primary components of these beliefs (Hofer & Pintrich, 1997; Schommer & Walker, 1995). Most commonly, epistemological beliefs are referred to as "individuals' beliefs about the nature of knowledge and the processes of knowing" (Hofer & Pintrich, 1997, p. 117). To better understand the structure of beliefs about the nature of knowledge and learning, Schommer (1990) employed factor analysis to assess the epistemological beliefs and identified four independent dimensions: innate ability (i.e., ability to learn is innate); simple knowledge (i.e., knowledge is discrete and unambiguous; quick learning (i.e., learning is quick or not at all); and certain knowledge (i.e., knowledge is certain). Anderson (2015) proposes three dimensions of teachers' beliefs: beliefs about the goals and purposes of teaching, beliefs about the nature of the subject and belief about teaching and learning in the subject. All of these beliefs, but particularly beliefs about the purposes of teaching the subject, were found to influence science teachers' teaching practices.

There has also been some discussion about whether teachers' epistemological beliefs are domain specific. While Schommer and Walker (1995) assume that these beliefs are domain independent, studies by Topcu (2012) Urhahne and Kremer (2023), for example, found that they can also differ across domains and subjects. Van Driel et al. (2007) further highlights the importance of domain-specific curricular beliefs, referring to teachers' beliefs about the importance of emphasising particular topics or curricular objectives.

In relation to ICT integration, an exploratory mixed-methods study by Kim et al. (2013) found that both teachers' conceptions of teaching and epistemological beliefs were related to teachers' ICT integration practices. For example, teachers who believed that the source of knowledge was authority (e.g., accepting the answer from an authority figure) tended to have more teacher-centred ICT integration practices. In the study by Hennessy et al. (2005), it was discussed that the way teachers integrate ICT into their teaching also depends on their views about the nature and goals of the subject.

Understanding the beliefs that guide teachers' ICT integration practices is very important in facilitating change in ICT integration practices (Ertmer & Ottenbreit-Leftwich, 2010; Guskey, 2002; Levin, 2015). However, it is assumed that teachers' beliefs are very difficult to change, because, according to Richardson (1996), they are derived from previous personal experiences, experiences with schooling and instruction, and experiences with formal knowledge. Personal experience refers to those experiences in life that shape, for example, beliefs about the world, about oneself and about others.

Experiences with schooling and instruction include experiences from one's own school-time as a student, which in turn form beliefs about the nature of teaching. Finally, experience of formal knowledge includes knowledge of the school subject as well as pedagogical knowledge. This type of experience is thought to contribute to beliefs about the nature of the subject.

Teachers' Digital Skills

In addition to attitudes and beliefs, teachers' digital skills are also a well-documented teacher-level predictor of teachers' ICT use (Atman Uslu & Usluel, 2019; Dogan et al., 2021; Hatlevik, 2017; Inan & Lowther, 2010; Kaarakainen & Saikkonen, 2021; Suárez-Rodríguez et al., 2018). Digital skills have been shown to moderately or strongly influence teachers' use of ICT (Dogan et al., 2021; Hatlevik, 2017; Petko, 2012), implying that teachers who feel more competent in using ICT, will also use ICT more often. Although the context is very different, digital skill adequacy has also been identified as a factor influencing HE teachers' ICT integration in Nigeria, Hong Kong and Philippines (Ejinkeonye & Usoroh, 2016; Ho & Albion, 2010; Lau & Albion, 2010; Limon, 2015).

Digital skills or digital competence have thus been conceptualised and measured in different ways across studies, and there has been extensive discussion over the years about what teachers' digital competence should include (Angeli & Valanides, 2009; Johannesen, 2014; Hsu, 2010). In empirical studies on predicting teachers' ICT use, it seems to be common to include digital competence as a self-reported measure of how teachers perceive their competence in using ICT (Atman Uslu & Usluel, 2019; Dogan et al., 2021; Hatlevik, 2017; Inan & Lowther, 2010; Petko et al., 2018). Thus, there are also studies that use tests of teachers' digital competence (Hatlevik, 2017; Kaarakainen & Saikkonen, 2021). In terms of conceptualisation, some include both technological and pedagogical aspects of teachers' digital competence (Atman Uslu & Usluel, 2019; Dogan et al., 2021), while others inlcude only the technological aspects (Hatlevik, 2017; Inan & Lowther, 2010).

When comparing different studies and causal models, the interplay between digital competence, other variables and ICT use is found to be quite complex. The path models explained by Dogan et al (2021) and Inan and Lowther (2010) have justified that digital competence or computer proficiency[13] indirectly influence teachers' ICT use through beliefs, such as teachers' perceived usefulness of ICT. A study in HE also found that HE teachers with higher level of digital competence have more positive attitudes towards ICT use (Ho & Albion, 2010; Lau & Albion, 2010).

To add to the complexity, digital competence also acts as an important mediator, mediating the effects of self-efficacy (Dogan et al., 2021; Hatlevik, 2017), demographic characteristics (Inan & Lowther, 2010), and school readiness (Petko et al., 2018) on teachers' ICT use. In the study by Petko et al.

[13] Computer proficiency refers to "teachers' perception of their own computer ability level" (Inan & Lowther, 2010)

(2018) school readiness included contextual conditions such as educational resources, the values, and goals of ICT integration in school, support, and collaboration among teachers regarding educational technology. Furthermore, the study by Atman Uslu and Koçak Usluel (2019) found that teachers' digital competence affects teachers' ICT use both outside and inside the classroom.

Acquiring enough digital skills has also been found to be an important condition for teacher' ICT use in qualitative-oriented studies (Fransson et al., 2018; Hennessy et al., 2005; Lindberg et al., 2017; Tallvid, 2016; Wang et al., 2014). Wang et al. (2014) used focus group interviews to examine middle school science teachers' perceived barriers to ICT use in school. According to the findings, teachers' lack of technological skills and integration strategies were perceived as barriers that negatively affected their ICT integration. There was also a fear of appearing inexperienced in front of the students.

Lindberg et al. (2017) examined views of Swedish upper secondary school teachers and students on the use of ICT, using both individual and focus group interviews. The study found that teachers' lack of both technological and pedagogical skills challenged their pedagogical and meaningful integration of ICT. Similar findings were found in the ethnographic study by Tallvik (2016), who examined teachers' reluctance towards using ICT in their teaching practices through interviews and observations. In fact, teachers' sense of a lack of technological competence was related to their reluctance to integrate laptops in the classroom. Fransson et al. (2018), on the other hand, takes a student perspective and focus on students' views on their teachers' ICT use. Students mentioned teachers' insufficient ICT skills as something that both reduces important teaching time, irritates them, and affects their confidence in their teachers. This does not show how this related to teachers' frequency of ICT integration, but rather how it can affect the quality of teaching.

Feelings of Lack of Time and Control

It is difficult to determine whether time and control are contextual or teacher-level conditions. Feelings of lack of time and control can be related to several different things. Firstly, time can be related to the time spent planning, searching for relevant learning material, and revising. Drossel et al. (2017) found that lack of time to prepare lessons negatively influenced teachers' use of ICT, but only in the two countries with low frequency of ICT use. Also, among HE teachers, having enough time to practice ICT, is positively related to their ICT use (Ejinkeonye & Comfort, 2016), while lack of such time hinders their use (Ho & Albion, 2010; Limon, 2015). However, these studies are mainly based on descriptive data or correlational analysis.

Feelings of lack of time have also been mentioned, both in relation to the limited time allocated to specific subjects (Lindberg et al., 2017), but also in relation to teachers' beliefs and priorities. In a study by Stein et al. (2020) on ICT integration among novice mathematics, it was found that teachers' sense of lack of time was related to opinions about the importance of covering all subject content rather than of teaching with ICT, which takes more time. This

is in line with the findings of the study by Wang et al. (2016), who found that middle school science teachers' feeling of lack of time, was not only related to lessons preparation, but also to all the time spent and wasted on solving technical problems. Furthermore, Tallvid (2016) discusses that lack of time does not necessarily have to be a time issue, but a matter of teachers' priorities and feelings of heavy workload.

The feeling of lacking or diminishing control over students' learning and behaviour also challenges teachers' ICT use (Stein et al., 2020; Tallvid, 2016). The presence of ICT makes teachers feel that they do not have full control over students' behaviour and learning. For example, some students have the tendency of playing games and chatting during class time (Tallvid, 2016).

Teacher and Demographic Characteristics

Studies have also focused on variables related to teacher and demographic characteristics to explain teachers' use of ICT. These are, for example, teaching experience, teacher experience with technology (Ritzhaupt et al., 2012), gender (Liu et al., 2017), age (Inan & Lowther, 2010a) and educational level (Ritzhaupt et al., 2012). Research suggests that teachers' ICT use is negatively influenced by teachers' teaching experience (Ibieta et al., 2017; Inan & Lowther, 2010; Liu et al., 2017; Ritzhaupt et al., 2012), but positively influenced by teachers' years of experiences with technology (Drossel et al., 2017; Hermans et al., 2008; Liu et al., 2017; Ritzhaupt et al., 2012). However, this effect is often indirect affecting ICT through other variables such as teachers' confidence and comfort using technology (Liu et al., 2017), computer proficiency and teacher readiness[14] (Inan & Lowther, 2010).

There are also some mixed results in terms of the variables of gender and age. Gender has been found to be a significant predictor in some studies, while some indicate that males are more likely to use ICT (Hermans et al., 2008), others report that females are more likely to use ICT (Liu et al., 2017). In the study by Liu et al. (2017) gender influences ICT use through teachers' confidence and comfort using technology. Age, on the other hand, is found to influence teachers' ICT use both directly (Drossel et al., 2017; Kaarakainen & Saikkonen, 2021) and indirectly (Inan & Lowther, 2010) through computer proficiency. However, gender and age may not be the most influential on ICT use, especially considering that they remain insignificant when controlling for other variables, such as beliefs and attitudes (Gil-Flores et al., 2017; Hermans et al., 2008; van Braak et al., 2004).

When analysing how these factors influence different types of ICT use, studies have yielded mixed results. Teachers' years of computer experiences has been found to influence teachers' class use of ICT in the study by Liu et al., 2017, but not in the study by van Braak et al. (2004) or Ibieta et al. (2017), where the factor was only a significant predictor for teachers' supportive ICT use. Teaching experience, on the other hand, was found to negatively

[14] Teacher readiness refers to "teachers' perception of their capabilities and skills required to integrate technology into their classroom instruction" (Inan & Lowther, 2010).

influence all types of ICT use (Ibieta et al., 2017; Liu et al., 2017). Gender is a factor associated with teachers' ICT integration in class (van Braak et al., 2004), but not necessarily associated with teachers' supportive ICT use (Liu et al., 2017; van Braak et al., 2004).

It is important to note that the teacher-level factors discussed here, do not include all teacher-level factors, thus providing an overview of the most documented factors on teacher-level factors related to teachers' ICT use. Other teacher-level conditions, that have been shown to be associated with teachers' ICT use in qualitative-oriented studies include, interest and enjoyment (Phua et al., 2012; Stein et al., 2020), feelings of lack of control (Stein et al., 2020; Tallvid, 2016), and purpose of use (Hennessy et al., 2005).

2.3.2 Conditions on School- and Contextual Levels

Teachers' ICT integration also depends on a list of conditions at school- and context level, categorized here in terms of 1) ICT infrastructure; 2) support and professional development; 3) curriculum, policies, and regulations; 4) student skills and ICT behaviour; 5) other contextual and cultural conditions.

ICT Infrastructure

A number of quantitative studies have found that ICT infrastructure, including the availability of ICT resources and internet access (Atman Uslu & Usluel, 2019; Drossel et al., 2017; Petko et al., 2018), software availability (Gil-Flores et al., 2017), and computer availability (Inan & Lowther, 2010a; Liu et al., 2017; Petko, 2012), positively influence teachers' ICT use, either directly, indirectly, or both. Several of these, including inadequate ICT infrastructure (e.g., network connectivity, teaching materials and tools) (Lindberg et al., 2017; Tallvid, 2016), have also been highlighted in qualitatively oriented studies as a barriers to teachers' ICT use. Lack of appropriate software and inadequate ICT infrastructure (Ejinkeonye & Usoroh, 2016; Ho & Albion, 2010; Lau & Albion, 2010; Limon, 2015) have also been identified as challenges to HE teachers ICT use in Nigeria, Hong Kong and the Philippines. On the contrary, their ICT integration is enhanced by adequate ICT infrastructure (Ejinkeonye & Usoroh, 2016).

Thus, having appropriate ICT infrastructure is far from being the decisive factor. The importance of ICT infrastructure for teachers' ICT integration has varied across studies. For example, Ritzhaupt et al. (2012), who collected data from 732 K-12 teachers to test a research-based path model, found that access to technology had a significant effect on teachers' technology use, but not on technology integration in the classroom. Drossel et al. (2017), who examined the role of school-level and teacher-level factors on teachers' ICT use in five countries, found that availability of ICT equipment had only a minor influence on teachers' ICT use in three of the five countries. This is similar to the findings of Inan and Lowther (2010) and Petko (2012), who also reported a small effect for computer availability. On the other hand, Gil-Flores et al. (2017), who examined the role of teacher characteristics and school infrastructure on teachers' ICT use using a multilevel logistic regression,

found that availability of educational software had a moderate influence on teachers' ICT use. This underlines the importance of providing teachers with appropriate educational software that can be used for teaching and student learning. Insufficient teaching materials were also identified as a reason for teachers' unwillingness to use laptops in the classroom in a qualitative study by Tallvid (2016). This was found to be related to difficulties in finding high quality materials online, as well as a fear of missing out of important parts of the curriculum. Teachers preferred to use educational materials that were prepared by a colleague rather than material that could be found online.

Internet connectivity was thus found to be of very little importance, and was found to have either no significant impact on teachers' use of ICT (Gil-Flores et al., 2017) or only a small impact (Drossel et al., 2017).

When it comes to the indirect effects of ICT infrastructure on teachers' ICT use, variables such as beliefs, and digital skills have emerged as important mediating variables. Inan and Lowther (2010) found that computer availability influenced teachers' ICT use through constructs such as computer proficiency, teacher beliefs and teacher readiness. The survey-based study by Liu et al. (2017) showed that technology availability, indirectly influenced teachers' ICT integration through teachers' confidence and comfort using technology.

Support and Professional Development

Several forms of support, including technical, administrative, and pedagogical support, as well as support from colleagues and others, have been found in quantitative studies to positively influence teachers' ICT integration or intention to use ICT, either directly or indirectly. (Atman Uslu & Usluel, 2019; Dogan et al., 2021; Gerick et al., 2017; Inan & Lowther, 2010a; Liu et al., 2017; Teo, 2019). On the contrary, qualitative studies (Stein et al., 2020; Wang et al., 2014) identified lack of technical, administrative and pedagogical support as barriers to teachers' use of ICT.

Thus, not all types of support seem to be equally important. Technical support has been found to have a relatively minor influence on teachers' ICT use (Inan & Lowther, 2010a; Liu et al., 2017). Some studies have found technical support to be either a non-significant factor or to have a negative influence on teachers' ICT use (Drossel et al., 2017; Gerick et al., 2017; Ritzhaupt et al., 2012). Dogan et al. (2021) found that technical support influenced teachers' use of instructional software, but not application software use. The relationship between support and ICT use is also not supported by Hatlevik and Hatlevik (2018), who found no significant relationship between lack of facilitation and ICT use. Lack of facilitation refers to lack of planning time, technical support, and provision. Thus, technical and maintenance support has been found to be a challenge to the use of ICT by HE teachers' ICT in Nigeria (Ejinkeonye & Comfort, 2016).

Pedagogical support and support from others still seem to be more important than technical support (Gerick et al., 2017; Inan & Lowther, 2010a). For example, Inan and Lowther (2010), who built a path model to examine

the interplay between teacher and school-level factors and their impact on teachers' ICT use, found that overall support has a moderate total influence on teachers' ICT use and is due to the indirect effects given great importance. In the study, overall support refers to administrative support and support from colleagues, parents, and school. Support from colleagues in the form of teacher collaboration is also important for teachers to develop their own ICT use and lessons (Drossel et al., 2017; Gil-Flores et al., 2017). The need for pedagogical support has also been identified among HE teachers in the Philippines (Limon, 2015) and Hong Kong (Ho & Albion, 2010).

Finally, studies have shown that teachers who participate in professional development use and integrate ICT in the classroom more often (Gerick et al., 2017; Gil-Flores et al., 2017; Ritzhaupt et al., 2012). The effect is small. A Nigerian study (Ejinkeonye & Comfort, 2016) also found that the availability of professional development increases HE teachers' ICT use. Lack of professional development opportunities, in turn, challenges HE teachers' ICT use (Ho & Albion, 2010; Limon, 2015).

Thus, according to a recent multi-level analysis, Kaarakainen and Saikkonen (2021) found that professional development had a statistically insignificant effect on Finnish primary school teachers' ICT use.

Similar to ICT infrastructure, teachers' beliefs and digital skills are important mediating variable of support on teachers' ICT use. Technical and overall support indirectly influence teachers' use of ICT through the mediating variables of computer proficiency, teachers' beliefs and readiness (Inan & Lowther, 2020), as well as teacher confidence and comfort using technology (Dogan et al., 2021; Liu et al., 2017). On the other hand, Petko et al. (2018) also found that school readiness influences teachers' ICT use both directly and indirectly through teachers' readiness. Unlike Inan and Lowther's (2010) definition of teacher readiness, teacher readiness refers to both teachers' perceived technology-related skills and their beliefs (Petko et al., 2018). In studies by Teo (2009; 2011), facilitating conditions indirectly influenced teachers' intention to use ICT through perceived ease of use and perceived usefulness, meaning that the higher the perceived adequacy of support, the higher the perceived usefulness and the more teachers' perceived that using ICT would be effortless. This in turn facilitates their intention to use ICT.

Curriculum, Policies and Regulations

The field of education, teachers' practices and not least teachers' ICT integration are also controlled and influenced by curriculum, policy, and regulations. However, the importance of school curriculum (Hennessy et al., 2005; Lindberg et al., 2017), school policies, lesson formats (Lindberg et al., 2017; Wang et al., 2014), and regulations (Razak et al., 2018) on teachers' ICT use has mainly emerged in qualitative-oriented studies. These are often reported as barriers to teachers' ICT use, including in HE (Limon, 2015). A school's ICT policy may restrict the use of a particular tool or learning material (Lindberg et al., 2017; Wang et al., 2014). However, having clear

rules and regulations that shape the ICT culture, is at the same time considered as a prerequisite for successful ICT integration (Razak et al., 2018). Another important condition for successful ICT integration is departmental responsibilities (Razak et al., 2018; Wang et al., 2014), which implies that it needs to be clarified who is responsible for what when it comes to ICT integration (e.g., budget solving, maintenance, teacher training, subject responsibilities).

The issue of curriculum is related to format of the lesson and the limited time allocated to the subject (Limon, 2015; Lindberg et al., 2017). Indirectly, the issue of an overloaded curriculum is also related to teachers' feelings of lack of time (Hennessy et al., 2005; Wang et al., 2014). Students' use of ICT requires extra time, which in turn reduces the time available for subject content. Curriculum requirements for the use of ICT in teaching also put pressure on teachers, which compromises their autonomy (Hennessy et al., 2005).

Student Skills and ICT Behaviour

There are also some challenges and concerns related to the students. One of the concerns is that, when using ICT, students are likely to be distracted from their task by playing games and being on social media. This is especially true for mobile devices (Chou et al., 2012; Håkansson Lindqvist, 2015; Lindberg et al., 2017).

Students' lack of digital skills has been identified as a barrier to teachers' ICT use. In a qualitative interview study by Midtlund et al. (2021) students' lack of digital competence was identified as a barrier for Norwegian secondary school teachers' use of ICT to foster students' collaboration and communication. Students' lack of digital competence has also been viewed as a barrier for successful use of wikis as a learning platform in HE (Lai and Lum, 2012). Another concern faced by teachers is security, privacy, and ethical issues. (Pegrum et al., 2013).

Other Contextual and Cultural Conditions

There are also several other contextual conditions worth mentioning, including grade level, number of students per class, subject taught, subject culture, and status of the subject. Teachers' ICT use (Liu et al., 2017) and integration (Ritzhaupt et al., 2012) were found to be negatively influenced by grade level. That is, the higher the grade level, the less teachers will use and integrate ICT in the classroom. The relationship between teachers' ICT integration and the number of students per class is also negative.

In addition, both quantitative (Kaarakainen & Saikkonen, 2021) and qualitative studies (Erixon, 2010; Hennessy et al., 2005) have found that the subject taught and culture can be related to the quality and quantity of teachers' ICT use. The study by Kaarakainen and Saikkonen (2021) showed that there were statistically significant differences between ICT use for different subject groups. For example, teachers of humanities and social sciences used ICT significantly more often than teachers of arts and skills (e.g.,

home economics and crafts). However, subject taught was not included in the multilevel analysis, meaning that subject taught did not emerge as a predictor of ICT use. Hennessy et al. (2005) found that English teachers' reluctance to use ICT was related to a desire to preserve the subject culture. Goodson and Mangan (1995, p. 615) define subject culture as ''the general set of institutionalized practices and expectations which has grown up around a particular school subject, and which shapes the definition of that subject as both a distinct area of study and as a social construct''.

Similar findings were reported by Erixon (2010) and Ho and Albion (2010). Erixon (2010) found that teachers of more "practical" subjects, such as home economics, were concerned about losing the practical nature of the subject if ICT was more integrated. There was also a concern that the subject would lose its popularity if practical matters were replaced by ICT. That ICT is used to varying degrees, but also differently in different subjects, is also confirmed by other studies (Howard et al., 2015). Especially when it comes to the subject of home economics, a study by Jenkins (2020) showed that the status of the subject or the feeling of not respecting HE as a school subject, has also been a hindering factor for implementing other types of curriculum change.

In conclusion, a considerable number of studies with different approaches have been published and several variables have been explored to enhance the understanding of the conditions related to teachers' use of ICT. In the following, I will present Bandura's triadic reciprocal causation model as a theoretical lens through which to view the findings of this thesis.

2.4 Bandura's Model of Triadic Reciprocal Determinism

This thesis contributes to a deeper understanding of HE teachers' ICT use through the lens of model of triadic reciprocal determinism of Bandura (1986). By adopting this model, I suggest that HE teachers' ICT use can be seen and understood as a complex interplay of behavioural, environmental, and personal conditions. In this sub-chapter, I describe the key tenets of Bandura's reciprocal determinism and demonstrate and exemplify how the model can be used to understand teachers' ICT use, drawing on both previous research and Albert Bandura's foundational work.

Reciprocal determinism is the central concept in social cognitive theory by Albert Bandura (1986), an extended version of the social learning theory developed in the 1960s (Bandura, 1978). Social cognitive theory and reciprocal determinism focus on different aspects of human behaviour, development and behavioural regulation and have been widely used in different fields of research, including marketing and consumption (Phipps et al., 2013), public health (Beauchamp et al., 2019), parenting (Merrifield et al., 2015) and education (Lu et al., 2022). Social cognitive theory and the triadic reciprocal causation model have also been used to examine teachers' ICT practices and ICT integration (Hatlevik, 2017; Perkmen et al., 2023; Rowston et al., 2021). However, few scholars have applied reciprocal determinism as

an analytical framework in mixed-methods studies to examine the interactions between the three triadic factors of behaviour, environment and personal factors to gain a deeper understanding of teachers' ICT use. Within the theory of reciprocal determinism, human behaviour and functioning are explained and understood as a part of a triadic system in which behavioural, personal and environmental determinants mutually influence and determine each other (Bandura, 1986, 1989b).

2.4.1 The Three Factors and Relationships of Reciprocal Determinism

The Three Triadic Determinants

The triadic reciprocal model highlights three main forces (personal, behavioural and environmental) that act as interacting determinants that influence each other in a bi-directional way (see Figure 1). Personal factors refer to cognitive, affective and personal elements, including gender, age, status, skills, expectations, beliefs, goals and intentions that influence and shape individuals' behaviour (Bandura, 1986, 1989b). Studies on teachers' use of ICT have identified a list of personal factors shown to be associated with or to influence teachers' use of ICT. These include different types of attitudes and beliefs (e.g. ICT self-efficacy, perceived usefulness, perceived ease of use), digital skills, feelings of lack of control and personal characteristics (e.g. age, gender, educational level) (Inan & Lowther, 2010; Liu et al., 2017; Ritzhaupt et al., 2012; Stein et al., 2020; Teo et al., 2018).

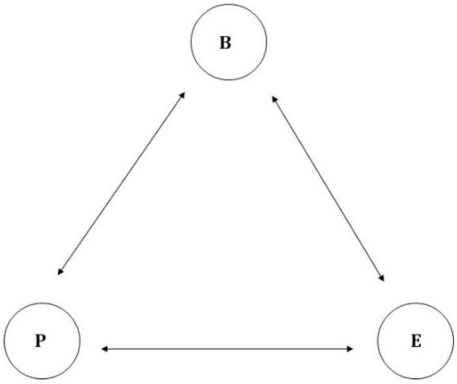
However, the environment can include both physical (e.g., buildings, infrastructure), institutional (rules, norms and regulations) and social (e.g. culture and social status) environments. The institutional environment can further vary depending on the school subject (Spillane & Burch, 2012). According to Bandura, the environment is seen as a non-fixed entity. Environmental structures and conditions are not automatically imposed on individuals; rather, they are activated and altered by specific behaviours (Bandura, 1989b).

Previous empirical studies have identified several environmental conditions found to either hinder or facilitate teachers' use of ICT. These include ICT infrastructure, availability and adequate support, professional development, lesson preparation time and school policies (Drossel et al., 2017; Gerick et al., 2017; Gil-flores et al., 2017; Inan & Lowther, 2010; Lindberg et al., 2017; Liu et al., 2017).

With regard to the behavioural aspect, Bandura (1986) pointed out that the individual is neither a passive recipient of external forces nor directly affected by personal factors. Human behaviour, cognition and other individual factors and environmental factors interact with each other in two directions, as explained in Figure 1.

Figure 1

Bandura's Model of Triadic Reciprocal Determinism



Note: Adapted from "Social foundations of thoughts and action" (p. 24) by A. Bandura, 1986, Prentice-Hall.

The Interplay Between Environmental, Personal and Behavioural Conditions

As mentioned earlier, the theory sheds light on three main relationships: between environmental and personal influences, environmental and behavioural influences and personal and behavioural influences. The first concerns the bi-directional causal relationship between environmental conditions and personal determinants. According to Bandura (1986), neither environmental conditions are simply imposed on individuals nor individuals act directly on environmental conditions; rather, environmental conditions have the potential to produce behaviours through an intermediate process that alters and develops personal characteristics, such as thought patterns, beliefs and goals. Individuals also tend to respond differently to different environmental influences based on their personal characteristics (Bandura, 1978, 1989b). The bi-directional relationship between environmental conditions and behavioural influences is two-fold. From an agency perspective, individuals have the capacity to self-regulate behaviour and select environments in which they act and pursue a goal. However, the environmental conditions within the chosen environment do not necessarily influence individuals' behaviour equally. The strength of the influence can vary according to individual performances, characteristics and context (Bandura, 1986). In this sense, individuals are both outcomes and creators of their environment (Bandura, 1989b). The interaction between environment and behaviour is briefly explained by Bandura (1978, p. 345) as follows: "'It is largely through their actions that people produce the environmental conditions that affect their behaviour in a reciprocal fashion". Bandura (1989) further pointed out that not all environmental conditions inevitably affect

human behaviour. Some environmental influences are unavoidable, while most environmental conditions influence human behaviour only when activated by specific circumstances. The person–behaviour inter-relationship, however, reflects the causal interactions between thoughts, values, feelings, expectations, self-perceptions, goals, intentions, and behaviours. What an individual thinks, believes, etc. influences how he or she behaves. The outcomes of actions can, in turn, influence and change an individual's thoughts, beliefs, emotions, etc. (Bandura, 1978, 1986, 1989b).

The interplay between behavioural, environmental, and personal influences can be partially confirmed in studies of teachers' ICT use. Various quantitative studies have found that several personal factors, such as digital competence, perceived usefulness and ICT self-efficacy, act as important mediators of external conditions on teachers' ICT use (Dogan et al., 2021; Inan & Lowther, 2010; Petko et al., 2018). Even qualitative studies have found that external environmental conditions perceived as barriers to ICT use are often associated with a particular feeling or belief. For example, Stein et al. (2020) identified a lack of time as a barrier to ICT use for novice mathematics teachers. When this barrier was mentioned, the importance of covering all content in teaching was also expressed.

To fully grasp the interaction between an individual, his/her behaviour and the environment, it is necessary to introduce the idea of personal agency, as most external influences on behaviour operate through cognitive processes. Bandura highlighted the importance of personal agency and personal self-regulatory mechanisms in his several publications (Bandura, 1986, 1989a, 2001).

2.4.2 Personal Agency

Personal agency is defined by Bandura (n.d.) as "human capability to influence one´s functioning and the course of events by one´s actions". According to the agency perspective, people have self-regulatory mechanisms through which they can regulate and exercise some control over their own thoughts, feelings, motivations and behaviour. Personal agency is also seen as the core of human activity; therefore, it is an important feature of humanity as well as that of the triadic reciprocal causation model (Bandura, 1991, 2001). Personal agency opposes the idea that the human mind is reactive and acts directly on beliefs, goals and expectations. Instead, it mentions, the human mind is both reflective and thoughtful. By exercising personal agency, individuals can set goals for themselves, compare the consequences of different actions and guide themselves to act in ways that produce desired outcomes (Bandura, 1991). Personal agency is exercised through different personal characteristics. Intentionality, forethought, self-regulatory capability and self-reflectiveness are the four core self-regulatory systems through which human agency operates within the triadic reciprocal model and which also mediate the external influences on behaviour (Bandura, 2001).

Intentionality and Forethought

Intentionality refers to an individuals' ability to intentional acts, carried out in a future perspective. It is not a matter of predicting future actions but rather of being committed to carrying out an action. Thus, an action intended to serve a particular purpose can produce both desirable and undesirable outcomes. A person can have good intentions for an action but still have negative consequences. However, regardless of the consequences, a person's intention is considered to influence the actions carried out (Bandura, 2001).

In terms of research on teachers' use of ICT, the technology acceptance model is one of the best-known conceptual models to include the construct of behavioural intention in using computers. Behavioural intention is further hypothesised to be determined by other factors and influence actual computer use (Davis et al., 1989; Turner et al., 2010). Hence, from a socio-cognitive perspective, individuals' intentions alone are not sufficient to explain or regulate behaviour (Bandura, 2001).

The capacity for forethought or outcome expectancy is another important feature of human agency. Through the exercise of forethought, individuals can foresee possible consequences of their future actions, set goals, adopt standards and develop a plan of action that is most likely to lead to desired outcomes that are consistent with the goals set (Bandura, 1986, 1989a, 2001). Thoughts about future desired outcomes and pre-set goals can further be transformed into present motivators that regulate and direct one's behaviour (Bandura, 1986, 1991). Individuals who are not clear about the goals or desired outcomes to be achieved are most likely to suffer from low motivation to act (Wood & Bandura, 1989). Forethought and outcome judgement are very similar to the construct of perceived usefulness (Davis, 1989). Teachers tend to use ICT to the extent they believe will be useful for their work and for students' learning (Inan & Lowther, 2010a; Teo, 2019). Thus, the influence of outcome expectations is partly dependent on self-efficacy beliefs or judgements about one's own ability to perform (Bandura, 1989a), which is probably why even the perceived usefulness of ICT has been found to mediate the effect of ICT self-efficacy on teachers' ICT use (Backfisch, Scherer, et al., 2021; Teo, 2009).

Self-Regulatory Capability

In addition to intentionality and the capacity for forethought, individuals also have self-directive capacities that support the regulation of thoughts, feelings, motivations, and behaviours. Individuals exercise some control over their own behaviour: through three sets of sub-functions: self-observation, judgemental process and self-reaction. One cannot influence a behaviour without being aware of it. Therefore, the first step is to develop the capacity for self-awareness by observing one's own behaviour, its effects and the cognitive and environmental conditions under which the behaviour occurs (Bandura, 1986, 2001). The aspects of behaviour that are the focus of observation may differ depending on the individual's values, conceptions, moods, etc. (Bandura, 1986, 1991).

The process of self-observing supports the individual's ability to set more realistic goals and evaluate progress towards achieving them (Bandura, 1991). Observing one's own behaviour also gives rise to self-reactive influences through the next judgemental sub-function, which, in turn, involves behavioural evaluation. This step involves comparing one's own performance with pre-determined standards and goals. Individuals often tend to strive to achieve their goals that are deeply rooted in the individual's belief system (Bandura, 2001). However, standards are shaped in part by others' reactions to one's behaviour, by looking at others' self-evaluative standards or through direct tuition (Bandura, 1986).

Few studies aimed at identifying the factors affecting teachers' ICT use have included goals as one of the variables to be examined. Petko (2018) investigated the interplay between school and teacher readiness for teachers' ICT integration and included the clarity and presence of shared school goals as an element of school readiness. These goals are likely to be adopted by teachers to direct and guide their ICT integration. However, from a socio-cognitive perspective (cf. Wood & Bandura, 1989), motivation to use ICT is likely to remain low if these goals are unclear, too distal, and set by others rather than by teachers themselves. Teachers' purposes of use were also found to be very critical in a qualitative study by Hennessy et al. (2005), which examined the use of ICT by English, mathematics, and science teachers.

By comparing one's own performance to personal standards and goals, one can sustain the effort required to achieve pre-set goals. In this way, goals serve as self-incentives to direct and motivate goal attainment. (Bandura, 2001). Individuals tend to perform in ways that result in positive and satisfying self-reactions (Bandura, 1986). However, not all goal types automatically contribute to self-reaction or regulate motivation and action. The type of goal matters. Goals must be sufficiently challenging and specific. Distal goals that are broken down into proximal sub-goals are preferable to goals that are set far in the future (Bandura, 2001). Goals are also partly determined by self-efficacy, which is 'beliefs about one's capability to exercise control over own level of functioning and events that affect one's life' (Bandura, 1991, p. 257). The stronger the belief in one's capability to act (sense of control), the higher and more challenging the goal (Wood & Bandura, 1989). Previous research has also emphasised the role of ICT self-efficacy as a very important predictor of teachers' ICT use and has demonstrated positive relationships (Gerick et al., 2017; Hatlevik, 2017; Kaarakainen & Saikkonen, 2021).

Furthermore, the more important the performance is to the individual's values, the more likely it is that the self-evaluative reactions will motivate the individual to sustain the effort required to achieve the pre-determined goals (Bandura, 1986). This also means that behaviour and motivation to act in a certain way are indirectly dependent on the individual's values, characteristics, beliefs, perceptions, etc. (cf. Bandura, 1986).

A number of studies have identified different types of beliefs and other individual preferences related to teachers' intentions and actual use of ICT. These include, for example, perceived usefulness (Teo, 2019), perceived ease of use (Kwon et al., 2019), epistemological beliefs (Kim et al., 2013; Tondeur et al., 2008), enjoyment and interest (Phua et al., 2012; Stein et al., 2020).

Self-Reflection

The final core element of the self-regulatory system is the capacity for self-reflective self-consciousness. This capacity enables individuals to reflect on themselves, their thoughts, values, motivations, and experiences. Individuals evaluate whether it is necessary to regulate their thinking in part based on the consequences that their actions create (Bandura, 1986, 2001). Individuals' beliefs about their self-efficacy are among the most influential and central mechanisms for regulating behaviour, emotions and motivation (Bandura, 1989a, 1997). Self-efficacy beliefs play an important role in regulating motivation, particularly through outcome expectations and goal setting.

Individuals who doubt themselves and do not believe in their capability (self-efficacy) to take certain courses of action to produce positive effects are less likely to be motivated to act. They may also have more challenges facing these difficulties (Bandura, 1986, 2001). A person with low self-efficacy often sets low-performance goals. Difficult tasks are also avoided, as they are often perceived as personal threats. The individual also tends to concentrate on personal weaknesses and all the obstacles he or she may encounter, rather than how he or she will achieve the goals (Bandura, 1994). Conversely, an individual with a strong belief in his or her abilities is more likely to set more challenging goals and is also more committed to achieving them compared to individuals with lack of this belief (Warner & Schwarzer, 2020). Although these individuals sometimes fail to achieve their goals, they recover quickly. Bandura (1986) further stated that four sources of self-efficacy exist: mastery experience, vicarious experience, verbal persuasion and physiological arousal, with mastery experience being the most influential source. Individuals need to experience multiple successes in overcoming difficulties to develop a high sense of self-efficacy.

Several studies confirm the role that self-efficacy plays in teachers' use of ICT. ICT self-efficacy has been shown to be related to teachers' perceived usefulness (Backfish et al., 2021b), perceived ease of use (Kwon et al., 2019; Teo, 2019) and digital competence (Hatlevik, 2017; Kwon et al., 2019). However, the mechanisms between these constructs are not fully understood. ICT self-efficacy has been found to be predicted by perceived ease of use and technical skills (Kwon et al., 2019). In the opposite direction, perceived usefulness, digital competence and ease of use (Backfish et al., 2021b; Hatlevik, 2017; Teo, 2019) have also been demonstrated to mediate the indirect effects of self-efficacy on teachers' ICT use. This implies that teachers' high self-efficacy is somehow related to a higher perceived usefulness of ICT use, higher level of digital competence, higher perceived ease of use and

higher frequency of ICT use. Similarly, a study on ICT use among teachers in Malaysia found that perceived ease of use was strongly correlated with HE teachers' intention to use computers (Phua et al., 2012).

A socio-cognitive perspective can provide some new insights into these findings. According to Bandura (1986), competence functioning depends on both skills and self-efficacy beliefs, which explains the close relationship between teachers' digital competence, self-efficacy and ICT use. However, possession of the required skills is not sufficient in determining behaviour if the individual has self-doubt and lacks the belief in his or her capability to perform. Conversely, competence development also requires self-efficacy beliefs and persistent effort (Bandura, 1986).

The perception that a person with higher self-efficacy is better equipped to face challenges and puts more effort into mastering them (Bandura, 2001) explains the relationship between teachers' self-efficacy and perceived ease of use. It also partially explains how people choose the environments in which they operate (cf. Bandura, 2001). Perceptions of one's self-efficacy will also influence the type of challenges and courses of action that individuals are prepared to take on and the extent to which they exert efforts to overcome these challenges. This often means that people with different self-efficacy beliefs end up in different environments. As external influences operate in different environments, different environments provide different social networks and support the development of certain competencies, skills, values and so on (Bandura, 1994, 2001).

Finally, self-efficacy also influences thought patterns and emotions and affects whether one views a challenge or achievement positively or negatively (Bandura, 2001). Therefore, from a socio-cognitive point of view, it is quite understandable that teachers' perceived usefulness is related to their ICT self-efficacy. A study by Backfish et al. (2021b) found that teachers with higher self-efficacy had a more positive view of the benefits of using ICT in teaching. The role of teacher efficacy as an important feature of teacher agency has also been demonstrated by other studies such as that of Jenkins (2020). Overall, the study of Jenkins (2020) is a good example of a study that applied Bandura's social cognitive theory to qualitatively examine the role of teacher agency in implementing curriculum changes among 12 HE teachers in secondary education in Australia. The study found that teacher agency can be expressed in three different ways: proactive, reactive and passive. Using Bandura's Triadic Reciprocity Framework Core Agency Concepts, proactive agency was found to be relatively rare among the teachers; however, it was the most desirable one for curriculum change. Proactive agency occurs when teachers initiate the changes themselves and, therefore, are the most personally motivated. Thus, this form of agency also requires key characteristics of intentionality, forethought, self-reaction, and self-reflection.

Reactive agency, that is when teachers respond to top-down initiatives from leadership, can also be effective for curriculum change if the right type of support is provided. Overall, when implementing any kind of change,

including digitalisation, what is most important for strengthening teachers' professional learning, both proactively and reactively, is that teachers have administrative support, positive relationships with colleagues and high-quality professional development. A need for sufficient time resources, clear communication between all parties and early involvement of teachers in the implementation of change also exists. Forcing teachers to change without properly communicating the change or involving them can lead to passive agency in which teachers are unwilling to engage in any kind of change. This state of affairs is also linked to feelings of lack of time, energy and interest, and to a sense that the subject of HE is not sufficiently respected (Jenkins, 2015).

2.5 Closing Remarks

Taken together, Chapter 2 has shown that ICT can be used by teachers in different ways to support students' learning outcomes. However, several aspects of teachers' use of ICT in HE still exist to support learning outcomes, about which relatively little is known.

Previous research also suggests that teachers, both from a Finnish perspective and in the context of HE, use ICT rather rarely to support students' active use of ICT and the development of ICT-based skills. In addition, a large amount of research has explored multiple variables to improve the understanding of the conditions related to teachers' use of ICT. While quantitative studies (cf. Inan & Lowther, 2010; Liu et al., 2017) tend to use research-based models to reveal significant relationships, qualitative studies (cf. Tallvid, 2016) usually rely on an inductive approach to gain deeper insights into teachers' ICT use. Qualitative studies have revealed conditions important for teachers' ICT use that are not necessarily identified in quantitative studies, such as subject culture and curriculum issues (cf. Erixon, 2010; Lindberg et al., 2017). Therefore, a combination of quantitative and qualitative data can provide added value and complementary insights into the complex phenomenon of teachers' ICT use and the conditions related to its use (cf. Gómez-Fernández & Mediavilla, 2022; Hatlevik & Hatlevik, 2018; Tondeur et al., 2008).

This chapter has further outlined the key elements of Bandura's model of reciprocal determinism that is used as the theoretical lens through which the findings of this thesis are viewed. An overview of the functioning of human agency within the model provides a clearer picture of the bi-directional relationships between personal, environmental, and behavioural conditions.

It is of particular importance to note that environmental conditions do not impinge on people. Rather, most hindering and facilitating conditions are mediated by self-regulatory mechanisms (Bandura, 1991), as discussed in the chapter. While the environment can provide with both external constraints on behaviour and potential opportunities for development, how these are received also depends on the individuals' beliefs, values, etc. (Bandura, 1986). Individuals (e.g. teachers) also tend to select environments based on what

they believe they can manage and set goals accordingly (Bandura, 1989a). Therefore, teachers always function in a network of environmental influences that are partly created by themselves (Bandura, 1989b). Thus, not all influences play an important role for all teachers, only those activated by their behaviour (Bandura, 1986). For example, the school's ICT infrastructure does not positively influence teacher's ICT integration if they do not take the opportunity to use it.

The strength of each triadic determinant may also vary depending on the activity, context, and individual factors. In some contexts, environmental influences may be the most dominant factor influencing behaviour, while in others, personal factors may be the most dominant. Sometimes, the relationship between beliefs and behaviour is so strong that not even negative consequences of behaviour lead to the correction of beliefs and behaviour (Bandura, 1986).

3. Research Philosophy and Methodology

Chapter 3 outlines the philosophical underpinnings of the thesis and presents the research design, methods and procedures used for the two original studies, the survey study (Publications I and II) and the interview study II (Publication III). The chapter ends with a discussion of methodological quality and ethical considerations.

3.1 The Philosophical Position of Critical Realism

This thesis adopts a mixed-methods research design informed by critical realism. Critical realism is a philosophical position that not only draws on the work of Roy Bhaskar (Bhaskar, 1998a, 2008) but also others, such as those of Andrew Sayer (2002), Margret Archer (2002;1998) and Danermark and Ekström (Danermark et al., 2019). Critical realism is seen as an alternative approach to positivism, hermeneutics and constructivism (Bhaskar, 2010; Danermark et al., 2019). Although mixed-methods research has commonly been associated with the philosophical tradition of pragmatism, several scholars have considered critical realism a valuable alternative philosophy (Elder-Vass, 2022; Maxwell & Mittapalli, 2010; Zachariadis et al., 2013).

One of the key features of critical realism is the combination of ontological realism and epistemological relativism (Zachariadis et al., 2013). While ontological realism asserts that a social world exists independently of our perceptions, knowledge and theories (Danermark et al., 2019; Sayer, 2002); epistemological relativism (i.e. knowledge of reality) assumes that an understanding of the social world is also dependent on the perspectives and standpoints of others (Maxwell & Mittapalli, 2010). This also supports the combination of quantitative and qualitative research approaches in this thesis.

To better understand ontological realism, Bhaskar (2013) distinguished between three overlapping domains of the world, namely the real, the actual and the empirical. The central idea is the distinction that is made "between scientific laws and patterns of events", where the laws are further dependent on mechanisms and structures (Bhaskar, 2008, p.12). Within this distinction, the real or the social world consists of structures and causal mechanisms that exist independently of the human mind to produce certain actions or events when triggered (Bhaskar, 2010, 2013). These events occur on both the actual and empirical levels of reality (Fletcher, 2017). The domain of the "actual" is, in turn, only a subset of the real and refers to the full set of events that occur, whether we experience them or understand them. A teacher will continue to use ICT in the classroom, whether it is observed or not. The final level, the empirical, is a subset of the actual and includes events that become empirical experiences (Bhaskar, 2010). These events are generated from structures that belong to the unobservable real. Structures, in this sense, are pre-existing to human activity and can be either natural (e.g. gravity) or social (e.g. group structures, communication structure) (Bhaskar, 2010; Danermark et al.,

2019). Although these structures lie beyond what we can observe in research, they have causal powers (e.g. gravity) and produce effects. In this sense, they provide conditions for human activity, but are also reproduced and transformed by human activity (Bhaskar, 1998b, 2010). These structures with causal mechanisms exist only in relation to the events they generate and can only be examined and identified through the events they produce (Bhaskar, 2014).

Translated into this thesis, the use of ICT by HE teachers is the main event that was the focus of this thesis. The lens of Bandura's reciprocal determinism was used as a theory to interpret the findings of both the survey study (Publications I and II) and the interview study (Publication III) and provide a deeper understanding of the phenomena of HE teachers' ICT use. Quantitative and qualitative elements were combined to reveal the conditions at both the personal and environmental levels that enable or constrain HE teachers' use of ICT. Quantitative research approaches were used in Publications I and II to explore patterns in HE teachers' use of ICT and examine the impact of teacher- and school-level factors on HE teachers' use of ICT. In Publication III, qualitative research approaches were used to increase the understanding of the conditions found in the quantitative phase to influence HE teachers' use of ICT as well as provide alternative conditions for HE teachers' ICT use. Further, a more detailed description of how quantitative and qualitative research methods integrated in a mixed-methods context is given.

3.1.2 Mixed-methods Enquiry and Research Design

A mixed-methods research approach was used to examine and understand the complex phenomena of HE teachers' ICT use. Several definitions of mixed-methods research have been introduced over the last decade. Here, I prefer to define mixed methods according to the definition provided by Johnson, Onwuegbuzie and Turner (2007):

> The type of research in which a researcher or team of researchers combines elements of qualitative and quantitative research approaches (e.g., use of qualitative and quantitative viewpoints, data collection, analysis, inference techniques) for the broad purposes of breadth and depth of understanding and corroboration. (p. 123)

Based on this definition, mixed-methods research appears to involve the integration of two types of data: research questions or data collection methods and analysis methods (Tashakkori & Creswell, 2007). The main purpose of integrating quantitative and qualitative methods is to gain a more nuanced and comprehensive understanding of the research problem, drawing on the strengths of both positions (Creswell & Creswell, 2018; Creswell & Plano Clark, 2011). As shown here, the concept of integration is quite central to mixed-methods settings (Plano Clark, 2019; Åkerblad et al., 2021) that can occur further at the level of study design, method, analysis and reporting, and interpretation and theory (Fetters et al., 2013; Moran-Ellis et al., 2006). In this thesis, quantitative and qualitative approaches are integrated at all four

levels: study design, methodology, analysis and reporting, and interpretation and theory.

At the study design level, an explanatory sequential mixed-methods design was selected, with elements of a convergent mixed-methods design. The explanatory sequential design is characterised by a two-phase data collection, with an initial phase of quantitative data collection followed by a phase of qualitative data collection (Creswell, 2014). Following this design, empirical data were collected through a two-phased data collection method in which quantitative survey data was collected first (Publications I and II), followed by qualitative data collection (Publication III). In this sense, the data were both collected and analysed at different times (see Figure 2). This design was best suited for providing a more comprehensive understanding of HE teachers' use of ICT. The elements of the convergent design are visible in the final interpretation stage in which the two types of datasets are merged rather than only explaining the quantitative data with the qualitative data (Creswell & Creswell, 2018).

At the methodological level, the quantitative and qualitative elements were integrated through *connecting* and *building* (Fetters et al., 2013), which took place during the sampling phase of the research process. The participants in the interview study (Publication III) were selected from the participants in the survey study (Publications I and II), indicating integration at the methodological level through connection. In addition, these participants were purposefully selected based on the findings in Publication I (building). Four participants from each of the three ICT user profiles identified in Publication I were selected for the interview study (Publication III). The findings from Publication I were also used to guide and build the hypothesis model in Publication III, which enabled the examination of the conditions influencing the different dimensions of ICT use by HE teachers. The findings from the survey study (Publications I and II) also informed the design of the semi-structured interview questions in the interview study (Publication III) to both clarify and enrich the quantitative findings in Publications I and II. The aim was to provide new insights into the conditions that enable or hinder HE teachers' use of ICT.

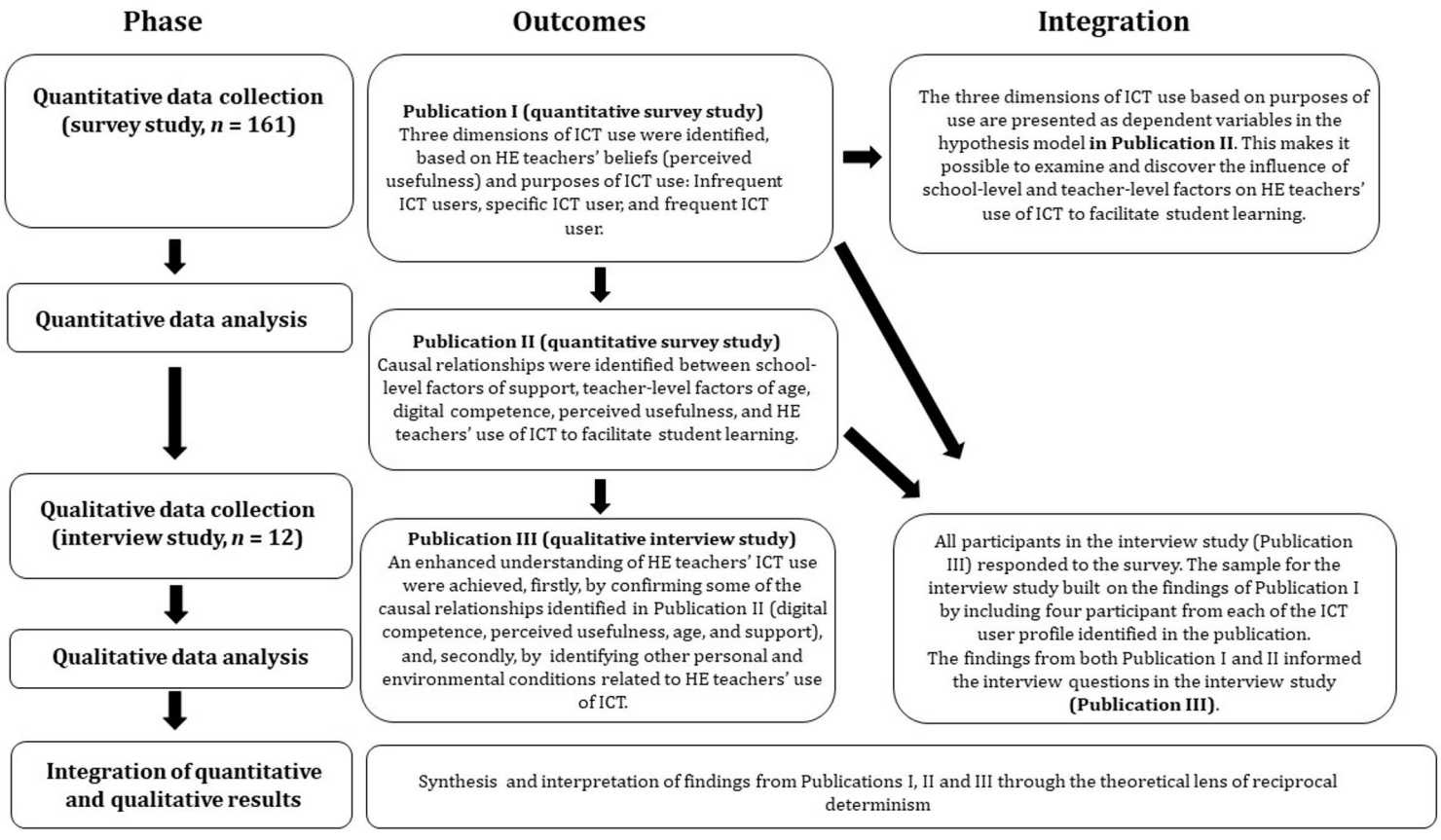
At the analysis and reporting levels, the quantitative (Publications I and II) and qualitative data (Publication III) were analysed and presented separately. This was a logical choice, as the three publications included in this thesis have been published separately. Thus, some intra-method mixing (Tashakkori et al., 2015) occurred in relation to the third study, where both open-ended and more structured interview questions were employed to study more deeply the factors that were found to significantly influence HE teachers' ICT use. Open-ended questions were used to gain new insights into the phenomena under study.

At the level of interpretation and theory (Moran-Ellis et al., 2006), the findings were initially discussed separately. Thus, at the final interpretive level, the quantitative findings from the survey study (Publications I and II)

and qualitative findings from the interview study (Publication III) were integrated and merged, with both data being equally valued. The interview study (Publication III) provides a more in-depth understanding of the quantitative findings in the survey study (Publications I and II), as in a typical explanatory sequential mixed-methods design. In this phase, the quantitative and qualitative data also converged and informed each other to draw conclusions about the research objective. This research phase indicated that the design used was not purely explanatory sequential and had elements of convergent mixed-methods design, where data are usually merged (Creswell & Creswell, 2018). The theoretical lens of reciprocal determinism was used to provide a deeper, enriched theoretical meaning and understanding of the integrated findings. An illustration of the research design is provided in Figure 2.

Figure 2

Different Stages and Levels of Data Integration in the Use of a Mixed-Methods Approach



3.2 The Survey Study

In this sub-chapter, I will present and discuss the sample, sampling technique, data collection method, measures and data analysis techniques used for the survey study and the quantitative phase of this thesis (Publications I and II).

3.2.1 Participants and Data Collection

The survey study was conducted in the context of Finnish lower secondary education. The empirical survey data used in Publications I and II were collected in March 2016 (related to my master's thesis). The sample consisted of 161 HE teachers working in both Swedish and Finnish language schools in lower secondary education across Finland (Sundqvist, 2016). A self-report survey instrument was used to collect the data in collaboration between Åbo Academi University and the University of Helsinki. A combination of probability and non-probability sampling techniques was used to recruit the participants (Cohen et al., 2000; Cowles & Nelson, 2015; Fricker, 2008). Representative samples were drawn using a probability multistage sampling technique (Cowles & Nelson, 2015). Using this approach, 198 HE teachers were randomly selected from a register of all lower secondary education schools in Finland (n = 695) at that time. The teachers' contact details were obtained from the school websites. Non-probability convenience sampling was employed by sending the survey to all HE teachers (n = 74) working in Swedish-speaking lower secondary education, to all HE teachers who were members of a subject association for HE and to two Facebook groups consisting of HE teachers in Finland. The advantages of non-probability convenience sampling are its wide dispersion and convenience. However, the disadvantage is that it affects the generalisability of the results (Taherdoost, 2016a).

To enable generalisation, the sample size must be large enough. Email invitations to participate in the online survey, which included a link to the online survey and a cover letter, were sent an estimated total of 2494 HE teachers. However, a possibility of a teacher receiving the same questionnaire several times exists, as he or she may be a member of several groups. Due to the use of non-probability sampling techniques and duplicate invitations to participate in the survey, the response rate was problematic to assess. According to a national survey (Kumpulainen, 2014), 936 teachers worked as subject teachers in HE. The response rate was 88.1%, which meant that in practice there could be approximately 1062 subject teachers in HE. Although the final response rate could not be calculated, it can be concluded that the response rate was quite low. Hence, the optimal sample size must also be balanced against what is possible in terms of time and other resources (Cowles & Nelson, 2015). A dropout analysis could not be fully carried out due to the combination of probability and non-probability sampling techniques. The reasons for the known non-response are reported in Sundqvist (2016).

An online questionnaire (see Appendix A) was developed using a survey tool offered by Åbo Academi University (e-lomake). The questionnaire consisted of both open-ended and closed-ended questions. However, in Publications I and II, only closed-ended questions with measurements at nominal and ordinal levels were used (see Measures on 3.2.2).

The questionnaire was pilot tested (Cohen et al., 2000) to ensure reliability and validity. The survey was sent to five HE teachers, two Swedish-speaking teachers and three Finnish-speaking teachers.

The questionnaire, with a cover letter, was sent or delivered to the participants by email or via two closed Facebook groups. The main purpose of the cover letter was to explain the aims and background information of the research, confidentiality of the data, use of data, principles of voluntary participation and anonymity (Finnish National Board on Research Integrity TENK, 2019). Participants were asked to self-report their age group, teaching qualification, use of different types of ICT in teaching and for student learning, purpose or dimensions of ICT use, perceived usefulness of ICT in teaching and for student learning, perceived usefulness of ICT use in supporting student achievement of learning goals, their ICT self-efficacy, perceived digital competence, perceived support, and perceived availability of ICT infrastructure. Nine questionnaires were excluded from the analysis, five of which were due to double registration and four because the teachers worked at vocational institutions.

3.2.2 Measurements

Use of Different Types of ICTs

Through using 13 items (see Appendix B), HE teachers were asked to rate their frequency of using different types of software applications and digital learning content using a five-point Likert scale ranging from 1 (*never*) to 5 (*very often*). While the term ICT is used in this thesis to describe both hardware, software, applications, digital learning content and networks (OECD, 2012; UNESCO, 2009) Publication I was limited to assessing HE teachers' ICT only related to different types of software applications and digital learning content. The items were adapted from Bilbao–Osorio and Pedró's (2010) and Ilomäki's (2016) classification of different digital learning materials. Thus, the list is modified to include software applications and digital learning content typical of that period.

Purpose of ICT Use

HE teachers were asked to self-report their frequency of ICT use for different purposes (e.g., for administrative tasks, in class for students to communicate with each other) using a five-point Likert scale ranging from 1 (*never*) to 5 (*very often*). The 14 items (see Appendix B) addressing HE teachers' purpose of ICT use were adapted from Howard et al. (2015) and van Braak et al. (2004).

Perceived Usefulness of ICT in HE

This concept was measured by two different scales (see Appendix B), g*eneral perceived usefulness,* and *beliefs about using ICT to achieve learning objectives within HE* (referred to as teachers' beliefs in Publication I). The general perceived usefulness scale included 22 items and refers to teachers' perceptions of the usefulness of using ICT to enhance teaching and student learning (e.g., "ICT integration facilitates repeating work", "ICT integration promotes students' ability to search for, collect and process information"). Items were rated on a 5-point Likert scale ranging from 1 (*strongly disagree*) to 5 (*completely agree*), of which 15 items were influenced and 5 items adopted from Hernándes-Ramos et al. (2014) and two items were adapted from the scale of Scherer et al. (2015).

In relation to *beliefs about using ICT to achieve learning objectives within HE* (or teachers' beliefs), teachers were asked to rate the extent to which they believed that the use of ICT would support students' achievement of learning objectives related to the core content of HE. This measure was rated with 15 items (e.g., For developing cost-consciousness in everyday life) using a five-point Likert scale ranging from 1 (*not important at all*) to 5 (*very important*). These items are not adapted from any scale, but emphasise the importance of considering teachers' belief about the subject when studying teaching practices (Ertmer & Ottenbreit-Leftwich, 2010; Pajares, 1992).

ICT Self-Efficacy

ICT self-efficacy is a single-item measure in which teachers were asked to rate their ability to integrate ICT in teaching (see Appendix B). The Likert scale ranged from 1 (*very poor*) to 5 (*excellent*). Although self-efficacy is considered to be a very important belief when it comes to explaining teachers' use of ICT (Hatlevik & Hatlevik, 2018; Hatlevik, 2017), this measure was only used in Publication I, due to the single item-measure.

Digital Competence

This concept was measured by asking HE teachers to evaluate their own digital competence using a nine-item, five-point scale ranging from 1 (*strongly disagree*) to 5 (*completely agree*). The items (see Appendix B) were influenced and developed in line with the definition of digital competence provided in the Recommendation on key competences for lifelong learning, adopted in 2006 (Recommendation of the European Parliament and of the Council of 18 December on key competences for lifelong learning (2006/962/EC)).

ICT Infrastructure

The availability of ICT infrastructure was measured by asking HE teachers to rate access to different types of computers and network connections (see Appendix B). A five-point scale was used, ranging from 1 (*strongly disagree*) to 5 (*completely agree*). The eight statements in the scale were developed partly based on Bilbao-Osorio and Pedró's (2009) conceptualisation of ICT infrastructure.

Support

Regarding the support measure, HE teachers were asked to rate their perceptions of the adequacy of support using a five-point Likert scale ranging from 1 (*strongly disagree*) to 5 (*completely agree*) (see Appendix B). The scale consisted of 10 items (e.g., I have received enough technical support from the school to use ICT in the classroom), which were adapted and modified from both Inan and Lowther's (2010) TTQ-Scale (Teacher Technology Questionnaire) and the European Commission's (2013) questionnaire, used for 2nd Survey of Schools: ICT in education -study.

Background Variables

Age and teaching qualification (TQ) are the two background variables used. HE teachers were asked to report their age group, as well as their educational background and degree. The variables used in Publications I and II respectively are reported in Table 1.

3.2.3 Data Analysis

Factor Analysis: Exploratory and Confirmatory Factor Analysis

Factor analysis is a multivariate statistical procedure that is used to reduce a set of data or variables to the smallest number of factors, also known as constructs, dimensions and latent variables. This makes the data more manageable and easier to understand. (Huck, 2012; Watkins, 2018) Factor analysis is also widely used for instrument development, refinement, and for construct validation (Brown, 2015). There are different types of factor analysis. Here, I will distinguish between the two main types, namely exploratory factors analysis (EFA) and confirmatory factor analysis (CFA), as the former is applied in Publication I and the latter in Publication II. Although both EFA and CFA aim to determine the number and nature of factors that explain the patterns of correlations observed between a larger set of indicators, there are some differences in terms of prior specifications. (Brown, 2015)

Exploratory factor analysis (EFA) is a method most often used in the exploratory phase of scale development, when the researcher has small or no prior sense of the theoretical nature or number of factors. EFA is used when the researcher wants to reduce the amount of data, identify the factor structures in a data set, and provide evidence of construct validity. (Huck, 2012; Watkins, 2018)

Although CFA is very similar to EFA, they differ in some respects. CFA is considered a subset of structural equation modelling (SEM), which used to assess relationships between observed variables and latent constructs (Rencher & Christensen, 2012). Unlike EFA, CFA is hypothesis-guided and requires the researcher to have some kind of prior knowledge of the construct being studied (Brown, 2015). CFA can also be used to verify the underlying structure of a construct identified in an EFA (Pett et al., 2003).

In Publication I, three EFAs was performed, using the Statistical Package for Social Science (SPSS Statistics 25) to assess the construct validity of the

measures, *the purpose of ICT use*, *teachers' beliefs*, and *the use of different types of ICT* (see Appendix B; Publication 1, Appendix 2, 3, 4). Construct validity is about how well the selected items from an assessment can be used in the expected way to measure a theoretical concept (Taylor, 2013).

As a first step, the suitability of the data for EFA was checked using the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett' test of sphericity (Huck, 2012). The KMO measure evaluates the extent to which the correlations between the variables account for the shared variance between variables (Watkins, 2018). Data are considered suitable for EFA if the KMO measure is greater than .60 and if Bartlett's test of sphericity produces a significant value (Huck, 2012).

As a second step, for the measures *purpose of ICT use* and *teachers' beliefs* (see 3.2.2 Measures), maximum likelihood (ML) was chosen as the factor extraction method and varimax orthogonal rotation method as method for factor rotation. There is no single criterion that determines the choice of factor extraction method (Williams et al., 2010). Some scholars state that ML is best suited for data that are assumed to be normally distributed (Mulaik, 2009). Considering that the data showed some issues with normality (Watson, 2017), an EFA with principal axis factoring (PAF) and varimax orthogonal rotation method was more suitable when assessing the construct validity of the *use of different types of ICT.*

The interpretation and selection of the number of factors and the items that make up the factors, constitute the third and final step of EFA. The number of factors was selected based on the generated eigenvalues greater than 1. The eigenvalue refers to the variance of the variables explained by the suitable number of factors. (Brown, 2015; Huck, 2012) The selection of the most suitable solution and the variables that best define each factor was finally based on a detailed examination of factor loadings (greater than .32) (Tabachnick & Fidell, 2007) and the size of communality for each variable (between .40 and 1.0) (Pett et al., 2003). Factor loadings between .30 and .40 are minimally acceptable values, although higher values are preferred (Hair et al., 2014). Examining the factor loadings and deleting problematic loadings is one way to establish convergent validity for each variable, which is subtype of construct validity (Huck, 2012). Communalities predict the usefulness of the variable and refer to the amount of variance in each variable that can be explained by the factor (Watson, 2017). Higher values of communalities indicate more useful variables. (Brown, 2015). The identified factor structures were used for further analysis in Publication I.

In Publication II, CFA was used as a first step to investigate the measurement quality of the latent construct used in further analysis in the SEM modelling. CFA was used to assess the construct validity (Huck, 2012) of the three-factor structure of teachers' frequency of ICT use for different educational Purposes (ICT for cooperation, ICT for facilitating pupils' learning, ICT for administration and lesson planning), the one-factor structure of perceived usefulness of ICT in Home Economics, the one-factor

structure of digital competence, the one-factor structure of ICT infrastructure, and the one-factor structure factor of support (see Appendix B; Publication II, Table A1).

The appropriateness of the proposed factor structures and the validity of the SEM measurement model were assessed using several model fit indices, including the Chi-Square Test of Model Fit, the Root Mean Square Error of Approximation (RMSEA), Comparative Fit Index (CFI), and the Tucker-Lewis Index (TLI) (Hair et al., 2014). Both chi-square ($\chi 2$) and RMSEA are absolute fit indices that determine how well the specified model fits the observed data. A non-significant Chi-Square Test of Model Fit indicates that the factor model fits the data well. For RMSEA, there seems to be no clear cutoff for acceptable values (Marsh et al., 2004). Some researchers suggest that RMSEA values below .05 reflect a close fit, values below .08 an acceptable fit, and values above .10 a poor fit (Browne & Cudeck, 1993; Marsh et al., 2004).

CFI and TLI are incremental Fit Indices, which in turn measure how well the specified model fits compared to an alternative null model, in which there is no correlation between the variables. (Hair et al., 2014) For CFI and TLI, values range from 0 and 1, with values above .90 reflecting a well-fitting model (Hair et al., 2014; Marsh et al., 2004). In addition to the fit indices, convergent and discriminant validity was assessed by evaluating factor loadings and intercorrelations.

Internal Consistency Reliability: Cronbach's Alpha

Internal consistency reflects the extent to which the items on a scale are interrelated and measure the same construct (Huck, 2012; Tavakol & Dennick, 2011). Cronbach's alpha coefficient has become a popular and useful index for examining the internal consistency of a scale. Cronbach's alpha coefficient varies between 0 and 1. Hence, there is no clear consensus on recommended alpha values. (Taber, 2018) Most commonly, values greater than .70 are considered adequate (Taber, 2018), thus there are also researchers (van Griethuijsen et al., 2015) who consider values of .60 and even lower to be acceptable. According to Tavakol and Dennick (2011), internal consistency should be calculated before using the subscale for further analysis to assess validity.

Cronbach's alpha was used in Publication I to assess the internal consistency of the items in the three-factor structure of *purpose of ICT use (*ICT for cooperation, ICT for facilitating pupils' learning, ICT for administration and lesson planning), the three-factor structure of *teachers' beliefs* (food habits and choices, environmental and cost-consciousness, practical skills), and the three-factor structure of *different types of ICT* (applications and digital content, tools for online teaching, social media). In Publication II, Cronbach's alpha was used to calculate the internal consistency for the subscales perceived usefulness of ICT in home economics, digital competence, ICT-infrastructure, and support.

K-Means Cluster Analysis

There are several clustering methods offered by different statistical packages. K-means cluster analysis (KCA) is an iterative non-hierarchical clustering technique that is used to identify the optimal clustering solution in a dataset by minimising the within-cluster variance and maximising the between-cluster variance. (Everitt et al., 2011; Hair et al., 2014) In Publication I, KCA was used to identify ICT user profiles among subject teachers in HE based on their similarities in purpose of ICT use and beliefs about the perceived importance of using ICT in HE.

There are no standardized methods for determining the true number of clusters. The optimal number of clusters in Publication I was mainly selected by rule of thumb (Kodinariya & Makwana, 2013), which means that it is up to the researcher to estimate the optimal number by, for example, comparing different k-means clustering solutions, by varying the number of clusters. The selection of clusters was also supported by the elbow method (Yuan & Yang, 2019), which is a visual method that calculates the within-cluster sum of squared errors for each value of k from 1–10 and plots the values on a scatterplot. The place where the line bends (the elbow is reached), locates the optimal number of clusters. The optimal number of clusters is further validated and profiled by comparing how the clusters differ significantly from each other in terms of external variables not used in the formation of clusters, such as ICT self-efficacy, and use of different ICTs (Hair et al., 2014).

Analysis of Variance

One-way analysis of variance (ANOVA) is a statistical model used to compare differences between groups by focusing on differences in group means. (Huck, 2012; Sprinthall, 2014) In Publication I, one-way ANOVAs with Scheffe's post hoc test were conducted to determine whether there were significant differences between HE teachers in different ICT user profiles on the measures of purpose of ICT use and teachers' beliefs. The purpose of the ANOVA was also to use it as a technique to determine whether the identified ICT user profiles differed from each other on variables that were not included in the cluster analysis, such as ICT self-efficacy and use of different types of ICT. The post-hoc test is an important follow-up test to the ANOVA to gain insight into which groups are different from each other (Huck, 2012). The effect size for the main analysis in ANOVA was assessed using partial eta squared η_{p}^2, where .01 represents small effect, .06 a medium effect, and .14 a large effect. Cohen's d was in turn used to interpret the effect sizes of the differences in the pairwise comparisons, i.e. how the HE teachers in different ICT user profiles differ in their ICT self-efficacy and use of different ICTs. For Cohen's d, values of .20, .50, and .80 indicate small, medium, and large effects respectively (Cohen, 1988).

Chi-Square Test of Independence

The non-parametric Chi-square ($\chi 2$) test of independence is a statistical test that determines whether there is a significant relationship between two

nominal or categorical variables (McHugh, 2013). In Publication I, the Chi-square test of independence was performed to determine if there were any significant differences between the profiles in terms of demographics, such as age, and teacher qualification (TQ).

Structural Equation Modelling

Structural equation modelling (SEM) is a combination of two statistical techniques, confirmatory factor analysis and path analysis, and is used to analyse pre-specified structural relationships between constructs (Weston & Gore, 2006). SEM is a powerful analysing technique that can be used to examine complex multi-equation models with several variables, including direct and indirect effects, while at the same time accounting for measurement errors. Given that the method can estimate the degree of measurement error, SEM is very useful for identifying causal connections between abstract, unobserved latent constructs (e.g., perceived usefulness), which also makes the method popular in the social and behavioural sciences. (Bollen & Noble, 2011)

In Publication II, a SEM with weighted least square mean and variance adjusted (WLSMV) estimator, was conducted to examine the hypothesised direct and indirect relationships between perceived usefulness of ICT in home economics, age, digital competence, ICT infrastructure, support and the three dimensions of ICT use: for cooperation, for facilitating pupils' learning and for administration and lesson planning. These analysis were conducted using Mplus statistical software, version 8.2 (Muthén & Muthén, 2017).

Performing a SEM involves six separate steps: model specification, identification, data preparation and screening, estimation, evaluation of fit and modification (Weston & Gore, 2006). As a first fundamental step, the structural model of the factors influencing HE teachers' ICT use was designed. This step involves defining and specifying the relationships between different constructs in the model based on prior research and theory (Weston & Gore, 2006). The second step, model identification, determines whether the model can be testable, and checks whether the set of parameters to be estimated (e.g., regression coefficients, variance, covariance) are consistent with observed data (Byrne, 2012). The third step is to prepare the data for SEM by solving data-related issues. The Statistical Package for the Social Sciences (SPSS Statistics 25) was used to prepare the data. Issues with non - normal distribution were fixed by deleting a few items that violated the normality. The fourth step involves model estimation. There are several estimation methods available for SEM. In Publication II, the weighted least squares means and variance adjusted (WLSMV) estimation techniques was chosen, as it is recommended for categorical data (Wang & Wang, 2012) and can be used with different samples sizes (Beauducel & Herzberg, 2006). After estimation, the fit of the model should be evaluated. The model fit is assessed by using fit indices, such as Chi-Square Test of Model Fit, Comparative Fit Index (CFI), the Tucker-Lewis Index (TLI), and the Root Mean Square Error of Approximation (RMSEA) (Marsh et al., 2004). However, the previously reported cut-off

values for these indices should be interpreted with caution, as they can be influenced, by for example, sample size and complexity of the model (Marsh et al., 2004). As a final step, it can be necessary to modify or respecify the model (Weston & Gore, 2006). As an outcome of the peer review process, the model was improved by deleting a latent variable (ICT self-efficacy) with a single indicator. When analysing the model results, bootstrapping method was employed to estimate standard errors and to obtain confidence intervals for the indirect and total effects. Confidence intervals (95 %) were computed through 1000 bootstrap draws. (Muthén & Muthén, 2017) The standardized regression coefficient (β) was used as an indicator for interpreting the effect size.

3.3 The Interview Study

In this sub-chapter I will present and discuss the sample, sampling technique, data collection method, measures and data analysis techniques used for the interview study and the qualitative phase of this thesis (Publication III).

3.3.1 Participants and Data Collection

A purposeful stratified sampling technique was used to select participants for the interview study (Publication III). Purposeful stratified sampling is a useful sampling technique in mixed-methods research that involves selecting cases based on pre-defined criteria or parameters. The purpose is to ensure both in-depth information about the phenomenon under study and capture major variations in cases (Palinkas et al., 2015; Patton, 2002). This sampling technique was used to select 12 participants, 4 from each of the 3 ICT user profiles (frequent ICT users, specific ICT users and infrequent ICT users) identified in Publication I. Each profile represented HE teachers with similar ICT use characteristics. In the process of finding and recruiting four candidates from each of the three ICT user profiles, the email addresses collected in the questionnaire survey were used to invite HE teachers to participate in the qualitative interview study. In this sense, email addresses were used for sampling purposes only. Participants were also informed of the source of their email addresses. Hence, 94 HE teachers were invited to participate. Despite this, only 12 HE teachers participated in the final study. There were several reasons for non-participation. Of the 94 teachers, 16 could not be reached, 5 had made career changes, 4 declined to participate, 4 felt they did not have the time, 3 were retired and 3 were on various leaves of absence. Further, 48 teachers gave no reason for not participating in the study.

A semi-structured interview technique was used as a data collection method in the study, consisting of both unstructured open-ended questions and more structured theory- or hypotheses-directed questions. This form of interview is useful not only when the researcher wants to gain deeper insights into certain topics, but also when he or she wants to know how the

phenomenon under study is understood, from the participants' points of view (Flick, 2014; Patton, 2002).

The interviews (Publication III) were conducted, either online via Zoom (n = 10), or face-to-face at the teacher's workplace (n = 2), between November and December 2019. The semi-interview guide was developed in five phases, as proposed by Kallio et al. (2016): (1) identifying the prerequisites for the use of semi-structured interviews, (2) retrieving and using prior knowledge, (3) formulating the preliminary semi-structured interview guide, (4) pilot testing of the interview guide and (5) presentation of the final semi-structured interview guide.

In the first phase of the development of the guide, semi-structured interviews were considered a suitable data collection technique, as some knowledge of the topic under study was already available, and the main purpose of Publication III was to take a teacher's perspective to enhance the understanding of HE teachers' ICT use (Flick, 2014). This was done by investigating their experiences, opinions and perceptions of their own ICT use, goals for ICT use, and conditions related to their use. In addition, the purpose was to capture unrecognised beliefs and values that were not easy to investigate quantitatively (Patton, 2002).

The second phase involved the use of prior knowledge, and the creation of a theoretical base, for developing the interview guide. Prior knowledge, consisted of empirical knowledge from Publications I and II, and theoretical knowledge of Bandura's model of reciprocal determinism, both of which were used to inform the structure of the interview guide.

In the third phase of guide development, the interview guide was formulated with the main themes and follow-up questions (Kallio et al., 2016). The first version was quite extensive and consisted largely of hypothesis-directed questions.

In the fourth phase, the semi-structured interview guide was pilot tested three times. All three pilot interviews were transcribed and preliminarily analysed. Based on the pilot studies, some questions were removed, and minor changes were made to the wordings of the questions. At the final stage of development, the guide was ready for use. The final questions used in the interview guide (Appendix C; Appendix D) in the interview study (Publication III), were related to three main themes: use and experience of ICT use, goal of ICT use and conditions for ICT use. The teachers were free to respond to these main themes with the help of probing follow-up questions. For the conditions related to their ICT use, teachers were also asked about their perceptions of the usefulness of ICT in HE, the adequacy of support, their confidence and ability to use ICT, and their digital competence. These variables have been shown in Publications I and II, to be significantly associated with HE teachers' ICT use.

Prior to the interviews, participants were informed about the aims and procedures of the study, data processing and the main ethical principles guiding the research, such as voluntariness, the right to withdraw consent,

autonomy, and confidentiality (Finnish National Board on Research Integrity TENK, 2019). Written informed consent was obtained from all participants to take part in the interview, by signing the consent document in person, electronically with a digital signature, or by email. As the study included HE teachers from both Finnish and Swedish language schools, the interviews were conducted in either Finnish or Swedish. The interviews, which lasted between 40 and 70 minutes, were recorded with an audio recorder. The recorded oral interviews were later transcribed verbatim (Kvale & Brinkmann, 2009). As the intention was not to provide a detailed linguistic analysis, non-verbal utterances were not transcribed into text. The interviews produced 140 pages of transcribed text. Each interview, on average, produced between 9 and 17 pages of text.

3.3.2 Data Analysis

Qualitative content analysis was used to analyse the data in Publication III. Content analysis is a systematic procedure for analysing textual, verbal and visual data in order to enhance the understanding of, and provide new knowledge about the phenomena under study (Krippendorff, 2004). There are several approaches to analysing data using content analysis (Graneheim et al., 2017). In Publication III, an abductive approach to qualitative content analysis was chosen, combining both inductive, and deductive analysing approaches.

The analysis largely followed a step-by-step process outlined by Erlingsson and Brysiewicz (2017):

1) Familiarization.
2) Selection of predetermined themes.
3) Identification of meaning units.
4) Creation of codes.
5) Creation of subcategories.
6) Creation of categories.

As abductive reasoning was used in Publication III, the steps were followed in a somewhat non-linear order. The first step, familiarization, involves getting familiarized with the data by reading the transcript several times. In the second step, a deductive approach was used to develop and select main themes that reflected the threefold research question in Publication III: ICT use, goal of ICT use, and influences. However, this step was not described by Erlingsson and Brysiewicz (2017). Based on the main themes, central meaning units were identified in the third step of the analysis process. The fourth step, creation of codes, was inductive in nature and involved the inductive abstraction of the meaning units into codes. In the fifth and sixth steps, the codes were compared and sorted into main- and subcategories. An example of the content analysis process, inspired by Erlingsson and Brysiewicz (2017), is illustrated in Figure 3. To ensure trustworthiness, especially credibility, the meaning units, codes, and categories were checked

several times. To ensure relevant categorization, some of the interpretations were discussed with the co-author. (Graneheim & Lundman, 2004)

Figure 3

Steps in the Content Analysis Process

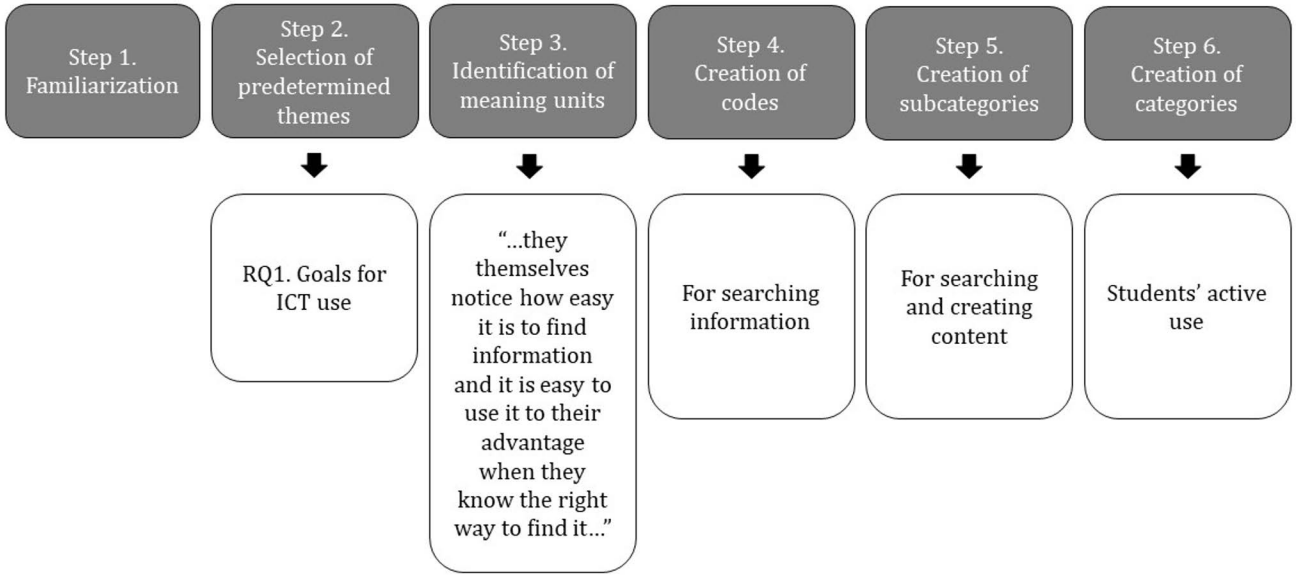


Table 1

Summary of Research Methodologies and Data Collection

Publications	Aim	Data, sample, and method	Measures	Analysis
I	To explore Finnish subject teachers' use of ICT in HE, by identifying patterns in their ICT use based on the purpose of ICT use, and their beliefs about the importance of using ICT, to achieve learning objectives in HE (referred to as teachers' beliefs)	Survey-data 161 subject-teachers in HE Self-report survey instrument	Use of different types of ICTs Purpose of ICT use Teachers' beliefs (beliefs about using ICT to achieve learning objectives within HE) ICT self-efficacy Age and teaching qualification	Exploratory factor analysis Cronbach's alpha K-means cluster analysis Analysis of variance and chi-square test of independence Software for data analysis: SPSS Statistics
II	To investigate the direct and indirect effects of teacher and school-level factors on subject teachers' use of ICT in HE	Survey-data 161 subject-teachers in HE Self-report survey instrument	ICT for cooperation; ICT for facilitating pupils' learning; ICT for administration and lesson planning Perceived usefulness of ICT in HE Digital competence ICT infrastructure Support Age, teaching qualification	Confirmatory factor analysis Cronbach's alpha Structural equation modelling Software for data analysis: Mplus statistical software
III	To enhance the understanding of Finnish HE teachers' use of ICT, by drawing on the model of triadic reciprocal causation and investigating their goals of ICT use, their ICT use, and related conditions.	Interview-data 12 subject-teachers in HE Semi-structured interviews	A combination of structured and unstructured interview questions on HE teachers' goals for ICT use, their ICT integration practices and the conditions they perceived to influence their ICT use	Abductive approach to qualitative content analysis Software for data analysis: Nvivo

3.4 Assessing the Quality of the Thesis

Several languages and multiple terms are introduced in research to assess the quality in quantitative, qualitative and mixed-methods research. In this thesis, a need existed to assess the quality of the quantitative survey study (Publications I and II), and the qualitative interview study (Publication III), separately as an initial phase of a mixed-methods study. The quality issues related to mixed-methods studies have, in turn, been addressed and assessed with their own set of quality criteria (Dellinger & Leech, 2007; O'Cathain, 2010). Quality is also discussed from the critical realist perspective; therefore, it is assessed against some of the basic principles of critical realism.

To provide some clarity to the multiple terms used, Figure 4 summarises a set of criteria, that I considered appropriate for assessing the quality of quantitative, qualitative, and mixed-methods studies. These criteria were based on contributions from several researchers. *Validity* and *reliability* are two well-known concepts, that have commonly been used as quality criteria in quantitative research (Bryman et al., 2008; Metsämuuronen, 2006; Taherdoost, 2016b). Introduced by Lincoln and Guba (1995), *credibility*, *transferability*, *dependability,* and *confirmability* are four well-known core criteria for establishing trustworthiness in qualitative research.

Criteria for assessing the quality of mixed-methods research were presented by O'Cathain (2010), which were also based on contributions from other researchers. Finally, the quality of a critical realist approach to mixed-methods research, was assessed or discussed in relation to the ontological and epistemological assumptions of critical realism, the notion of human agency, and the importance of abduction, theory, and theory building. Note that Figure 4 neither provides a comprehensive illustration of all the criteria proposed in the literature, for assessing the validity, reliability, trustworthiness, and quality in quantitative, qualitative and mixed-methods research nor of assessing quality of the study, with a critical realist perspective for mixed-methods research.

Figure 4

Criteria and Considerations for the Evaluation of the Quality of the Thesis

Quality assessment criteria		
Quantitative research criteria	**Mixed-methods research criteria**	**Qualitative research criteria**
Validity ❖ External validity: generalisability ❖ Internal validity: Content validity; construct validity (discriminant and convergent validity) **Reliability** ❖ Internal consistency	**Quality domains** ❖ Planning quality ❖ Design quality ❖ Data quality ❖ Interpretive rigour ❖ Inference transferability ❖ Reporting quality	**Trustworthiness** ❖ Credibility ❖ Transferability ❖ Dependability ❖ Confirmability
Quality considerations from the perspective of critical realism		

3.4.1 Quality of Quantitative Research Phases

Both validity and reliability are discussed, when assessing the quality of the quantitative research phase, of this mixed-methods research. In this thesis, the *validity* of the quantitative survey study (Publications I and II), has been evaluated through both *external* and *internal validity* (Metsämuuronen, 2006). *External validity,* concerns the generalisability of the study findings (Metsämuuronen, 2006). In the case of the quantitative survey study, it could be expressed as "Do the causal relationships and correlations identified in Publications I and II, persist despite differences in context, time, etc.?" (Ferguson, 2004).

To improve the *external validity* of the survey study, probability sampling was chosen. This meant that each HE teacher working in secondary education in Finland, had an equal probability of being selected. Thus, probability

sampling was combined with non-probability sampling of convenience to ensure a sample size large enough for the analysis performed. This could threaten the generalizability of analysis performed (Vogt, 2007). Although there are no clear-cut sample size requirements, larger sample sizes are often preferred to smaller sample sizes, to reduce the risk of bias, and to achieve stable and accurate effect estimates (Sim et al., 2022). Non-probability sampling strategies, such as convenience sampling, are unfortunately considered to have a higher risk of bias (Cohen et al., 2000).

In contrast, *internal validity* refers to the extent to which a researcher measures what he or she intends to measure (Metsämuuronen, 2006). Internal validity can be assessed through content validity, construct validity and criterion validity. In this thesis, internal validity was evaluated through both content and construct validity. Criterion validity, especially predictive validity, has been difficult to establish, because no long-term study has been carried out. Criterion validity concerns the extent, to which a measure is related to another external criterion, an outcome (Vogt, 2007).

Content validity, refers to whether the survey instrument is relevant and adequately covers all the relevant content it aims to measure (Vogt, 2007). While construct and criterion validity, can be assessed statistically, content validity relies on subjective assessment, in the form of expert evaluations and judgments (Almanasreh et al., 2019; Taherdoost, 2016). For this study, a panel of experts has not been used, to assess the relevance of the survey elements; however, the preliminary questionnaire was pilot tested by five teachers and experts in the field of HE, who also provided valuable written feedback on their experiences with challenges and issues faced while filling out the questionnaire. The written feedback led to minor changes in wording, translations, formatting and length to avoid misunderstandings, ensure clarity and make it easier to complete. Additional information was also provided, when asked about the purposes for which HE teachers' used ICT. This was to ensure that the participants included both teachers' and students' use of ICT. Theory can also be used to determine whether certain elements or items should be included to measure a construct (Almanasreh et al., 2019; Metsämuuronen, 2006).

The majority of the items for the different scales used in Publications I and II were selected based on previous research and theory (see 3.4.2 Measures). Thus, according to the literature, the scale of digital competence is considered to have low content validity in this thesis. Teachers' digital competence (see Appendix B), has been measured narrowly, focusing primarily on technological competence (cf. Instefjord & Munthe, 2016; Redecker & Punie, 2017; Skantz-Åber et al., 2022). Moreover, ICT self-efficacy was measured using only one item.

Construct validity, is similar to content validity, but goes a step further and includes the operationalised construct (Cohen et al., 2000). Therefore, this form of validity refers to how well the instrument measures the concept that it is intended to measure (Vogt, 2007). Construct validity can be assessed

statistically, through the sub-types of discriminant and convergent validity (Taherdoost, 2016b). While convergent validity refers to the extent, to which two measures of the same construct are correlated, discriminant validity defines the extent to which two constructs that should not be related, also differ from one another (Hair et al., 2014). As already described earlier, factor analysis (Hair et al., 2014; Huck, 2012) was used to provide evidence of construct validity (convergent and discriminant validity), for the constructs used in the main analysis in both Publications I and II. In relation to Publication I, an exploratory factor analyses (EFA) was conducted, while confirmatory factor analysis (CFA), was conducted in relation to Publication II. Convergent validity criteria for the constructs used in Publication I, were considered met, as factor structures were selected based on eigenvalues greater than 1, and factor loadings greater than .40 (Straub & Gefen, 2004). Discriminant validity for the constructs used was also largely met, with one exception in which an item within one of the three-factor structures *of purpose of ICT use* (ICT for administration and lesson planning), cross-loaded at .49 with another factor. To establish discriminant validity, the goal was to have no cross-loadings above .40 (Straub & Gefen, 2004).

In Publication II, construct validity for the constructs used in the SEM model was assessed and established, by using multiple fit indices with cut-off criteria. Model fit indices were used to assess the validity of the SEM measurement model (Hair et al., 2014; Sun, 2005). In other words, this meant assessing the extent to which the hypothesised SEM model, containing complex relationships between age, support, ICT infrastructure, digital competence, perceived usefulness of ICT in HE and the three dimensions of HE teachers' ICT use (ICT use for cooperation, ICT for facilitating pupils' learning, ICT for administration and lesson planning), fitted the data and was comparable to a baseline model in a better way. The values of the RMSEA, TLI and CLI fit indices confirmed good construct validity, for all the measures used in Publication II, as well as good model fit for the measurement model in the SEM. However, in both cases, the chi-square test (χ^2), was found to be non-significant. The goodness of fit index of chi-square (χ^2), is considered difficult to use, as it is a mathematical function of sample size. Therefore, a recommended statistically insignificant chi-square test, is difficult to achieve, as it is rarely used as a single measure (Hair et al., 2014).

Reliability is a measure of consistency and repeatability and determines whether an instrument can produce consistent and reproducible results over time (Mellinger & Hanson, 2021). Cronbach's alpha, a measure of internal consistency, described in more detail in Chapter 3.2.3 (Data Analysis), provided evidence of internal consistency, reliability in Publications I and II. With the exception of two scales, all scales in Publications I and II achieved acceptable values of at least .70. Two scales (ICT for administration and lesson planning; social media), reached lower Cronbach's alpha values of .66 and .59 respectively (see Publication I, Appendix 2, Appendix 3), but were still

considered acceptable, especially considering the small number of items loading on the factors (van Griethuijsen et al., 2015).

3.4.2 Quality of the Qualitative Research Phase

Multiple criteria were used to assess the quality of qualitative research, and still, no agreement has been reached on which the most suitable core criteria for qualitative research are (Flick, 2014). Alternative criteria for validity and reliability have been suggested, for example, by Lincoln and Guba (1985), who used the concept of trustworthiness. In establishing trustworthiness in the qualitative study in this thesis (Publication III), the following criteria were considered based on Lincoln and Guba: *credibility* (i.e. truth value), *transferability* (i.e. applicability), *dependability* (i.e. consistency) and *confirmability* (neutrality).

Credibility is similar to internal validity, and reflects the congruence between findings and reality (Korstjens & Moser, 2018; Stahl & King, 2020). Credibility can be ensured through subjective judgement within the preparation, organisation and reporting phases. Within the preparation phase, *credibility* can be confirmed by choosing the right strategies and most suitable data collection methods (Elo et al., 2014; Korstjens & Moser, 2018). For example, the use of interview data was considered appropriate for the application of qualitative content analysis (Graneheim & Lundman, 2004). The sampling strategy and sample size, were also important for establishing credibility in the preparation phase when using content analysis (Elo et al., 2014). The recruited participants were selected based on the ICT user profiles identified in Publication I; therefore, they were considered appropriate, as they represented HE teachers who used ICT in three different ways: frequently, infrequently and specifically for certain purposes only. However, due to major challenges in recruiting research participants, a sample size of 12 HE teachers was justified as sufficient, although it may have compromised full data saturation (Elo et al., 2014b; Guest et al., 2006). In the preparation phase, three pilot tests were conducted to ensure that the questions (Appendix C; Appendix D) were understandable and yielded rich data (Elo et al., 2014).

In the organisation phase, investigator triangulation was used as a strategy to increase credibility (Korstjens & Moser, 2018). A co-author was involved in verifying the interpretation of some transcripts and developing categories. The interpretation of the transcripts, codes and categories, has also been rechecked several times to minimise misinterpretations (Elo et al., 2014).

Transferability or applicability, refers to the extent to which the findings from one context can be transferred to another context (Korstjens & Moser, 2018). Transferability is achieved when thick and rich descriptions of the context, participants, settings, climate and process, as well as the factors influencing data collection exist (Amankwaa, 2016; Korstjens & Moser, 2018; Stahl & King, 2020). To increase transferability, descriptions were provided

with reference to the sample size, sample, sampling strategy and analysis process.

Dependability can be compared to the quantitative term "reliability", and is related to the consistency and stability of the enquiry. Dependability is established when an enquiry process is performed under similar circumstances, and produces similar results (Lincoln & Guba, 1985). However, *confirmability* is related to objectivity or neutrality, and refers to the "degree to which the findings of the research could be confirmed by other researchers" (Korstjens & Moser, 2018, p. 121). Auditing and keeping reflective diaries were two strategies used, to establish both dependability and confirmability (Flick, 2014; Korstjens & Moser, 2018; Lincoln & Guba, 1985).

To contribute to the dependability and confirmability of the interview study, a README file was created, containing information about the study, software used and the files available. These files included, for example, raw data (transcripts), data analysis, transcription conventions and documentation of the analysis process. Conformability was also ensured through the use of quotations from the interview (Elo et al., 2014b).

3.4.3 Quality of the Mixed-Methods Research Phase

Several researchers have recently discussed and proposed, different criteria to be used to address and assess the quality of mixed-methods research (Dellinger & Leech, 2007; Fàbregues & Molina-Azorín, 2017; O'Cathain, 2010). The quality of the mixed-methods approach used in this thesis, was assessed using a quality framework proposed by O'Cathain (2010), which was divided into the following eight quality domains: (1) planning quality, (2) design quality, (3) data quality, (4) interpretive rigour, (5) inference transferability, (6) reporting quality, (7) synthesisability and (8) utility. These domains were divided into a comprehensive list of domain items. As the framework was relatively comprehensive, the quality of this mixed-methods study was evaluated using the first six domains, and selected items within the framework. The areas of synthesisability and utility were considered difficult to assess. The utility of the study findings may be challenging to assess, as HE is a very small school subject and profession. However, the findings of this thesis might still have high application value, in terms of future curriculum work.

Planning quality can be assessed in terms of items such as foundational elements, rationale transparency and planning transparency, and it is related to how well the mixed-methods design study is planned (O'Cathain, 2010). Foundational elements can be ensured by conducting a literature review prior to conducting a mixed-methods study. Unfortunately, no literature review had been conducted, to provide an overall understanding of the research phenomenon. Thus, considering that the empirical survey data were collected as part of my master's thesis on the same topic, I already had some familiarity with and understanding of the research phenomena under study

prior to conducting the mixed-methods study. To ensure planning quality, a research plan was drawn up during the planning phase, outlining the aims of the study and the research questions of the original studies. I also participated in a PhD course on mixed methods, to make the rationale for using a mixed-methods design in this thesis more transparent. However, these items were difficult to assess, as they belonged to the early planning phase of the study.

Design quality refers to the choice and description of the design used, and how well the design fits the research question. Design quality has been evaluated through design transparency, design suitability and design rigour (O'Cathain, 2010). To achieve design transparency and design suitability, a detailed description of how and when quantitative and qualitative data, are integrated throughout the study is provided in sub-chapter 3.1, as well as the purposes of using mixed methods. To ensure design transparency, the key aspects of the design used are illustrated in Figure 2. The quantitative and qualitative methods used, were considered suitable and appropriate and fit for purposes, as they addressed research questions separately but still covered the same broad phenomenon, that is HE teachers' ICT use. In terms of the rigour of the design, it has been partially compromised, due to the challenges of finding a mixed-methods design, that was fully fit for the purpose of this thesis. A sequential explanatory design, with elements of a convergent mixed-methods design was used. A sequential explanatory design, requires qualitative data to provide an in-depth understanding of quantitative data (Creswell & Creswell, 2018). In addition, qualitative and quantitative data, have also been merged and informed of where they were of equal value. However, this approach is not considered faithful to the sequential explanatory mixed-methods design.

Data quality refers to the data collection methods and analysis and is assessed by data transparency, data rigor/fidelity, sampling adequacy and analytical adequacy. Data transparency addresses how well the methods are described (O'Cathain, 2010). Data rigor/fidelity refers to the extent to which the methods are adequately implemented. Analytic adequacy, refers to the extent to which the analysis methods are performed appropriately, and fit the research questions (Tashakkori & Teddlie, 2008).

Data transparency, data rigor/fidelity and analytic adequacy, were ensured through peer-reviewed research articles (Publications I–III), and a detailed description of the methods and the analytical techniques used in the publications. Each of the quantitative and qualitative methods used in this thesis, has been thoroughly described, both in the published articles and in this thesis. The analytical techniques in Publications I–III, were also appropriately undertaken, as described in Chapter 3. In terms of sampling adequacy, the sample size could have been advantageously larger in both the survey study and the interview study (Elo et al., 2014b; Wolf et al., 2013).

Interpretive rigour refers to the quality and accuracy of conclusions drawn from a mixed-methods approach. In this thesis, interpretive transparency was ensured by reporting the findings of the quantitative (Publications I and II),

and qualitative (Publication III) studies separately. This made it clear which findings were drawn from which methods. I also pursued interpretive consistency by first discussing the findings, of the included publications separately and then combining them using a theoretical lens. In terms of theoretical consistency, the findings were discussed, to support the assumed relationships proposed in Bandura's reciprocal determinism theoretical framework. The relationships found were further supported by findings from other empirical studies. When it comes to interpretive bias reduction, I attempted to explore and explain the contradictory findings found in the publications.

Inference transferability is similar to generalisability in quantitative research, and transferability in qualitative research, and refers to "the degree to which conclusions can be applied to other entities or settings" (O'Cathain, 2010, p. 549). The sample size and sampling strategies used in the survey and interview studies were described throughout the study process. However, it was still difficult to assess inference transferability. Hence, the study findings could be generalised to other HE teachers in lower secondary education in Finland, as the thesis addresses a very current phenomenon regardless of the context. Conditions that have been shown to be related to HE teachers' ICT use in this mixed-methods study, might also apply to other HE teachers in Finland and other Nordic countries. For example, in Sweden, the subject of Home and Consumer Studies shares several similarities with the school subject of HE in Finland (Tuomisto et al., 2017).

Reporting quality is assessed through report availability, reporting transparency and yield. Report availability was partly compromised due to the COVID-19 pandemic. Survey data were collected in 2016, and interview data were collected three years later in 2019. This was before the outbreak of the COVID-19 pandemic. The corresponding articles were published one after the other in 2021 and 2022 which is after the COVID-19 outbreak. Given teachers' widespread and increased use of ICT during the COVID-19 outbreak (Lavonen & Salmela-Aro, 2022), the published articles can be considered slightly delayed (O'Cathain, 2010). Reporting transparency refers to clear and adequate descriptions of the key elements of a study (O'Cathain, 2010). Reporting transparency was partly ensured by providing a description of the mixed-methods design used, the methodology used in terms of sampling, data collection and analysis as well as where synthesis took place. Yield refers to new insights and knowledge gained from a mixed-methods study. Yield has been ensured in the discussion chapter, in which the data from the survey study and the interview study have been integrated, to provide new insights and knowledge on HE teachers' ICT use.

3.4.4 Quality Considerations from the Perspective of Critical Realism

The quality of this thesis will also be assessed and discussed from the perspective of critical realism. Hence, I will not discuss quality according to

any specific and fixed criteria, but rather in relation to some of the core features of critical realism, such as the ontological and epistemological assumptions of critical realism, the role of human agency and the use of abduction and theories.

One of the main features of critical realism is the combination of ontological realism and epistemological relativism (Zachariadis et al., 2013). Conducting a mixed-methods study, such as that in this thesis, which combines quantitative and qualitative methods, can be seen as a way of emphasising the main feature of critical realism. Although some criticism has been faced by quantitative methods within critical realism, it has also been argued that quantitative methods are valuable within the critical realist tradition, particularly when combined with qualitative methods (Danermark et al., 2019; Maxwell & Mittapalli, 2010). The application of statistical analysis, such as factor analysis, can be useful in the exploratory phase of the research process. These analyses can identify patterns, which, in turn, suggest about some underlying causal structures or mechanisms that have generated these patterns (McEvoy & Richards, 2006; Mingers, 2000). However, it is recommended that quantitative methods are complemented by qualitative methods to provide more in-depth knowledge of these potential mechanisms. For example, from a critical realist perspective, one would want to know, "under what circumstances do support measures have a positive impact on the use of ICT by HE teachers?" Content analysis, as used in Publication III, may have the potential to provide more in-depth knowledge about the types of support that teachers demand and value.

Human agency is another important feature of critical realism. According to a critical realist perspective, all activities depend on the ability of individuals to generate change, which requires the intentional and purposeful actions of individuals (Bhaskar, 2013). By applying quantitative analysis methods, such as SEM, it is possible to study the impact of potential characteristics of human agency, such as ICT self-efficacy, on the use of ICT by HE teachers. However, the qualitative analysis methods made it possible to identify conditions that support some of the characteristics of human agency.

Critical realism also emphasises the use of abduction and multiple theories (Danermark et al., 2019). Features of abductive reasoning, combined with induction and deduction, can be observed throughout the entire research process (see Figure 2). In Publication I, induction was used to identify patterns in HE teachers' use of ICT. However, Publication I also contained elements of deduction. The patterns investigated in the k-means clustering analysis were based on previous research, which meant that a general pattern already existed.

In Publication II, deduction was applied through the development and testing of hypotheses, again based on established theories and previous research. However, as the findings of Publication II could not capture the complex nature of HE teachers' use of ICT and raised even more questions, Publication III used abductive reasoning to explore HE teachers' experiences

and perceptions qualitatively. Bandura's model of triadic reciprocal causation was used as an alternative theoretical lens, through which to reflect on the findings. Finally, the findings from Publications I–III were viewed through the lens of Bandura's model of triadic reciprocal causation.

According to critical realism, no ultimate true fact or theory exists. Therefore, the use of multiple theories and modifying them, is highly recommended (Danermark et al., 2019). Publications I–III have all been based on different theoretical expectations.

3.5 Ethical Considerations

When conducting research, there are ethical considerations, a set of principles, that need to be followed, and that underpin the research process. This mixed methods study followed the ethical principles for research in the humanities and social and behavioural sciences established by National Advisory Board on Research Ethics in 2009, as the ethical principles published in 2019 (Finnish National Board on Research Integrity TENK, 2019) were not yet relevant at the time of data collection in 2016 and 2019. The following three main ethical principles were included: respect for the autonomy of research subjects, avoidance of harm, privacy, and data protection.

The autonomy of research subjects refers to the extent to which the research participant can make their own decisions about whether to participate in research (National Advisory Board on Research Ethics, 2009). The ethical principle of autonomy, therefore requires that the participants participation in research is voluntary, and protected by informed consent. In the survey study, the participants received a link to the questionnaire along with a cover letter. The cover letter provided participants with information about the aims of the study, the researcher's contact details, the estimated time needed for completing the survey, the use of the data, the ethical principles of the study such as the principles of voluntary participation, anonymity, and confidentiality of the data. The participant's decision to complete and return the survey was considered as an affirmative consent. According to the prevailing ethical principles[15], in addition to verbal or written consent, a participant's behaviour, such as responding to a survey questionnaire, can be interpreted as consent to participate. (National Advisory Board on Research Ethics, 2009).

In the interview study, information about the recording of the interview was added to the cover letter. The cover letter was sent before participants gave their consent to participate in the study. To protect the participants' right to autonomy, they were also asked to confirm the informed consent either by signing the form on the spot, by using an electronic signature, or by confirming by email. The consent form included additional information about the possibility to withdrawing consent, how the interview would be recorded,

[15] Ethical principles of research in the human sciences were updated in October 2019.

how the data would be archived, and how the data would be used for future research purposes.

Avoiding harm includes, for example, treating participants with respect and reporting the study findings in a way that does not cause them harm (National Advisory Board on Research Ethics, 2009). One way to avoid harm is to estimate the length of the interview correctly. The length of the interview was correctly estimated thanks to pilot testing. As this research did not involve private matters, avoiding psychological, financial, and social harm was not a major issue.

Privacy and data protection concerns confidentiality, protection of research data, storage and deletion of data, and protection of participants in the publication of articles (National Advisory Board on Research Ethics, 2009). In terms of personal data, both email addresses and the name of the school where the teachers worked were collected in the survey study. Email addresses were only used for sampling purposes in relation to the interview study. This personal data was later deleted and destroyed from the original data file, as well as from any other type of file used for analysis. Neither survey data nor interview data are stored with identifiers.

A data management plan was also created for data protection purposes, providing a more detailed description of how the data is managed and stored during and after the research project. As data management planning was not yet relevant in year 2016, when the quantitative data was collected, the data management plan was not created until 2019.

To protect confidentiality, the data were not shared with anyone outside the research team (myself and co-authors). The participants' identity in the interview study was also protected by anonymising the interview data.

Scribendi proofreading (Scribendi, 2023) and an AI-powered assistance tool (Deepl, 2023) were used in the final stages to identify and correct grammatical and spelling errors in the text of this thesis and to improve clarity of the writing.

4. Summary of the Publications

The aim of this thesis was to investigate HE teachers' use of ICT in teaching and supporting students' learning in lower secondary education, and deepen the understanding of the conditions related to their ICT use. In the following chapter, I will provide a summary of the three publications, which are further based on two separate original studies: (1) a survey study and (2) an interview study. The publications are presented in terms of aim and research questions, participants and data, analysis, and findings. I have chosen not to summarise the discussions for each publication to avoid repetition in the discussion chapter. Publication I aims to answer the first research question of this thesis, "What are the dimensions of HE teachers' ICT use and how do they relate to teachers' beliefs?". Publication II contributes to answering the second research question, "How can teacher-level (digital competence, age, perceived usefulness) and school-level (support, ICT infrastructure) factors explain HE teachers' use of ICT in teaching and learning?". Publication III contributes to answering the third research question of this thesis, "How can HE teachers' use of ICT in teaching and student learning be understood through their ICT integration practices, goals for ICT use and related conditions?".

4.1 Survey Study: Publications I and II

Both Publications I and II were based on empirical data collected within the survey study.

4.1.1 Publication I

Publication I was entitled "Finnish Subject Teachers' Beliefs and Use of Information and Communication Technology in Home Economics' and aimed to explore patterns in Finnish subject teachers" use of ICT, by identifying ICT user profiles based on the purpose of ICT use, and teachers' beliefs[16] about the importance of using ICT, to achieve the learning objectives in HE (see Measurements 3.2.2). Moreover, the study examined whether differences existed in terms of demographics, ICT self-efficacy and use of different types of ICT within the established ICT user profiles. The following research questions were addressed in Publication I:

1. What are the dimensions of ICT usage among subject teachers in HE?
2. What kinds of ICT user profiles can be identified among subject teachers in HE?
3. What kinds of differences can be found among the user profiles with regard to subject teachers' demographics (age, teaching

[16] Refers to teachers' beliefs in Publication I. Included as part of the "perceived usefulness of ICT in HE" measure in this thesis.

qualification), perceived ICT self-efficacy and use of different types of ICT?

Using data from the survey study collected in 2016, the sample included 161 Finnish HE teachers. The majority (58.4%) were aged between 46 and 60 years, and 123 teachers were qualified to work as subject teachers in HE. Teaching qualification was the only question with missing data for five teachers. Two measures (purpose of ICT use, teachers' beliefs about the importance of using ICT for achieving learning objectives within the core content in HE) were used in the main analysis, and three additional measures (use of different types of ICT, ICT self-efficacy and demographics) were used in the further analysis. Age and teaching qualifications were used as demographic variables.

As a first step in the data analysis, three EFAs were conducted and showed that a three-factor structure for the *purpose of ICT use*, *teachers' beliefs, and the use of different types of ICT* best modelled the observed data. Answering the first research question in Publication I, the three-factor structure of the *purpose of ICT use* (10 items), indicated that HE teachers used ICT for three different purposes: ICT use for cooperation, ICT use for facilitating pupils' learning and ICT for administration and lesson planning (see Publication I, Appendix 2).

The three-factor solution for *teachers' beliefs* (12 items), was described by their beliefs about the importance of using ICT, to achieve the learning objectives with three different curricular emphases: food habits and choices, environmental and cost consciousness, and practical skills (see Publication I, Appendix 3). Finally, the three-factor solutions for the measure of *use of different types of* ICT (13 items), were labelled applications and digital content, tools for online teaching and social media (see Publication I, Appendix 4).

In the second step, a k-means algorithm cluster analysis (KCA), was performed that showed that a three-cluster solution was considered and selected, as the most meaningful solution for describing the patterns in HE teachers' use. This answered the second research question. The profile groups were based on the purpose of ICT use, and the beliefs of HE teachers, and they were further labelled as infrequent ICT users (n = 60), specific ICT users (n = 43) and frequent ICT users (n = 58). Infrequent ICT users were characterised by infrequent ICT use and neither positive nor negative beliefs about the importance of using ICT in HE. Specific ICT users used ICT specifically for administration and lesson planning, and held negative beliefs in terms of the importance of using ICT in HE. Frequent ICT users used ICT frequently for all three dimensions of use, and held positive beliefs about the importance of ICT in HE.

Finally, to address the third research question, the chi-square test revealed that no differences were found in age, or teaching qualifications between the ICT user profiles. However, ANOVA revealed that frequent ICT users perceived their ability to use ICT (ICT self-efficacy), to be significantly higher

than infrequent ICT users. In conclusion, the findings of Publication I showed three dimensions of HE teachers' ICT use, which were further used in the next study to predict the effects of teacher- and school-level factors, on HE teachers' three different types of ICT use. The findings of this study also established three ICT user profiles, through which the relationship between HE teachers' frequency and purpose of ICT use, their beliefs and ICT self-efficacy could be confirmed.

4.1.2 Publication II

Publication II was entitled "Predicting Finnish Subject-teachers' ICT Use in Home Economics based on Teacher- and School-level Factors". The aim was to use a hypothesised research model, to examine the direct and indirect effects of teacher'- and school-level factors on HE teachers' three different dimensions of ICT use, as identified in Publication I. Following research questions were addressed:

1. To what extent do teacher-level factors (perceived usefulness of ICT in HE and digital competence) explain subject teachers' use of ICT in HE?
2. To what extent do school-level factors (ICT infrastructure and support) explain subject teachers' use of ICT in HE?
3. To what extent does perceived usefulness of ICT in HE mediate the indirect effects of age, ICT infrastructure and support on subject teachers' use of ICT in HE?
4. To what extent does digital competence mediate the indirect effects of age, ICT infrastructure and support on subject teachers' use of ICT in HE?

Similar to Publication I, Publication II was based on empirical data from the survey; therefore, it included 161 HE teachers in both Finnish and Swedish language lower secondary education in Finland. In the hypothesised research model, 8 measurement scales were used. The three dimensions of ICT use, identified in Publication I, were used as outcome variables in the model: ICT use for cooperation, ICT use for facilitating pupils' learning and ICT for administration and lesson planning. The following measures were used as predictor variables in the model: age, digital competence, perceived usefulness of ICT in HE[17], ICT infrastructure and support (see Appendix B).

As the first step in the data analysis, CFA was conducted to assess the construct validity and measurement quality of the scales in structural

[17] *Note*, the scale for perceived usefulness of ICT in HE in Publication II was composed of two scales: beliefs about using ICT to achieve learning objectives within HE (i.e., referred to as teachers' beliefs in Publication I) and general perceived usefulness. Both scales measure the perceived usefulness of ICT, with one focusing more on the value of using ICT in relation to subject-specific curricular beliefs and the other on the value of using ICT for teacher's work and students' learning in general.

equation modelling (SEM). The preliminary CFA model confirmed a good model fit, indicating that the factor structures for the variables used in the hypothesised research model were acceptable.

SEM was conducted as the main analysis to evaluate the indirect and direct effects of teacher- and school-level factors on HE teachers' ICT use. Based on the findings of the SEM, the research model achieved a good fit and explained 30% of HE teachers' ICT use for cooperation, 52% of ICT for facilitating pupils' learning and 41% of ICT for administration and lesson planning.

In relation to research question 1, and the direct effects of teacher-level factors on HE teachers' ICT use, digital competence was found to positively influence all three dimensions of ICT use with a strong regression weight, while perceived usefulness only had a positive, moderate direct effect on HE teachers' ICT use for facilitating student learning. In terms of research question 2, contrary to my expectation, ICT infrastructure did not show a significant effect on HE teachers' ICT use. However, support was found to have a negative direct effect on HE teachers' use of ICT to facilitate pupils' learning and administration and lesson planning.

In relation to research questions 3 and 4 and the indirect effects, perceived usefulness was found to mediate the positive effects of support on HE teachers' ICT use. However, digital competence mediated the indirect negative effects of age and the positive effects of support on all dimensions of ICT use.

Overall, based on both indirect and direct effects (total effects), the teacher-level factor of digital competence and perceived usefulness and the school-level factor of support were considered the most important predictors of HE teachers' use of ICT to facilitate student learning. Digital competence and perceived usefulness were important mediators of both teacher-level and school-level factors of age and support. These variables explained 52% of HE teachers' ICT use for facilitating pupils' learning. A third qualitative-oriented study was conducted to provide insights into other conditions related to HE teachers' ICT use and confirm the variables found in Publications I and II.

4.3 Interview Study: Publication III

Publication III was entitled "Home Economic Teachers' ICT Use in Finland Seen from a Lens of Reciprocal Determinism". The aim was to enhance the understanding of Finnish HE teachers' use of ICT by examining their ICT integration practices, goals for ICT use and related influences,[18] and by using Bandura's model lens of triadic reciprocal causation. The study was further designed to provide different perspectives, on the conditions that hindered or enabled HE teachers' use of ICT. The following research question was addressed:

[18] Influences are also referred to as conditions in this thesis

1. How can Finnish HE teachers' use of ICT, their goals and their influences be understood through the lens of reciprocal determinism?

The participants in this study included 12 lower secondary subject teachers in HE, 4 from each of the ICT user profiles established in Publication I. The data consisted of qualitative interview data collected through semi-structured interviews. The HE teachers were asked about their ICT use, their goals for using ICT and the influences that contribute to their use of ICT (Appendix C; Appendix D). The audio-recorded data were transcribed verbatim.

Qualitative content analysis with abductive coding was used to analyse the data. Inductive and deductive reasoning, were combined in an analysis process consisting of six main steps, including familiarisation with the data, deductive selection of pre-determined themes, identification of meaning units, inductive creation of codes, subcategories and main categories. The themes of ICT use (behaviour), goals of ICT use and influences were developed deductively based on the research question of the study.

In response to the first theme, *goals for use*, HE teachers aimed to use ICT to support both students' learning and teachers' work. HE teachers used ICT to support students' attention, motivation and interest, to increase their understanding of concepts and topics, and increase engagement and self-awareness. In terms of supporting their own work, one HE teacher used ICT to increase his or her own motivation, and another to support his or her instructional work.

In response to the second theme, *ICT use,* HE teachers were found to integrate ICT in three different ways: students' active use, teacher-directed use and cross-curricular use.

Finally, within the third theme, *influences*, the HE teachers provided a list of conditions that either hindered or facilitated their use of ICT. As the results were discussed in terms of triadic reciprocal determinism, these conditions were divided into personal and environmental conditions in the discussion section.

ICT infrastructure, organisational factors, support, subject culture and student factors were all found to be related to HE teachers' use of ICT. For example, in terms of support, HE teachers particularly valued technical and pedagogical support from the school, ICT teacher training programmes, and collegial support. However, most of the aforementioned conditions were cited as challenges to HE teachers' use of ICT, including students'-expectations of the subject, low status of HE, limited time allocated to the subject, broad curriculum, impractical instructional facilities, lack of financial resources, time constraints, technical and ethical safety issues, dysfunctional devices, poor internet connection, low access to teacher training programmes, students' low level of digital skills and ICT behaviour involving surfing on websites.

HE teachers' use of ICT was also negatively influenced by lack of digital competence, lack of interest and motivation and beliefs about the nature of the subject in terms of prioritising traditional and practical skills.

In contrast, HE teachers' use of ICT was positively related to digital competence, interest and motivation, positive beliefs about the usefulness of using ICT and beliefs about the nature of the subject.

Drawing on Bandura's model of reciprocal determinism, it can be concluded that HE teachers' use of ICT or *behaviour* was related to both *environmental* and *personal* conditions.

The findings also highlighted some interactions between HE teachers' ICT use and personal and environmental conditions, which are discussed further in the discussion chapter.

5. Concluding Discussion

The aim of this thesis was to investigate HE teachers' use of ICT in teaching and for students learning in lower secondary education and to further deepen the understanding of the conditions related to HE teachers' use through the lens of Bandura's reciprocal determinism. This concluding discussion is guided by the three research questions presented in this thesis (see 1.2 Aim, research questions and structure of the thesis). The main findings of the three studies are discussed separately, in relation to previous research. Finally, the quantitative and qualitative findings are integrated and discussed through the conceptual lens of Bandura's reciprocal determinism, to provide a more comprehensive understanding of how HE teachers' use of ICT, is related to environmental and personal conditions.

5.1 Dimensions of HE Teachers' Use of ICT and Relationships with Teachers' Beliefs

The first research question in this thesis was designed to explore patterns in HE teachers' use of ICT, by identifying the dimensions of ICT use and determine the relationships and associations between HE teachers' use of ICT and their beliefs. The beliefs examined were ICT self-efficacy, and perceived usefulness (see discussion of beliefs in Section 2.3.1 Conditions on teacher level). This research question was answered by Publication I.

Partly in line with previous studies (Howard et al., 2015; Ibieta et al., 2017; Meneses et al., 2012; Suárez-Rodríguez et al., 2018b; van Braak et al., 2004), which distinguished between ICT use outside the class (professional and supportive), and ICT use inside the class (instructional and administration), the results of Publication I revealed three dimensions of HE teachers' ICT use: ICT use for cooperation; ICT use for facilitating pupils' learning; and ICT use for administration and lesson planning. In line with these studies, ICT use for cooperation, as well as for administration and lesson planning, reflected ICT use outside the class, while the dimension of ICT use for facilitating pupils' learning reflected HE teachers' ICT use inside the class and actual ICT integration. Based on the items included, this latter dimension included both teacher-directed and student-directed ICT use, in line with study by Atman Uslu and Koçak Usluel (2019).

The findings also supported previous research, showing that teachers use ICT more often outside the classroom than inside the classroom (Ibieta et al., 2017; Suárez-Rodríguez et al., 2018; van Braak et al., 2004). The relatively low use of ICT by HE teachers to facilitate pupils' learning, largely supported previous reports showing that ICT is used quite rarely in artistic and practical school subjects (Fraillon et al., 2020; Tanha-Piironen et al., 2016).

The relationship between HE teachers' use of ICT, and their beliefs about the importance of using ICT in HE (hereafter referred to as perceived usefulness), was investigated using KMA analysis and ANOVA. The findings showed three different profiles of ICT users*, infrequent ICT users*, *specific ICT*

users and frequent ICT users, which further confirmed the relationship between HE teachers' ICT use and the perceived usefulness of ICT in HE. In line with previous research (Backfisch, Scherer, et al., 2021; Inan & Lowther, 2010a; Petko, 2012), perceived usefulness was found to be related to teachers' use of ICT for facilitating student learning. HE teachers who were frequent ICT users used ICT most frequently for all dimensions of use, and had the most positive beliefs about the usefulness of using ICT in HE. In contrast, teachers who belonged to the group of infrequent ICT users used ICT significantly less for all three dimensions of use and held more negative beliefs about its usefulness. Specific ICT users used ICT specifically for administration and lesson planning and held neutral beliefs about its usefulness. A possible explanation for this later relationship, could be provided by Atman Uslu and Koçak Usluel (2019), who found that ICT use before class mediated the indirect effect of teachers' beliefs on teachers' ICT integration. This, in turn, further emphasised the importance of teachers' supportive use outside of the class.

Another interesting finding was the role that value beliefs and domain-specific curricular beliefs, play, in explaining HE teachers' use of ICT. Related to teachers' beliefs, HE teachers were asked to estimate their beliefs about the importance of ICT in relation to the core content and objectives of HE, suggesting a rather domain-specific belief. However, this corroborated findings from studies in other subject areas (Anderson, 2015; Kim et al., 2013; Van Driel et al., 2007), which emphasised the importance of other educational beliefs in explaining and understanding teachers' practices.

Finally, the association between ICT user profiles and ICT self-efficacy was examined. The significantly higher ICT self-efficacy beliefs of frequent ICT users compared to infrequent ICT users, supported recent studies, showing that beliefs about the self, such as self-efficacy beliefs, play a role in both teachers' beliefs about the usefulness of ICT and teachers' ICT integration (Backfisch, Scherer, et al., 2021; Drossel et al., 2017; Gerick et al., 2017; Kaarakainen & Saikkonen, 2021; Teo, 2009).

In summary, the findings of Publication I, showed three dimensions of ICT use as well as associations between HE teachers' ICT use, and teachers' beliefs, both in terms of value- and subject-specific curricular beliefs (perceived usefulness) and self-beliefs (ICT self-efficacy). However, to identify other conditions related to HE teachers' use of ICT to support student learning, Publication II examined the role of different teacher- and school-level factors in HE teachers' three dimensions of ICT use.

5.2 The Role of Teacher- and School-Level Factors on HE Teachers' Use of ICT

The second research question was answered by Publication II, in which an SEM was conducted to examine the effect of teacher-level factors such as digital competence, perceived usefulness and age, and school-level factors, such as support and ICT infrastructure, on three dimensions of HE teachers'

ICT use, as identified in Publication I. The predictive role of these variables for the second dimension of ICT use, ICT for facilitating pupils' learning, was of primary interest in this thesis.

The findings of Publication II, confirmed the predictive power of the teacher-level factors of digital competence (Atman Uslu & Usluel, 2019; Hatlevik, 2017; Kaarakainen & Saikkonen, 2021; Suárez-Rodríguez et al., 2018b), and perceived usefulness (Backfisch, Scherer, et al., 2021; Ibieta et al., 2017; Inan & Lowther, 2010a; Pynoo et al., 2011; Teo, 2019) on HE teachers' ICT use, in particular, for facilitating pupils' learning. This suggested that teachers who perceived the use of ICT as more useful in supporting student learning, and who perceived their digital competence to be higher, also used ICT more often to facilitate students' learning.

Interestingly, HE teachers' perceived digital competence was found to have the strongest influence on HE teachers' use of ICT outside the classroom for administration and lesson planning, and the second strongest influence on their use of ICT in the classroom. This largely supports the work of other studies (Atman Uslu & Usluel, 2019; Suárez-Rodríguez et al., 2018b), which have found that teachers' digital competence, especially technological competence, is more important for their use of ICT outside the classroom than in the classroom. Thus, this finding can also be explained by the fact that HE teachers' perceived digital competence was also measured, focusing mainly on technological competence rather than pedagogical digital competence (see Appendix B).

Furthermore, consistent with previous research, Publication II also demonstrated the importance of value and subject-specific beliefs of perceived usefulness and digital competence as mediators. Teachers' digital competence mediated the negative effects of age (Inan & Lowther, 2010) and the positive effect of support (Petko, 2018) on all three dimensions of ICT use (Atman Uslu & Koçak Usluel, 2019). This suggested that older teachers, compared to younger teachers, tended to perceive their digital competence as weaker and, as a result, used ICT for different purposes to a lesser extent.

Thus, contrary to our expectations and previous research (Inan & Lowther, 2010; Scherer, 2015), perceived usefulness of ICT in HE, only mediated the relationship between support (Inan & Lowther, 2010; Teo, 2009), and ICT use for facilitating pupils' learning. This further implied that HE teachers with a greater perceived adequacy of support, also held higher beliefs about the usefulness of ICT in HE. This, in turn, indirectly influenced their level of ICT integration.

Taking into account school-level factors, Publication II could not show that ICT infrastructure had a significant effect on HE teachers' use of ICT, contrary to previous studies (Atman Uslu & Usluel, 2019; Drossel et al., 2017; Inan & Lowther, 2010a; Liu et al., 2017; Petko, 2012; Petko et al., 2018).

Hence, this insignificant effect may explain the findings of international reports that have found that Finnish schools are at the forefront of ICT infrastructure and digitalization, with large investments in ICT infrastructure

(European Commission, 2019a, 2019b; Fraillon et al., 2020) but simultaneously lag behind in integrating ICT into teaching and learning (Fraillon et al., 2020; OECD, 2019b). Thus, it is noteworthy that the reports referenced here were conducted before the WHO declared the COVID-19 outbreak on 11 March, 2020. This was critical, as education had changed dramatically due to COVID-19, exposing challenges in terms of digitalisation (Lavonen & Salmela-Aro, 2022; Vincent-Lancrin et al., 2022).

Another surprising finding was the negative direct effect of support on HE teachers' ICT use, which differed from studies that reported a positive direct effect (Atman Uslu & Usluel, 2019; Gil-Flores et al., 2017; Liu et al., 2017). In contrast, Publication II showed a positive indirect effect of support on HE teachers' ICT use through digital competence and perceived usefulness (Inan & Lowther, 2010; Teo, 2009). These findings or inconsistencies are likely to be related to the type of support. Pedagogical support (Gerick et al., 2017) and collegial support (Drossel et al., 2017; Gil-Flores et al., 2017; Inan & Lowther, 2010a), have been found to be more important than technical support, which in turn has been found to have a negative influence on teachers' ICT use (Drossel et al., 2017; Gerick et al., 2017; Ritzhaupt et al., 2012). Thus, based on the findings of this publication, it seems that HE teachers are looking for support that also enhances their digital competence, and emphasises the benefits of using ICT.

Overall, the findings of Publication II confirmed previous research on how age, digital competence, perceived usefulness, and support influence teachers' ICT use. The insignificant role of ICT infrastructure, and the effects of digital competence and perceived usefulness, also suggested that the teacher plays a significant role in ICT integration.

However, the teacher- and school-level factors explained 52% of HE teachers' use of ICT for facilitating pupils' learning, which meant that 48% of the variation was still not explained by the model. This, in turn, suggested that other conditions also exist that are important in relation to HE teachers' ICT use. Therefore, Publication III took a qualitative perspective to improve the understanding of HE teachers' ICT use by looking at HE teachers' ICT integration practices, goals of use and conditions related to their use of ICT.

5.3 HE Teachers' Use of ICT through Goals of Use, ICT Integration Practices and Related Conditions

The third research question of this thesis was answered by Publication III, that aimed to improve the understanding of HE teachers' use of ICT by exploring their goals of using ICT, their ICT integration practices and the conditions associated with their use.

In terms of goals for ICT use, Publication III showed that HE teachers used ICT to support both students' learning and teachers' own work. Previous research had reported several ways in which ICT could be used to facilitate student learning (cf. Fernández-Gutiérrez et al., 2020; Strømman, 2022; Sung et al., 2016). Most commonly, HE teachers reported using ICT to support

students' motivation, attention and interest, which was perhaps one of the most reported affective learning outcomes (Montrieux et al., 2015; Sung et al., 2016) associated with ICT use, even in HE (Beinert et al., 2020; Ho & Albion, 2010; Surgenor et al., 2016; Veeber et al., 2017). Interest, attention and motivation have a strong impact on students' learning process and success through increased engagement (Renninger & Hidi, 2015; Ryan & Deci, 2000).

Some teachers reported that they used ICT to improve students' cognitive achievements, by increasing their understanding of concepts and topics. ICT was also used to increase students' engagement, self-awareness, and responsibility for their own learning, which could be observed as supporting their self-regulated learning (Zimmerman, 2002). The development of self-regulation plays an important role in health and for coping with daily life (Brownlee et al., 2005; Kuhnle et al., 2012), and it is also in line with the emancipatory practice on which HE is partly based (Baldwin, 1984; Brown & Paolucci, 1979; Turkki, 1995).

As partly expected, no HE teachers used ICT to support students' cooperative and interaction skills, which was in line with a Norwegian study (Beinert et al., 2020), reporting that digital tools are rarely used for these purposes. Thus, HE offers excellent opportunities to develop these skills through working face-to-face (Lindblom et al., 2016; Taar, 2017; Taar & Palojoki, 2022), without involving computer-mediated communications and non-verbal cues (Hall, 2018; Lee et al., 2011).

An unanticipated finding, was that ICT was not mentioned as being used to promote students' digital competence. Acquiring digital skills and practicing reliable information as a basis for decisions in everyday life, are important aspects of being a conscious and responsible consumer (Brečko & Ferrari, 2016; Finnish National Agency of Education, 2014; Lubowiecki-Vikuk et al., 2021).

In terms of HE *teachers' ICT integration practices*, they differed somewhat from the reported goals for ICT use. The findings of Publication III showed that there are three ways of integrating ICT into teaching: students' active use, teacher-directed use and cross-curricular use. HE teachers' ICT integration practices partially supported previous studies, that had reported at least two main ways of integrating ICT into teaching and learning: teacher- and student-centred approach (Atman Uslu & Usluel, 2019; Comi et al., 2017). In terms of students' active use, HE teachers used ICT[19] mainly for searching and creating content, and less often for formative assessment, providing feedback and promoting communication and interactions, which was broadly consistent with studies reporting on the use of ICT by Estonian (Veeber et al., 2017) and Hong Kong HE teachers (Ho & Albion, 2010; Lau & Albion, 2010) as well as Finnish teachers (Fraillon et al., 2020; Leino & Nissinen, 2012). Thus, in line with their goals for ICT use, HE teachers used ICT for formative assessment and supported students' self-awareness through reflection and feedback,

[19] It should be noted that Publication III, as well as the study reported by Fraillon et al. (2020) were conducted before the outbreak of corona-pandemic.

which, in turn, could be seen as promoting self-regulated learning (Zimmerman, 2002).

In line with several previous studies (Ho & Albion, 2010; Lau & Albion, 2010; Limon, 2015; Veeber et al., 2017), HE teachers also used ICT to support teacher-directed practices, such as presenting and visualising information, archiving and providing learning materials, and summative assessment.

The cross-curricular use of ICT is neither exclusively teacher-led nor student-led. Nevertheless, this type of use adds to the literature by proposing ICT as a tool to promote the creation of cross-curricular learning environments that span multiple school subjects. Interdisciplinary teaching approaches are offered in Finnish core curricula, as a way of organising teaching and are particularly suitable for HE, due to the nature of the subject and the breadth of subject content (Finnish National Agency of Education, 2014).

In terms of conditions related to HE teachers' ICT use, a range of environmental and personal conditions were cited as hindering and facilitating the use of ICT by HE teachers. Contrary to expectations, ICT infrastructure[20], in particular, the availability of tools, was the most frequently mentioned condition related to HE teachers' use of ICT. Although ICT infrastructure is an important prerequisite for ICT use (Atman Uslu & Usluel, 2019; Gil-Flores et al., 2017; Inan & Lowther, 2010a; Petko, 2012; Tallvid, 2016), its predictive value is usually low (Drossel et al., 2017; Inan & Lowther, 2010a; Petko, 2012).

The challenges of time constraints related to the lesson structure and the limited time allocated to the subject (Lindberg et al., 2017) were expected, given that HE covers broad content and is still viewed as one of the smallest school subjects in the Finnish education system.

The organisational barriers in the form of ethical and technical security issues, concerned both ethical issues of student privacy and integrity, and technical security, in the form of handling digital devices in the kitchen. Similar concerns have been raised by, for example, Pegrum et al. (2013).

Concerns about inadequate instructional facilities, and a lack of financial resources were not confirmed by other studies, which may point to subject-specific challenges. For example, the low status of HE was cited as a contributing factor to HE teachers' experiences of lacking the financial resources to purchase appropriate equipment. The classroom was also considered impractical for the integration of ICT. It would be important to ensure that HE classrooms are designed and equipped with all the necessary equipment and ICT infrastructure (Anttalainen & Manninen, 2013), to meet the needs of the subject.

[20] Again, it should be noted that COVID-19 has most likely improved both the availability and the quality of ICT infrastructure in Finnish schools, although there are still large differences between schools. (Vuorio et al., 2021)

Support was identified as a condition that both facilitated and hindered HE teachers' use of ICT (Inan & Lowther, 2010). The findings also provided some perspectives on the type of support desired by teachers, pointing to a need for school support (Inan & Lowther, 2010), ICT teacher training (Gerick et al., 2017; Ritzhaupt et al., 2012), peer support and shared practices (Drossel et al., 2017; Gil-Flores et al., 2017). HE teachers further desired technical support to use specific devices and applications and requested that teacher training programmes focus on how to implement ICT in pedagogical practices in HE. This confirms the importance of both technical (Liu et al., 2017), and pedagogical support (Gerick et al., 2017).

The findings of Publication III also appeared to be consistent with other research (Erixon, 2010; Hennessy et al., 2005; Ho & Albion, 2010), which had reported that subject culture can influence ICT integration practices within a school subject. Subject culture can be seen as a set of practices and expectations, that have shaped the school subject over a longer time period (Goodson & Mangan, 1995). For example, the students' expectations of doing something practical were cited by some HE teachers as a reason for not prioritising ICT use. The breadth of the HE curriculum meant that the HE teacher had to choose a focus area, based on his or her own interests.

In terms of teaching factors, confirming previous research (Lindberg et al., 2017; Wang et al., 2014), teachers' digital competence was cited as a contributing factor to their ICT use, and a lack of such competence in the opposite direction challenged their use.

Furthermore, confirming the findings of Inan and Lowther (2010), older age was mentioned as a negative condition affecting HE teachers' motivation and eagerness to develop the skills needed for ICT integration. In addition, consistent with studies emphasising the role of motivational constructs in ICT use (Hatlevik & Hatlevik, 2018; Inan & Lowther, 2010; Liu et al., 2017; Teo, 2009), interest and motivation were generally mentioned by the majority of the HE teachers as a condition, that either hindered or facilitated ICT use directly or indirectly.

In terms of teachers' beliefs, the findings of Publication III emphasised the importance of perceived usefulness, as a value belief (Backfisch, Scherer, et al., 2021; Inan & Lowther, 2010a) and epistemological belief (Anderson, 2015; Hennessy et al., 2005; Kim et al., 2013; Urhahne & Kremer, 2023). Some teachers wanted to emphasise practical hands-on skills rather than focusing on ICT, which reveals the role of domain-specific epistemological beliefs.

HE teachers also struggled with feelings of lack of time, energy, and effort, which prevented them from using ICT and participating in ICT teacher training programmes. These findings were further in line with previous studies that reported a lack of time as a barrier to teachers' use of ICT (Drossel et al., 2017; Lindberg et al., 2017; Tallvid, 2016). According to Stein et al. (2020) and Wang et al. (2016), lack of time can also be related to priorities and other beliefs, such as the perceived usefulness of ICT. The feeling that using ICT would be effortless or teachers' perceived ease of use, has been

found to be related to teachers' intention and use of ICT in several studies (Tallvid, 2016; Teo, 2009, 2019), including in HE (Phua et al., 2012). In terms of teacher characteristics, age and prior experience with ICT and education (Liu et al., 2017; Ritzhaupt et al., 2012), were cited as related to HE teachers' use of ICT.

Finally, Publication III showed that student factors, particularly students' lack of digital skills, hindered HE teachers' use of ICT, as also mentioned by Midtlund et al. (2021) and Lai and Lum (2012). Another student factor was disruptive behaviour and misuse of ICT, by playing games and surfing other websites, which was also confirmed by previous studies (Chou et al., 2012; Håkansson Lindqvist, 2015; Lindberg et al., 2017).

In summary, the findings indicate that the use of ICT by HE teachers is hindered and facilitated by several conditions, most of which are considered barriers.

5.4 Findings through the Lens of Bandura's Model of Reciprocal Determinism

Social cognitive theory of triadic reciprocal determinism by Bandura (1986) was used as a theoretical lens in this thesis, to deepen the understanding of Finnish HE teachers' use of ICT in teaching and student learning, and identify the conditions that hinder and enable their use of ICT. The purpose of applying this conceptual lens was two-fold. First, drawing on both quantitative and qualitative findings, I aimed to identify the environmental and personal conditions related to HE teachers' use of ICT. Second, I intended to highlight the complex interplay between some of the personal, environmental, and behavioural conditions. I also touched on some mechanisms of human agency within the theoretical model, as some of these conditions have been shown to have an agency function within the conceptual model of triadic reciprocal causation.

5.4.1 Environmental and Personal Conditions Related to the Use of ICT by HE Teachers

The first phase of applying the lens of Bandura's triadic reciprocal causation (Bandura, 1986), focused on identifying the personal and environmental conditions related to HE teachers' use of ICT. Publications I–III identified several conditions related to HE teachers' use of ICT, as well as connections between environmental, personal, and behavioural conditions.

The behavioural aspect in Bandura's model, reflects HE teachers' ICT integration practices. In Publications I and II, this constituted the second dimension of HE teachers' ICT use: the use of ICT to facilitate pupils' learning. In Publication III, HE teachers' ICT integration was further described to include teacher-directed use, student-active use and cross-curricular use of ICT.

Several personal conditions have been shown to be related to and influence HE teachers' use of ICT. Findings from Publication I emphasised the

role of teachers' perceived usefulness (Inan & Lowther, 2010), and ICT self-efficacy beliefs (Backfish et al., 2021b) on HE teachers' ICT integration. The role of perceived usefulness as a personal condition was further confirmed by all three included publications (Inan & Lowther, 2010a; Teo, 2019). As described in Section 2.3.1 (Conditions on teacher-level), and in Section 3.2.2 (Measurements), in this thesis, perceived usefulness includes perceived beliefs about the usefulness or value of ICT as well as subject-specific curricular beliefs.

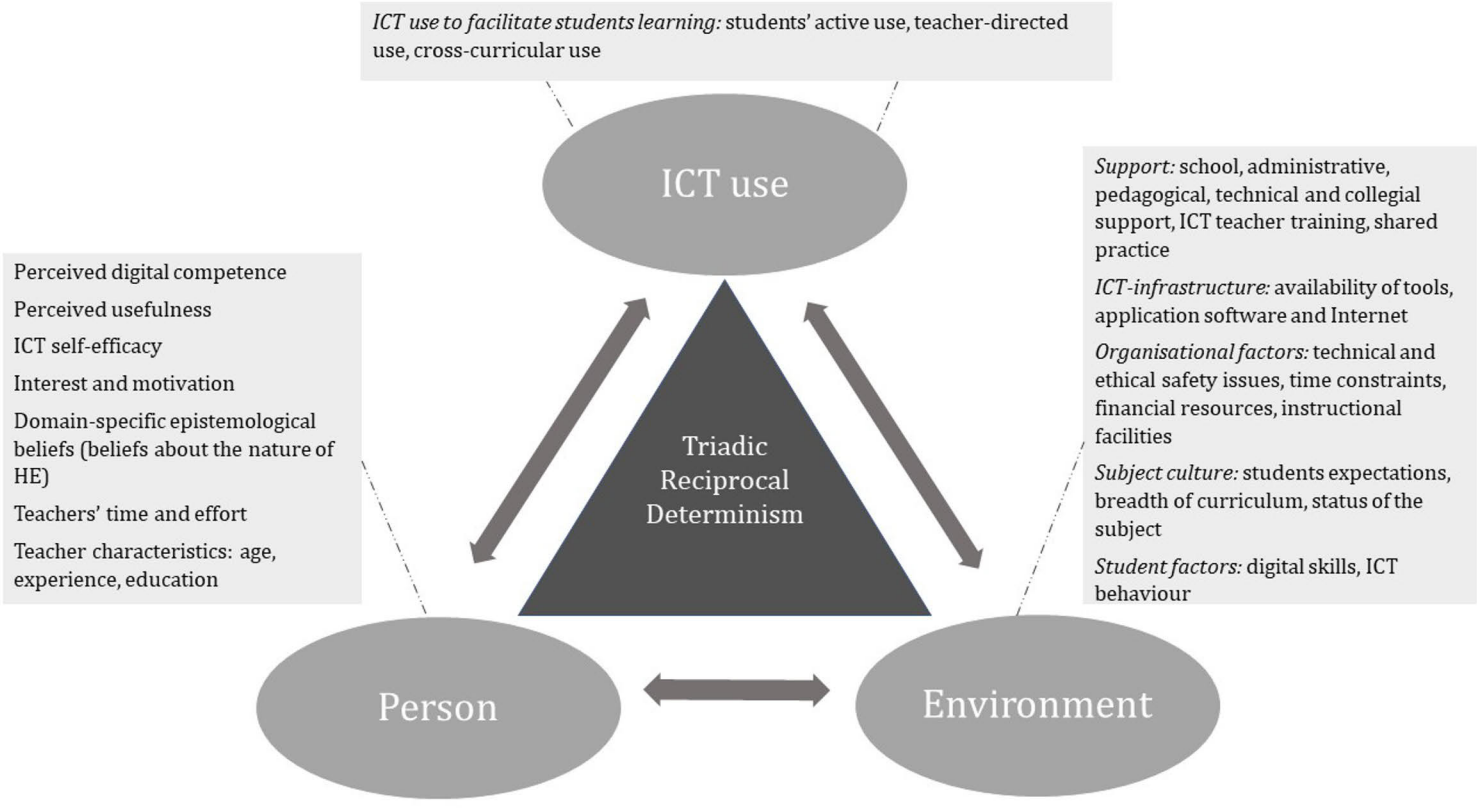
Both Publications II and III confirmed the importance of age and digital competence, as personal conditions that hindered or facilitated HE teachers' use of ICT. While older age was negatively related to HE teachers' development of digital competence and HE teachers' use of ICT (Inan & Lowther, 2010a), perceived digital competence (Hatlevik, 2017; Kaarakainen & Saikkonen, 2021) was positively related to HE teachers' use of ICT. Other personal conditions that were found to either hinder or facilitate HE teachers' use of ICT were personal interest and motivation, domain-specific epistemological beliefs (Anderson, 2015; Kim et al., 2013; Urhahne & Kremer, 2023), own time and effort (Lindberg et al., 2017; Tallvid, 2016),and teachers' characteristics of prior experience, age and education (Liu et al., 2017; Ritzhaupt et al., 2012).

Several environmental conditions (Bandura, 1989b), such as physical, social and institutional conditions, have been found to be associated with the use of ICT by HE teachers. Publications II and III confirmed the pivotal role of support for HE teachers' use of ICT. In Publication II, support was considered to positively influence HE teachers' use of ICT, but only indirectly when support also influenced teachers' perceived digital competence and the perceived usefulness of ICT in HE. This provided further evidence of the interplay between environmental, personal and behavioural conditions (Bandura, 1986).

Other conditions identified as environmental conditions in Bandura's model were pedagogical, technical, school, and collegial support, professional development, ICT infrastructure, technical and ethical safety issues, time constraints, financial resources, instructional facilities, subject culture and students' digital skills and ICT behaviour. These were all cited as either hindering or facilitating the use of ICT by HE teachers. Thus, not all conditions may be equally important (Bandura, 1986, 1997). These personal, environmental, and behavioural conditions are depicted in Figure 5.

Figure 5

Findings Through the Lens of Triadic Reciprocal Determinism



5.4.2 The Interplay between Environmental, Personal and Behavioural Conditions

In this second phase of applying Bandura's triadic reciprocal causation, the findings from Publications I–III were brought together to illuminate the complex interplay between environmental, personal, and behavioural conditions. As personal and environmental conditions do not impinge on people, the belief construct of ICT self-efficacy and perceived usefulness are also briefly discussed as part of the mechanisms of personal agency (Bandura, 2001).

According to Bandura (Bandura, 1986, 1989a), people are neither autonomous human beings nor directly affected by environmental influences. Instead, people can influence or regulate their own motivation and behaviour within the scope of Bandura's triadic reciprocal causation, in which environmental, behavioural and personal[21] conditions operate as interacting determinants (Bandura, 1997).

As previously discussed, the quantitative phase of this thesis (Publications I and II), had identified some interactions between the environmental conditions of support and the personal conditions of ICT self-efficacy, perceived usefulness, digital competence, age and HE teachers' ICT integration. The role of these conditions, apart from self-efficacy beliefs, was also partially confirmed by the qualitative findings. An integration of the findings from Publications I–III provided more information on how these conditions may interact with each other.

Confirming reciprocal determinism and Bandura (1989b), the findings from both Publications II and III indicated that HE teachers' use of ICT is rarely directly hindered or facilitated by environmental conditions. For example, in Publication II, support and participation in ICT teacher training influenced HE teachers' use of ICT by first changing their personal conditions, such as their perceived digital competence and perceived usefulness of ICT in HE. In contrast, in Publication III, personal interests and motivation were mentioned as a contributing reason why an HE teacher decided to participate in professional development, to enhance his or her digital skills. Furthermore, a lack of such interest and motivation was cited as a barrier to HE teachers developing the skills required, to use the available tools. A lack of peer support was also cited as negatively affecting a teacher's personal interest in using ICT. This further confirmed a great deal of studies (Hatlevik & Hatlevik, 2018; Inan & Lowther, 2010a; Liu et al., 2017; Teo, 2009), that showed that various motivational constructs have an important mediating role in mediating the effects of external conditions, such as support, collegial collaboration and ICT infrastructure. According to Bandura (1978, 1989b), people also tend to react to environmental influences based on personal characteristics. For example, in both Publications II and III, older age was found to be associated with a lack of motivation to develop their own digital

[21] Includes both affective (e.g., interest), and cognitive (e.g., digital competence) conditions.

skills. This further meant that environmental conditions do not influence the behaviour of all individuals equally.

Surprisingly, although ICT infrastructure had no predictive value in Publication II, in Publication III, all HE teachers mentioned access to tools, internet and application software as either hindering or facilitating their use of ICT. Moreover, ICT infrastructure was mentioned as being related to HE teachers' perceived usefulness of ICT. In contrast, teachers' inability to solve problems when using ICT was cited as a reason for not using the available applications. HE teachers are also more likely to use tools and applications that provide benefits. This supported an interplay between environmental, personal and behavioural conditions and was partly consistent with previous studies, that have found that ICT infrastructure is also related to personal factors, such as teachers' beliefs and digital competence (Inan & Lowther, 2010a; Liu et al., 2017). Access to ICT equipment, such as computers and internet access, does not matter much if the teacher does not have the skills to use them or does not see the value of using them.

There are several other examples of environmental conditions interacting with personal and behavioural conditions. In Publication III, a teacher expressed a belief or desire to prioritise the traditional practical skills in HE rather than having to keep an eye on computers, which shows an interplay between technical and ethical security issues (environmental) and domain-specific epistemological beliefs (personal). In contrast, the perception of viewing ICT use as part of life skills was related to a more positive view of ICT use in HE. In turn, the perceived belief about usefulness or value (personal) was highlighted in all three studies, as an important motivational personal construct influencing HE teachers' use of ICT (behaviour).

Other environmental conditions that were not necessarily mentioned in relation to personal conditions were subject culture, various organisational factors and student factors. Thus, they still set the limits of what is possible when it comes to HE teachers' ICT integration (Bandura, 1986).

Hence, providing HE teachers with the right environmental conditions and possessing the necessary competences will not be enough for successful ICT integration. Although the primary aim was not to study the role of human agency in reciprocal determinism, it is difficult not to highlight some of the features of the human agency as it plays a pivotal role in the model of reciprocal determinism and mediates the majority of external influences (Bandura, 1991). Human agency involves several self-regulatory mechanisms, such as intentionality, forethought, self-regulatory capability and self-reflection, through which individuals can motivate themselves and guide their behaviour (Bandura, 1991). Environmental facilitators or barriers can have different effects on behaviour, depending on self-regulatory mechanisms. Through these mechanisms, people also select the environment in which they want to act to achieve certain goals (Bandura, 2001).

Here, I will emphasise the role of HE teachers' ICT self-efficacy as a function of self-reflection and their perceived usefulness of ICT in HE, as part

of the capacity for forethought or outcome expectations. While Publication I confirmed the importance of ICT self-efficacy beliefs in HE teachers' ICT integration, the role of the perceived usefulness of ICT in HE was confirmed by all three publications.

According to Bandura (1986, 2001), self-efficacy beliefs, or beliefs in one's own abilities, are a crucial self-reflective and motivational construct that influences whether people think optimistically or pessimistically. Self-efficacy further influences whether one sets challenging goals for one's behaviour and makes efforts to overcome potential barriers (Bandura, 1989; 1997). Therefore, in line with this, HE teachers with lower self-efficacy beliefs may be more self-hindering, focusing more on failures and obstacles compared to teachers with higher self-efficacy (Bandura, 1994). This also explains why ICT self-efficacy was found to be positively related in Publication I, not only to HE teachers' frequency of using ICT for facilitating students' learning, but also to teachers' perceived usefulness of ICT in HE (Backfisch, Scherer, et al., 2021; Teo, 2009). HE teachers who judge themselves as having good abilities to implement ICT in teaching anticipate more positive outcomes (perceived usefulness) of their ICT use, which further influences the frequency of using ICT to facilitate student learning (Bandura, 1997).

Perceived usefulness, which is a part of the mechanism of forethought (Davis, 1989), refers to the ability to motivate oneself by envisioning the likely outcomes of one's own actions from a future perspective (Bandura, 1989a). Because people prefer to act in a way that produces desired results, HE teachers can guide their ICT use on their judgement of potential outcomes, such as perceived benefits (Bandura, 1986). In contrast, people avoid acting in a way that is self-harming or provides negative outcomes. This may also explain why subject culture involving, for example, students' expectations of doing something practical in HE, and teachers' domain-specific epistemological beliefs about prioritising the traditional practical skills in HE, were mentioned in Publication III in relation to their limited use of ICT and perceived benefits of using ICT in HE. Valuing the use of ICT in HE also emerged in Publication II, as an important predictor of HE teachers' use of ICT to facilitate student learning. Jenkins (2020) also found that teachers' desire to facilitate student learning outcomes functions as an important motivator and driver for teachers who enacted proactive agency to implement curriculum changes.

Based on this, ICT self-efficacy beliefs and perceived usefulness, both as mechanisms of personal agency, appear to play a key role in influencing the types of activities HE teachers choose to engage in (Bandura, 2001). This is also in line with a study by Jenkins (2020), which demonstrated that self-reflection and forethought were combined with the two other core properties of agency intentionality and self-reactiveness, as important characteristics for HE teachers who enacted proactive agency when implementing curriculum changes in the classroom. Compared to the other forms of agency, reactive

and passive agency, proactive agency is the most desirable, since teachers are personally motivated to make changes.

In contrast, Jenkins (2020) found that HE teachers who enacted passive agency had low efficacy and motivation to engage in curriculum changes. They also mentioned several contextual factors influencing their motivation, interest and agency. Traces of passive agency can also be observed in the findings of Publication III, in which a lack of motivation and interest as affecting their ICT use was often mentioned by teachers and found to hinder HE teachers' development of skills to use tools available.

Personal agency also plays a key role in overcoming challenges (Bandura, 2001). For example, through the capacity of forethought, HE teachers are more likely to put effort into overcoming barriers to ICT use, as well as setting goals for themselves to achieve the desired results. For HE teachers, these goals would likely be about developing their own digital skills and taking advantage of the available support and ICT infrastructure. These conditions were found to be positively related to or mentioned in relation to HE teachers' perceived usefulness in Publications II and III. As not all conditions are equally influential (Bandura, 1986), some challenges may emerge as more dominant constraints than others. Subject culture (Goodson & Mangan, 1995), including students' and teachers' long-standing expectations of and beliefs about HE as a school subject, may be difficult to change (Ertmer & Ottenbreit-Leftwich, 2010; Richardson, 1996). Over a long period of time, other conditions that have shaped the current state of HE as a school subject and affect the resources available for HE teaching are the limited time allocated to the subject and the breadth of HE curricula (Drossel et al., 2017; Hennessy et al., 2005; Lindberg et al., 2017; Stein et al., 2020). These might function as the primary determinants if they are strong and limit HE teachers' self-influence (Bandura, 1986).

Since ICT efficacy and perceived usefulness are found to motivate HE teachers' use of ICT, a question of great interest is: How can we improve these mechanisms of personal agency? The most influential sources for developing self-efficacy beliefs are mastery experience and personal attainment (Bandura, 1986). Therefore, it is important to give HE teachers more opportunities to master their use of ICT and overcome challenges (Bandura, 1997). By encouraging HE teachers to reflect on their own ICT use, they can learn to experience successes as well as perform appropriately with ICT (Bandura, 1986). In Publication III, a lack of previous experience in using ICT was mentioned by one HE teacher as the reason for the limited use of ICT in HE. Increased experience was also found in the study by Jenkins (2020) to be important for HE teachers to improve their efficacy in making curriculum changes. In Publication III, having access to support immediately when needed was also mentioned as desirable. These forms of support could make it easier for teachers to solve difficulties they faced and turn failures into successes by receiving feedback on their ICT use. This would eventually increase their self-efficacy (Bandura, 1986). Self-efficacy beliefs can also be

reinforced by seeing other people or teachers perform successfully. In Publication III, HE teachers further appreciated additional peer support and desired more opportunities to share best practices. In particular, collegial collaboration has been shown in previous research to have a positive impact on teachers' self-efficacy in using ICT (Hatlevik & Hatlevik, 2018).

Similar forms of support were also seen as desirable in the study by Jenkins (2020), who listed positive collegial environments, administrative support, good quality professional development and increased experience and confidence, as some of the contextual factors that supported both HE teachers' proactive and reactive agency. In summary, it is important to provide HE teachers with various forms of tailored support to help them create positive experiences with ICT use and increase their motivation as well as agency to use ICT in HE, to facilitate student learning and overcome actual and potential challenges.

5.5 Limitations and Strengths

This thesis has some limitations and strengths. First, I will point out the main limitations linked to the measures, sample size, sample procedures and data analysis. I will also discuss the strengths of this thesis, which lie primarily in combining quantitative and qualitative techniques.

In Publication I, HE teachers' ICT self-efficacy was measured using a single-item scale. Thus, there has been some discussion of the appropriateness of single-item scales compared to multiple-item scales. According to Bandura (2006), self-efficacy scales should be constructed by accounting for a specific domain of functioning. This would mean that HE teachers' ICT self-efficacy beliefs are properly assessed in relation to their perceived capability to perform different tasks using ICT tools. In contrast, it has also been demonstrated that a single-item measure, could be a feasible option with good convergent, discriminant and predictive validity, especially for small sample sizes (Diamantopoulos et al., 2012; Hoeppner et al., 2011). However, caution must be used when interpreting the findings.

Some content validity (Metsämuuronen, 2006) issues with the digital competence scale used in Publication II were also found. The scale only targeted technical digital competence, which indicated that HE teachers' perceived that digital competence is measured quite narrowly (see Appendix B). Today, teachers' digital competence is conceptualised to include several dimensions, including pedagogical competence (Instefjord & Munthe, 2016; Redecker, 2017). Teachers' perceived digital competence is further based on self-reported data, which also threatens the validity and might lead to over- or underestimation of their digital competence.

Overall, when it comes to survey instrument development, it also needs to be mentioned that the rapid development of ICT has brought new skills and functions for ICT in education. Given this, many of the scales would probably have looked different if a similar questionnaire had been constructed today. For example, when it comes to the purpose of ICT use, more emphasis would

have been placed on using ICT to support the development of twenty-first century skills and self-regulated learning (Atman Uslu & Usluel, 2019; Redecker, 2017).

When it comes to sample size, there are no clear-cut recommendations for optimal sample size. Complexity of the model, number of indicators and effects of factor loadings are a few factors that might impact sample size requirements when performing an SEM (Sim et al., 2022; Wolf et al., 2013). Although more is not always better, a larger sample than 161 could result in a more stable and accurate estimation of the effects. Due to the small sample size, caution must be applied when interpreting the findings of Publications I and II. This thesis is also limited by its capacity to generalise the research findings. Due to difficulties in recruiting participants, probability sampling was combined with non-probability convenience sampling in the survey study. This, combined with the small sample size, might have threatened the external validity and generalisability of the findings (Vogt, 2007).

Transferability issues also apply to the interview study (Publication III), which included only 12 participants. Although a sample size of 12 is likely to be enough to provide rich information (Guest et al., 2006), three of the categories identified during the process of qualitative content analysis were based on only one observation. This affected the data saturation and the adequacy of the findings. A narrative analysis could have improved the transferability and credibility of the findings.

In addition, from a critical realist perspective, longer text segments could have provided thicker descriptions of the conditions challenging or enhancing HE teachers' use of ICT as well as captured the complex interplay between behavioural, personal and environmental conditions better compared to content analysis (McAllum et al., 2019).

Finally, some limitations related to the time period also existed. As studies and reports (Strietholt et al., 2021; Vuorio et al., 2021) indicate, the COVID-19 pandemic has had a great impact on teachers' ability to use ICT in education. In addition, the absence of longitudinal data might also have impacted the accuracy of the effects of different variables on HE teachers' use of ICT.

The current thesis also has some notable strengths. The main strength lies in the use of a convergent, mixed-methods sequential explanatory design with features of convergent mixed-methods design. This combination made it possible to expand the understanding and provide a more comprehensive view of HE teachers' use of ICT. While the quantitative findings investigated significant relationships between variables, the qualitative findings provided a deeper understanding of the quantitative findings as well as new insights into the phenomenon under study.

The participants in the interview study were further selected from the three ICT user profiles identified in Publication I, which made it possible to explore a variety of perceptions. Another important strength is the theoretical contribution of applying Bandura's reciprocal determinism to provide new perspectives on the conditions related to HE teachers' use of ICT. This

provided a basis for understanding how to support HE teachers in their ICT integration.

Some strengths and limitations attached to the philosophical position of critical realism were also considered for this thesis. Several studies (Elder-Vass, 2022; McEvoy & Richards, 2006) have highlighted the value of critical realism as an underpinning philosophy for mixed-methods research. Using multi-methodological approaches can be valuable from several points of view. Within this thesis, the quantitative methods, such as cluster analysis, factor analysis and SEM used in the exploratory stages (Publications I and II) have supported the identification of patterns in data and important relations between variables. The qualitative study has contributed to clarifying these relations as well as pointing out other conditions or mechanisms of importance for HE teachers' use of ICT. The theoretical lens of Bandura's reciprocal determinism has also made it possible not only to examine the interplay between variables at the behavioural, personal, and environmental levels but also to shed light on human agency. From both a socio-cognitive and critical realist perspective, a human being is seen as an intentional agent who has the capacity to generate change through intentional and purposeful acts (Bandura, 1986; Bhaskar, 2013). From a critical realist point of view, using theories and theoretical concepts is essential for understanding reality and social phenomena (Danermark et al., 2019).

Thus, one notable limitation related to the philosophical position is that it could guide the selection of methodological approaches within this thesis to a greater extent. Other methods, such as narrative analysis instead of content analysis in the interview study, are likely to exist, which could better capture the conditions that give rise to the phenomena (HE teachers' use of ICT) under study.

5.6 Implications and Suggestion for Further Research

Despite these limitations, there are also some notable theoretical and practical implications related to the findings of this thesis. I will also provide some suggestions for further research.

In recent decades, several conceptual models have been developed, constructed and tested (Ajzen, 1991; Davis et al., 1989; Fishbein & Ajzen, 1975; Teo, 2009), to explain human behaviour and reveal the multiplicity of factors or conditions influencing teachers' use of ICT. The models used show that unidirectional models are usually preferred over reciprocal models. Based on the findings in this thesis, I argue that a mixed-method study design combining quantitative and qualitative methods, can support a complex understanding of teachers' use of ICT. While the quantitative phase of this thesis provide empirical evidence that age, support, digital competence and beliefs about the usefulness of ICT matter to HE teachers' ICT use, the qualitative study has highlighted other conditions or challenges that are most likely to be ignored in the quantitative studies. These include, for example, the subject culture and organisational conditions. Integrating both approaches

can support the application of Bandura's conceptual model of reciprocal determinism, as a theoretical lens for understanding behaviour, such as teachers' practices. However, it must be pointed out that additional analysis and research is required to be able to confirm the interplay between all the conditions identified in the publications to understand the use of ICT by HE teachers and explore the main characteristics of teachers' personal agency.

These findings also have significant practical implications for understanding what is important for HE teachers when using ICT. In the long term, this study can contribute to developing HE teachers' ICT teaching practices through targeted professional development.

Finally, I will make some suggestions for further research. The qualitative findings were good at pointing out conditions that hindered or facilitated HE teachers' use of ICT but could not assess statistical significance. Further modelling research could be conducted to determine the significance of the conditions revealed in Publication III on HE teachers' use of ICT, such as the role of subject culture, domain-specific epistemological beliefs, and organisational issues. Hence, more research is needed to explore HE teachers' ICT integration practices. In this thesis, self-reported survey and interview data (Publication III) were combined to explore HE teachers' ICT (Publications I and II) integration practices. The findings show that ICT is quite versatile for use to support both teachers' work and students' learning. Thus, future studies could complement interview data with classroom observation data to add valuable insights into how teachers integrate ICT into teaching practices to support students' learning outcomes.

Although this thesis did not primarily aim to examine the nature of human agency within Bandura's socio-cognitive theory, the empirical findings shed light on the role of both self-efficacy beliefs and perceived usefulness as part of human agency within the model of reciprocal determinism. Thus, significantly more research is needed to determine the impact of self-efficacy on HE teachers' use of ICT. It would also be fruitful to analyse the role of other elements of human agency, such as intentionality and self-reactiveness, in HE teachers' use of ICT.

5.7 Conclusions

The main aim of this thesis was to deepen the understanding of Finnish HE teachers' use of ICT in teaching and student learning. This aim was approached using mixed methods and Bandura's model of reciprocal determinism to explore both HE teachers' ICT integration practices, and identify the conditions that enable and hinder their ICT use.

In terms of ICT integration practices, it can be concluded that although HE teachers use ICT for various purposes to support both affective and cognitive learning outcomes, ICT is used quite infrequently to facilitate students' learning. ICT was used with less focus on promoting students' digital competence, as this was not mentioned as a goal of their ICT use.

Confirming Bandura's reciprocal determinism, one of the significant findings based on this thesis is that HE teachers' use of ICT can be understood through an interplay of behavioural, personal, and environmental conditions. As most of the environmental conditions were found to be mediated by, or related to personal conditions, such as perceived usefulness, digital competence and motivation, it can be concluded that these conditions simply do not impinge on HE teachers.

The findings also emphasised the role of ICT self-efficacy and perceived usefulness as part of the mechanisms of personal agency, through which HE teachers exercise some self-influence over their own ICT use.

By providing insight into the complexity of teachers' use of ICT, it is easier to recognise the importance of tailoring support measures to the specific school, school subject and teacher to improve teachers' personal agency to face and overcome actual and potential barriers and challenges.

In conclusion, to resolve difficulties, it would be important that teachers, when needed, are provided with both easily accessible technical and pedagogical support at both school and classroom levels. Support should be provided as part of an ongoing strategy, with opportunities for feedback, especially when the aim is to facilitate the development of teachers' digital competence. The findings also underline the importance of supporting HE teachers in building more collegial networks for peer support, and the exchange of best practices in ICT integration. From the perspective of Bandura's theory of reciprocal determinism and human agency, these forms of support would provide HE teachers with more positive experiences with ICT use, in overcoming actual challenges in their ICT use as well as strengthen their beliefs in their own ability to use ICT and generate expectations for positive outcomes. Furthermore, it can support teachers in setting clear goals to work towards, and overcome potential challenges, such as continuing building their digital competence.

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Appendices

Appendix A: The Original Questionnaire (in Swedish and in Finnish)

Table A2. Enkätundersökning: IKT i huslig ekonomi

Del 1. Bakgrundsfaktorer

1. Hur gammal är du?
   - Under 25
   - 25–30
   - 31–35
   - 36–40
   - 41–45
   - 46–50
   - 51–55
   - 56–60
   - Över 60

2a. Vilken skola jobbar du på? (Namn på skolan kommer inte publiceras utan tillfrågas för att underlätta datainsamlingen och den geografiska indelningen)

_____

2b. I vilken kommun ligger skolan?

_____

3a. Vad har du för utbildning?

- Pedagogie magister/Åbo Akademi
- Pedagogie magister/Helsingfors universitet
- Pedagogie magister/Östra Finlands universitet

3b. Annat, vad?

_____

4a. Har du avlagt andra examen?

- Nej
- Högskoleexamen vid universitet
- Yrkeshögskoleexamen
- Yrkesexamen

4b. Ange typ av utbildning/examen

_____

Del 2. Användning av IKT

Pedagogiska applikationer = Pedagogiska applikationer är nätbaserade läromedel med vars hjälp eleven kan skapa, redigera och dela innehåll. Applikationer kan vara olika typer av text-, bildredigerings- och filmredigeringsprogram, men även diskussionsforum och chattar. Det finns

en mängd olika applikationer för att skapa egna tankekartor, presentationer, portfolion, fotoalbum och göra anteckningar.

Molnlagring = Molnlagring kan användas för att spara och dela datafiler, dokument, videor och bilder. Molnlagring kan uppfattas som ett lagringsutrymme tillgängligt via internet och kan därför nås via till exempel pekplattor, bärbara datorer och smarttelefoner. Några vanliga molntjänstverktyg är Google Drive, Dropbox, Youtube, Flickr, bloggar samt olika applikationer

5. Bedöm hur ofta du använder följande IKT-verktyg i undervisningen i huslig ekonomi på en skala 1–5 (1 = aldrig, 2 = sällan, 3 = ibland, 4 = ofta, 5 = mycket ofta). Utgå både från din och elevernas IKT-användning.

	Aldrig	Sällan	Ibland	Ofta	Mycket ofta
Stationära datorer	○	○	○	○	○
Bärbara datorer	○	○	○	○	○
Pekplattor	○	○	○	○	○
Mobil- eller smarttelefon	○	○	○	○	○
Interaktiva skrivtavlor (t.ex. Smartboard)	○	○	○	○	○
Projektor	○	○	○	○	○
Filmklipp	○	○	○	○	○
Recept i digital form	○	○	○	○	○
Nätbaserade spel (t.ex. Kahoot, Secondlife)	○	○	○	○	○
Bloggar (som elever driver själva)	○	○	○	○	○
Bloggar (som används t.ex. för kommunikation eller som informationsbank)	○	○	○	○	○
Nätbaserade presentationer (t.ex. Prezi- eller PowerPoint-presentationer)	○	○	○	○	○
Kunskapskälla (text, bild eller material från webbsidor som t.ex. Arktiset aromit, Ruokatieto, Terveyttä kasviksilla, Martha).	○	○	○	○	○
Sociala medier (t.ex. Facebook, Instagram, Twitter)	○	○	○	○	○

Molnlagringsverktyg (t.ex. iCloud, Google Drive, Dropbox eller skolans egna molnlagringstjänst)	○	○	○	○	○
Verktyg eller pedagogiska applikationer för att skapa, dela och redigera innehåll (t.ex. Slideshare, QR-koder, Vimeo, iMovie, Windows Movie Maker)	○	○	○	○	○
Verktyg eller pedagogiska applikationer för dokumentation (t.ex. Blogger, Wikier, Evernote, Popplet)	○	○	○	○	○
Nätbaserade hemuppgifter	○	○	○	○	○
Nätbaserad bedömning (uppgifter och prov som bedöms på nätet)	○	○	○	○	○
Nätkurser (distansundervisning via t.ex. Moodle, Fronter)	○	○	○	○	○
Virtuella lärplattformar (t.ex. Fronter, Google Classroom, Moodle)	○	○	○	○	○

6. Andra verktyg, vad?

_____

_____

7. Bedöm hur ofta du använder dig av IKT för följande ändamål på en skala 1–5 (1 = aldrig, 2 = sällan, 3 = ibland, 4 = ofta, 5 = mycket ofta).

	Aldrig	Sällan	Ibland	Ofta	Mycket ofta
För planering av undervisningen.	○	○	○	○	○
För administrativa uppgifter.	○	○	○	○	○
För att dela material med andra kollegor.	○	○	○	○	○
För att skapa material med andra kollegor.	○	○	○	○	○
För att samarbeta med mina kollegor i huslig ekonomi.	○	○	○	○	○

För att samarbeta med andra läroämnen.	○	○	○	○	○
För att kommunicera med eleverna utanför klassrummet.	○	○	○	○	○
För distansundervisning.	○	○	○	○	○
I undervisningen för att variera undervisningen.	○	○	○	○	○
I undervisningen för att individanpassa undervisningen.	○	○	○	○	○
I undervisningen för att presentera ett område på ett strukturerat sätt (t.ex. olika matkulturer, privatekonomi).	○	○	○	○	○
I undervisningen för elevens informationssökning.	○	○	○	○	○
I undervisningen för elevernas kommunikation sinsemellan.	○	○	○	○	○
I undervisningen för att stärka elevens lärandemöjligheter.	○	○	○	○	○

8. Annat, vad?

_____

_____

9. Ungefär under hur stor andel av undervisningen tillämpar du IKT? Utgå från både din och elevernas IKT-användning.

	Mer än 75 %	51–75 %	25–50 %	11–24 %	6–10 %	1–5 %	Mindre än 1 %	Vet inte
I procent %	○	○	○	○	○	○	○	○

Del 3. Nytta med IKT i Huslig ekonomi

10. Bedöm hur väl följande påståenden stämmer in på dig på en skala 1–5 (1 = Håller inte alls med, 2 = Håller delvis inte med, 3 = Varken eller, 4 = Håller delvis med, 5 = Håller helt med).

	Håller inte	Håller delvis	Varken eller	Håller delvis med	Håller helt med

	alls med	inte med			
Integrering av IKT stärker elevens förståelse för teknikens möjligheter i vardagen och hemma.	○	○	○	○	○
Integrering av IKT stärker elevens förståelse för teknikens möjligheter i arbetslivet.	○	○	○	○	○
Integrering av IKT främjar elevens utveckling av kunskaper i hur de olika IKT-verktygen fungerar.	○	○	○	○	○
Integrering av IKT främjar utvecklingen av elevens kreativitets- och innovationsförmåga.	○	○	○	○	○
Integrering av IKT främjar utvecklingen av elevens problemlösningsförmåga.	○	○	○	○	○
Integrering av IKT främjar elevens förmåga att söka fram, samla in och bearbeta information.	○	○	○	○	○
Integrering av IKT främjar elevens utveckling av kritisk informationshantering.	○	○	○	○	○
Integrering av IKT främjar utvecklingen av färdigheter som behövs för att producera och redovisa information.	○	○	○	○	○
Integrering av IKT främjar elevens förmåga att hantera olika datortillämpningar såsom kalkylprogram, databaser och ordbehandlingsprogram.	○	○	○	○	○
Integrering av IKT främjar elevens förmåga att få tillgång till och använda olika nätbaserade tjänster.	○	○	○	○	○

Integrering av IKT främjar elevens förmåga att hantera potentiella risker på nätet.	○	○	○	○	○
Integrering av IKT främjar elevens förståelse för betydelsen av etiska principer samt informationens trovärdighet och tillförlitlighet.	○	○	○	○	○
Integrering av IKT främjar elevens förmåga att dela information och kommunicera på nätet.	○	○	○	○	○
Integrering av IKT främjar elevens förmåga att producera och redovisa information.	○	○	○	○	○
Integrering av IKT främjar elevens samarbetsförmåga.	○	○	○	○	○
Integrering av IKT gör att eleverna blir mer engagerade i sitt lärande.	○	○	○	○	○
Integrering av IKT i huslig ekonomi ökar elevens intresse för ämnet.	○	○	○	○	○
IKT hjälper mig att tillämpa nya undervisningsmetoder och innovationer i undervisningen.	○	○	○	○	○
IKT underlättar mina administrativa uppgifter (t.ex. bedömning, listor).	○	○	○	○	○
IKT underlättar bedömningsarbetet.	○	○	○	○	○
IKT underlättar kommunikationen mellan elev och lärare.	○	○	○	○	○
IKT underlättar kommunikationen mellan föräldrar och lärare.	○	○	○	○	○
IKT underlättar repeterande arbeten (t.ex. upprätthållande av olika listor).	○	○	○	○	○

Undervisningen utvärderas av eleven mer positivt när IKT integreras i undervisningen.	○	○	○	○	○
Integrering av IKT skapar mer jobb för mig som lärare.	○	○	○	○	○
Integrering av IKT leder till att eleven utvecklar sämre skrivkunskaper.	○	○	○	○	○
Integrering av IKT leder till sämre direktkontakt mellan lärare och elev.	○	○	○	○	○
Integrering av IKT hindrar eleven från att lära sig.	○	○	○	○	○
Integrering av IKT kräver för mycket tid.	○	○	○	○	○

Del 4. IKT i huslig ekonomi

11. Bedöm hur viktigt du anser IKT tillämpas inom följande centrala innehåll i undervisningen i huslig ekonomi, på en skala 1–5 (1 = inte alls viktigt, 2 = inte särskilt viktigt, 3 = varken eller, 4 = ganska viktigt, 5 = mycket viktigt).

	Inte alls viktigt	Inte särskilt viktigt	Varken eller	Ganska viktigt	Mycket viktigt
För utveckling av matlagnings- och bakningsfärdigheterna.	○	○	○	○	○
För att planera måltider.	○	○	○	○	○
För att reflektera över matval och matvanor utifrån näringsrekommendationer.	○	○	○	○	○
För att reflektera över matval och matvanor utifrån matsäkerhet.	○	○	○	○	○
Att utgående från livsmedelskännedom reflektera över matval och matvanor.	○	○	○	○	○
Att utgående från kännedomen om matkedjan (från jord till	○	○	○	○	○

bord) reflektera över matval och matvanor.					
Att utgående från ekonomin reflektera över matval och matvanor.	○	○	○	○	○
Att reflektera över matval och matvanor utgående från etiska aspekter.	○	○	○	○	○
För att utveckla färdigheter som behövs i ett hushåll och i vardagen, (t.ex. välja lämpliga rengöringsmedel, apparater, redskap och arbetssätt inom rengöring, textil- och materialvård).	○	○	○	○	○
För att utveckla miljömedvetenhet i vardagen.	○	○	○	○	○
För att utveckla kostnadsmedvetenhet i vardagen.	○	○	○	○	○
För att lära sig handla enligt goda seder.	○	○	○	○	○
För att eleverna ska lära sig bedöma boende- och hushållsrelaterade tjänster.	○	○	○	○	○
För att eleverna ska lära sig använda medier och teknik som redskap i vardagen.	○	○	○	○	○
För att fatta ansvarsfulla beslut och använda tillförlitlig information som grund för valen.	○	○	○	○	○
För att lösa problem gällande hushållens ekonomi.	○	○	○	○	○

12. Vad anser du vara husliga ekonomins mest centrala uppdrag ur elevens synvinkel?

_____

_____

Del 5. Digital kompetens & fortbildning

13. Uppskatta din digitala kompetens utifrån påståendena på en skala 1–5 (1 = håller inte alls med, 2 = håller delvis inte med, 3 = varken eller, 4 = håller delvis med, 5 = håller helt med).

	Håller inte alls med	Håller delvis inte med	Varken eller	Håller delvis med	Håller helt med
Jag har tillräckligt med kunskaper i hur de olika IKT-verktygen fungerar.	○	○	○	○	○
Jag kan tillämpa IKT på ett kreativt och innovativt sätt.	○	○	○	○	○
Jag kan tillämpa IKT för att lösa olika problem.	○	○	○	○	○
Jag kan tillämpa IKT för att söka fram, samla in och bearbeta information.	○	○	○	○	○
Jag kan kritiskt bedöma informationens värde på nätet.	○	○	○	○	○
Jag kan producera och redovisa information med hjälp av IKT.	○	○	○	○	○
Jag vet hur man får tillgång till och kan använda olika nätbaserade tjänster.	○	○	○	○	○
Jag kan hantera potentiella informationsrisker på nätet.	○	○	○	○	○
Jag har en förståelse för betydelsen av etiska principer samt informationens trovärdighet och tillförlitlighet.	○	○	○	○	○
Jag kan dela information och kommunicera på nätet.	○	○	○	○	○
Jag kan hantera kalkylprogram (t.ex. Microsoft Excel).	○	○	○	○	○
Jag kan söka information i olika databaser.	○	○	○	○	○
Jag kan hantera ordbehandlingsprogram (t.ex. Microsoft Word).	○	○	○	○	○

14a. Hur upplever du din förmåga att använda IKT i undervisningen?

- ○ Mycket dålig
- ○ Dålig
- ○ Varken dålig eller god
- ○ God
- ○ Mycket god

14b. Motivera svaret i fråga 14a.

_____

_____

15. Hur ofta har du under de senaste två åren deltagit i fortbildning inom IKT i huslig ekonomi?

- ○ Aldrig
- ○ 1 gång på två år
- ○ 1 gång per år
- ○ 2-3 gånger per år
- ○ Mer än 3 gånger

Del 6. Stöd

16. Bedöm stödåtgärdernas tillräcklighet på en skala 1–5 (1 = Håller inte alls med, 2 = Håller delvist inte med, 3 = Varken eller, 4 = Håller delvist med, 5 = Håller helt med).

	Håller inte alls med	Håller delvist inte med	Varken eller	Håller delvist med	Håller helt med
Jag har fått tillräckligt med tekniskt stöd av skolan för att kunna använda IKT i undervisningen.	○	○	○	○	○
Jag har fått tillräckligt med pedagogiskt stöd av skolan för att kunna använda IKT i undervisningen.	○	○	○	○	○
Jag har fått tillräckligt med stöd från mina ämnes-kollegor för att kunna använda IKT i undervisningen.	○	○	○	○	○
Jag har fått tillräckligt med stöd från andra kollegor för att kunna använda IKT i undervisningen.	○	○	○	○	○
Jag har fått tillräckligt med stöd från skolledningen för	○	○	○	○	○

att kunna använda IKT i undervisningen.					
Jag har fått tillräckligt med stöd från skolans IKT-plan för att kunna använda IKT i undervisningen.	○	○	○	○	○
Det finns ett tillräckligt utbud av fortbildningar inom IKT överlag.	○	○	○	○	○
Det finns ett tillräckligt utbud av fortbildningar inom IKT i huslig ekonomi.	○	○	○	○	○
Jag har fått tillräckligt med stöd från fortbildningar för att kunna använda IKT i undervisningen.	○	○	○	○	○
Jag har fått tillräckligt med stöd från ämnesfortbildningarna för att kunna använda IKT i undervisningen.	○	○	○	○	○

Tekniskt stöd = Tekniskt stöd handlar bland annat om att upprätthålla den tekniska utrustningen i klassrummet.
Pedagogiskt stöd = Pedagogiskt stöd handlar om att främja tillämpningen av IKT som pedagogiskt verktyg. I praktiken innebär detta till exempel att stöda lärarnas användning av IKT för planering av undervisningen.

Del 7. IKT-infrastruktur i huslig ekonomi
IKT-infrastruktur = En fungerande IKT-infrastruktur utgör en av grundförutsättningarna för att kunna använda IKT i undervisningen. Till IKT-infrastruktur hör bland annat bredband, internet, Wi-Fi och digitala verktyg.

17. Hur ser du på IKT-infrastrukturens tillgänglighet? Bedöm på en skala 1–5 (1 = Håller inte alls med, 2 = Håller delvist inte med, 3 = Varken eller, 4 = Håller delvist med, 5 = Håller helt med).

	Håller inte alls med	Håller delvist inte med	Varken eller	Håller delvist med	Håller helt med
Det finns god tillgång till stationära datorer.	○	○	○	○	○
Det finns god tillgång till bärbara datorer.	○	○	○	○	○

Det finns god tillgång till mobila enheter (t.ex. pekplattor).	○	○	○	○	○
Det finns god tillgång till interaktiva skrivtavlor.	○	○	○	○	○
Det finns god tillgång till projektorer.	○	○	○	○	○
Det finns god tillgång till datorer med internetanslutning.	○	○	○	○	○
Det finns god tillgång till internet.	○	○	○	○	○
Det finns god tillgång till trådlöst nätverk.	○	○	○	○	○

18a. Bedöm hur lätt/svårt det är att tillämpa IKT i undervisningen i huslig ekonomi.

- ○ Mycket svårt
- ○ Svårt
- ○ Varken svårt eller lätt
- ○ Lätt
- ○ Mycket lätt

18b. Motivera ditt svar i fråga 18a.

_____

_____

19. Finns det annat du vill tillägga om IKT-användningen i huslig ekonomi?

_____

_____

20. Din e-postadress:_____

Table A2. Kyselytutkimus: TVT kotitaloudessa

Del 1. Taustatekijät

2. Minkä ikäinen olet?
   - Alle 25
   - 25–30
   - 31–35
   - 36–40
   - 41–45
   - 46–50
   - 51–55
   - 56–60
   - Yli 60

2a. Missä oppilaitoksessa työskentelet? (tietoa käytetään vain vastaajien maantieteellisen jakauman selvittämiseksi)

_____

2b. Missä kunnassa koulu sijaitsee?

_____

3a. Mikä koulutus sinulla on?
- Kasvatustieteen maisteri/Åbo Akademi
- Kasvatustieteen maisteri/Helsingin yliopisto
- Kasvatustieteen maisteri/Itä Suomen yliopisto

3b. Jokin muu, mikä?

_____

4a. Onko sinulla muita tutkintoja?
- Ei
- Yliopistotutkinto
- Ammattikorkeakoulututkinto
- Ammattikoulututkinto

4b. Kerro tutkinnon tyyppi

_____

Osa 2. TVT:n käyttö

Pedagogiset sovellukset = Verkkopohjaisia opetusvälineita, joiden avulla opiskelijat voivat luoda, muokata ja jakaa sisältöjä. Sovellukset voivat olla tekstin-, kuvan- tai videonkäsittelysovelluksia, mutta myös keskustelufoorumeita ja rupattelupaikkoja. On olemassa erilaisia sovelluksia omien muistikarttojen, esitysten, portfolion, kuva-albumin ja muistiinpanojen laatimiseen.

Pilvitallennus = Pilvitallennusta voidaan käyttää tiedon, dokumenttien, videoiden ja kuvien tallentamiseen. Kyseessä on verkon kautta käytettävä tallennusalusta, johon pääsee käsiksi tableteilla/taulutietokoneilla,

kannettavilla tietokoneilla ja älypuhelimilla. Käytettyjä pilvipalveluja ovat Google Drive , Dropbox, Youtube, Flickr, blogit ja muut vastaavat sovellukset.

5. Arvioi kuinka usein käytät seuraavia TVT-työkaluja kotitalouden opettamisessa (1 = ei lainkaan, 2 = harvoin, 3 = joskus, 4 = usein, 5 = hyvin usein). Sekä oppilaan että opettajan TVT-käyttö.

	Ei lainkaan	Harvoin	Joskus	Usein	Hyvin usein
Pöytätietokoneita	○	○	○	○	○
Kannettavia tietokoneita	○	○	○	○	○
Tabletteja	○	○	○	○	○
Matka- tai älypuhelimia	○	○	○	○	○
Vuorovaikutteisia tauluja (esim. Smartboard)	○	○	○	○	○
Projektoria	○	○	○	○	○
Videoleikkeitä	○	○	○	○	○
Resepti digitaalisessa muodossa	○	○	○	○	○
Verkkopelejä (esim. Kahoot, Secondlife)	○	○	○	○	○
Blogeja (opiskelijoiden omia)	○	○	○	○	○
Blogeja (esim. viestintään tai tiedonjakeluun)	○	○	○	○	○
Digitaalisia esitelmiä (esim. Prezi- ja PowerPoint-esitelmiä)	○	○	○	○	○
Tietolähteitä (teksti, kuva tai materiaalia nettisivuilta, esim. Arktiset Aromit, Ruokatieto, Terveyttä kasviksilla, Martha)	○	○	○	○	○
Sosiaalista mediaa (esim. Facebook, Instagram, Twitter)	○	○	○	○	○
Pilvipalveluita (esim. iCloud, Google Drive, Dropbox tai koulun omia)	○	○	○	○	○
Työkaluja ja pedagogisia sovelluksia, joilla luodaan, jaetaan tai muokataan sisältöjä (esim. Slideshare, QR-	○	○	○	○	○

koodit, Vimeo, iMovie, Windows Movie Maker)					
Työkaluja ja pedagogisia sovelluksia dokumentointiin (esim. Blogger, Wiki, Evernote, Popplet)	○	○	○	○	○
Verkkopohjaisia kotitehtäviä	○	○	○	○	○
Verkkopohjaista arviointia (tehtäviä ja kokeita jotka arvioidaan verkossa)	○	○	○	○	○
Verkkokursseja (etäopiskelu esim. Moodlen, Fronterin välityksellä)	○	○	○	○	○
Virtuaaliset oppimisympäristöt (esim. Fronter, Google Classroom, Moodle)	○	○	○	○	○

6. Muita työkaluja, mitä?

_____

_____

7. Arvioi, kuinka usein käytät TVT-työkaluja seuraaviin toimintoihin, (1 = ei lainkaan, 2 = harvoin, 3 = joskus, 4 = usein, 5 = hyvin usein).

	Ei lainkaan	Harvoin	Joskus	Usein	Hyvin usein
Opetuksen suunnitteluun.	○	○	○	○	○
Hallinnollisiin tehtäviin.	○	○	○	○	○
Materiaalin jakamiseen kollegoiden kesken.	○	○	○	○	○
Materiaalin luomiseen kollegoiden kanssa.	○	○	○	○	○
Yhteistyöhön kotitalousopettajien kanssa.	○	○	○	○	○
Yhteistyön tekemiseen muiden oppiaineiden kanssa.	○	○	○	○	○
Kommunikointiin opiskelijoiden kanssa koulun ulkopuolella.	○	○	○	○	○
Etäopettamiseen.	○	○	○	○	○

Opetuksen monipuolistamiseen.	○	○	○	○	○
Opetuksen yksilöllistämiseen.	○	○	○	○	○
Opetuksessa aihealueen esittämiseen (esim. eri ruokakulttuurit, yksityistalous).	○	○	○	○	○
Tiedonhakemiseen opettamisessa.	○	○	○	○	○
Opiskelijoiden keskinäisen kommunikoinnin käyttämiseen opetuksessa.	○	○	○	○	○
Opetuksessa opiskelijan oppimismahdollisuuksien parantamiseen.	○	○	○	○	○

8. Muuhun tarkoitukseen, mihin?

_____

_____

9. Kuinka suureen osaan opetustasi sovellat TVT:tä. Arvioi prosenteissa (%), sekä oppilaan että opettajan TVT-käyttö.

	Enemmän kuin 75 %	51–75 %	25–50 %	11–24 %	6–10 %	1–5 %	Vähemmän kuin 1 %	En tiedä
Prosent eissa %	○	○	○	○		○	○	

Osa 3. TVT:n käytön hyödyt kotitaloudessa

10. Arvioi kuinka seuraavat väitteet pitävät mielestäsi paikkansa (1 = olen täysin eri mieltä, 2 = osittain eri mieltä, 3 = en osaa sanoa, 4 = osittain samaa mieltä, 5 = täysin samaa mieltä).

	Olen täysin eri mieltä	Osittain eri mieltä	En osaa sanoa	Osittain samaa mieltä	Täysin samaa mieltä
TVT:n integrointi vahvistaa opiskelijan ymmärrystä hyödyntää tekniikkaa arjessa ja kotona.	○	○	○	○	○
TVT:n integrointi vahvistaa opiskelijan	○	○	○	○	○

ymmärrystä hyödyntää tekniikkaa työelämässä.					
TVT:n integrointi edistää opiskelijan osaamisen kehittymistä ajatellen eri TVT-työkalujen toimintaa.	○	○	○	○	○
TVT:n integrointi edistää opiskelijan luomis- ja innovointikykyä.	○	○	○	○	○
TVT:n integrointi edistää opiskelijan ongelmaratkaisukykyä.	○	○	○	○	○
TVT:n integrointi edistää opiskelijan kykyä hakea, koota ja työstää tietoa.	○	○	○	○	○
TVT:n integrointi edistää opiskelijan kriittisen tiedonkäsittelyn kehittymistä.	○	○	○	○	○
TVT:n integrointi edistää opiskelijan valmiuksia tuottaa ja muokata tietoa.	○	○	○	○	○
TVT:n integrointi edistää opiskelijan kykyä käsitellä erilaisia sovelluksia kuten taulukkolaskenta-, tietokanta- ja tekstinkäsittelyohjelmia.	○	○	○	○	○
TVT:n integrointi edistää opiskelijan kykyä ottaa käyttöön erilaisia verkkopohjaisia palveluja.	○	○	○	○	○
TVT:n integrointi edistää opiskelijan kykyä käsitellä verkossa esiintyviä potentiaalisia uhkia.	○	○	○	○	○
TVT:n integrointi edistää opiskelijan kykyä ymmärtää eettisten periaatteiden sekä tiedon luotettavuuden ja uskottavuuden merkitystä.	○	○	○	○	○
TVT:n integrointi edistää opiskelijan kykyä jakaa	○	○	○	○	○

tietoa ja kommunikoida verkossa.					
TVT:n integrointi edistää opiskelijan kykyä tuottaa ja esittää tietoa.	○	○	○	○	○
TVT:n integrointi edistää opiskelijan yhteistyökykyä.	○	○	○	○	○
TVT:n integrointi edistää opiskelijan sitoutumista oppimiseensa.	○	○	○	○	○
TVT:n integrointi lisää opiskelijan kiinnostusta kotitalous-oppiaineeseen.	○	○	○	○	○
TVT:n integrointi mahdollistaa uusien opetusmenetelmien ja innovaatioiden mukaanottamisen opetukseen.	○	○	○	○	○
TVT:n integrointi helpottaa hallinnollisten tehtävien (arvioinnit, luettelot) hoitamista.	○	○	○	○	○
TVT helpottaa arviointiprosessia.	○	○	○	○	○
TVT helpottaa opettajan ja opiskelijan välistä viestintää.	○	○	○	○	○
TVT helpottaa vanhempien ja opettajien välistä kommunikointia.	○	○	○	○	○
TVT helpottaa rutiinitöissä (esim. luetteloiden ylläpito).	○	○	○	○	○
Opiskelijat näkevät opetuksen positiivisempana, kun TVT on mukana opetuksessa.	○	○	○	○	○
TVT:n integrointi opetukseen aiheuttaa opettajalee enemmän työtä.	○	○	○	○	○
TVT:n integrointi johtaa opiskelijoiden	○	○	○	○	○

kirjoittamistaitojen huonontumiseen.					
TVT:n integrointi heikentää lähikontaktia opettajan ja opiskelijan välillä.	○	○	○	○	○
TVT:n integrointi estää opiskelijaa oppimista.	○	○	○	○	○
TVT:n integrointi vie liikaa aikaa.	○	○	○	○	○

Osa 4. TVT kotitaloudessa

11. Arvioi, kuinka tärkeänä pidät sitä, että TVT:tä hyödynnetään seuraavissa keskeisissä opetussisällöissä (1 = ei lainkaan tärkeä, 2 = ei erityisen tärkeää, 3 = en osaa sanoa, 4 = melko tärkeä, 5 = hyvin tärkeä).

	Ei lainkaan tärkeä	Ei erityisen tärkeää	En osaa sanoa	Melko tärkeä	Hyvin tärkeä
Ruuanvalmistus- ja leivontataitojen kehittämiseen.	○	○	○	○	○
Aterioiden suunnitteluun.	○	○	○	○	○
Ruokavalintojen ja ruokailutapojen pohtimista suhteessa ravintosuosituksiin.	○	○	○	○	○
Ruokavalintojen ja ruokailutapojen pohtimista ruokaturvallisuuden näkökulmasta.	○	○	○	○	○
Ruokavalintojen ja ruokailutapojen pohtimista suhteessa elintarviketuntemukseen.	○	○	○	○	○
Ruokavalintojen ja ruokailutapojen pohtimista ajatellen ruokaketjun tuntemusta.	○	○	○	○	○
Ruokavalintojen ja ruokailutapojen pohtimista ajatellen taloutta.	○	○	○	○	○
Ruokavalintojen ja ruokailutapojen	○	○	○	○	○

pohtimista suhteessa eettisiin näkökohtiin.					
Kotitaloudessa ja arjessa tarvittavien valmiuksien kehittämiseen (esim. sopivien puhdistusaineiden, laitteiden, välineiden ja työtapojen valitsemiseen puhdistukseen ja tekstiilien ja materiaalien hoitamiseen).	○	○	○	○	○
Ympäristötietoisuuden kehittämiseen arjessa.	○	○	○	○	○
Kustannustietoisuuden kehittämiseen arjessa.	○	○	○	○	○
Hyvien tapojen oppimiseen.	○	○	○	○	○
Jotta oppilaat oppisivat arvioida asumiseen ja kotitalouteen liittyviä palveluita.	○	○	○	○	○
Jotta oppilaat oppisivat käyttämään mediaa ja tekniikkaa arjen työvälineinä.	○	○	○	○	○
Vastuullisten päätösten tekemiseen ja luotettavan tiedon käyttämiseen valintojen perustana.	○	○	○	○	○
Ongelmien ratkaisemiseen koskien kotitalouksien taloutta.	○	○	○	○	○

12. Mitkä ovat mielestäsi kotitalous-oppiaineen keskeisimmät tehtävät oppilaan näkökulmasta?

_____

_____

Osa 5. Digitaalinen osaaminen ja jatkokoulutus

13. Arvioi omaa TVT-osaamistasi seuraavien väitteiden avulla (1 = täysin eri mieltä, 2 = osittain eri mieltä, 3 = en osaa sanoa, 4 = osittain samaa mieltä, 5 = täysin sama mieltä).

	Olen täysin eri mieltä	Osittain eri mieltä	En osaa sanoa	Osittain samaa mieltä	Täysin sama mieltä
Minulla on tarpeeksi osaamista siinä, kuinka eri TVT-työkalut toimivat.	○	○	○	○	○
Osaan soveltaa TVT:tä luovalla ja innovatiisella tavalla.	○	○	○	○	○
Osaan soveltaa TVT:tä ongelmien ratkaisemiseen.	○	○	○	○	○
Osaan soveltaa TVT:tä tiedon etsimiseen, kooostamiseen ja työstämiseen.	○	○	○	○	○
Osaan arvioida kriittisesti netissä olevaa tietoa.	○	○	○	○	○
Osaan tuottaa ja esittää tietoa TVT:n avulla.	○	○	○	○	○
Tiedän, kuinka otetaan käyttöön erilaisia verkkopohjaisia palveluja.	○	○	○	○	○
Osaan käsitellä erilaisia tietoturvauhkia verkossa.	○	○	○	○	○
Ymmärrän eettisten periaatteiden sekä tiedon uskottavuuden ja luotettavuuden merkityksen.	○	○	○	○	○
Osaan jakaa tietoa ja viestiä verkossa.	○	○	○	○	○
Osaan käyttää taulukkolaskentaohjelmia (kuten esim. Microsoft Excel).	○	○	○	○	○
Osaan etsiä tietoa erilaisista tietokannoista.	○	○	○	○	○
Osaan käyttää tekstinkäsittelyohjelmia (kuten esim. Microsoft Word).	○	○	○	○	○

14a. Millaisena näet kykysi käyttää TVT:tä opetuksessa?

- ○ Hyvin huonona

- Huonona
- En osaa sanoa
- Hyvänä
- Erittäin hyvänä

14b. Perustele vastauksesi kysymyksessä 14a.

_____

_____

15. Kuinka usein olet viimeisten kahden vuoden aikana osallistunut jatkokoulutukseen koskien TVT:n käyttöä kotitaloudessa?

- Ei lainkaan
- Vain kerran kahden vuoden aikana
- Kerran vuodessa
- 2-3 kertaa vuodessa
- Enemmän kuin 3 kertaa vuodessa

Osa 6. Tuki

16. Mitä mieltä olet seuraavien tukitoimenpiteiden riittävyydestä? (1 = olen täysin eri mieltä, 2 = olen osittain eri mieltä, 3 = en osaa sanoa, 4 = olen osittain samaa mieltä, 5 = olen täysin samaa mieltä)

	Olen täysin eri mieltä	Olen osittain eri mieltä	En osaa sanoa	Olen osittain samaa mieltä	Olen täysin samaa mieltä
Olen saanut tarpeeksi teknistä tukea voidakseni käyttää TVT:tä opetuksessa.	○	○	○	○	○
Olen saanut tarpeeksi pedagogista tukea voidakseni käyttää TVT:tä opetuksessa.	○	○	○	○	○
Olen saanut tarpeeksi tukea ainekollegoiltani voidakseni käyttää TVT:tä opetuksessa.	○	○	○	○	○
Olen saanut tarpeeksi tukea muilta kollegoiltani voidakseni käyttää TVT:tä opetuksessa.	○	○	○	○	○
Olen saanut tarpeeksi tukea koulun johdolta voidakseni käyttää TVT:tä opetuksessa.	○	○	○	○	○
Olen saanut tarpeeksi tukea koulun TVT-suunnitelmalta	○	○	○	○	○

voidakseni käyttää TVT:tä opetuksessa.					
TVT-jatkokoulutusmahdollisuuksia on tarpeeksi.	○	○	○	○	○
Jatkokoulutusmahdollisuuksia koskien TVT:tä kotitaloudessa on tarpeeksi.	○	○	○	○	○
Olen saanut tarpeeksi tukea jatkokoulutuksista voidakseni käyttää TVT:tä opetuksessa.	○	○	○	○	○
Olen saanut tarpeeksi tukea ainekoulutuksista voidakseni käyttää TVT:tä opetuksessa.	○	○	○	○	○

Tekninen tuki = Käsittää muun muassa teknisen laitteiston ylläpidon luokkahuoneessa.
Pedagoginen tuki = Koskee TVT:n soveltamista pedagogisena työkaluna. Käytännössä tämä tarkoittaa esimerkiksi opettajien TVT-käytön tukemista opetuksen suunnittelussa.

Osa 7. TVT-infrastruktuuri kotitaloudessa

TVT-infrastruktuuri = Luo perusedellytykset sille, että TVT:tä voidaan käyttää opetuksessa. TVT-infrastruktuuriin kuuluvat muun muassa Internet, Wi-Fi ja digitaaliset työkalut.

17. Mitä mieltä olet käytettävissäsi olevasta TVT-infrastruktuurista? (1 = olen täysin eri mieltä, 2 = olen osittain eri mieltä, 3 = en osaa sanoa, 4 = olen osittain samaa mieltä, 5 = olen täysin samaa mieltä).

	Olen täysin eri mieltä	Osittain eri mieltä	En osaa sanoa	Osittain samaa mieltä	Täysin samaa mieltä
Pöytätietokoneita on hyvin saatavilla.	○	○	○	○	○
Kannettavia tietokoneita on hyvin saaatavilla.	○	○	○	○	○
Mobiililaitteita (esim. tabletteja) on hyvin saatavilla.	○	○	○	○	○
Vuorovaikutteisia piirtotauluja on hyvin saatavilla.	○	○	○	○	○
Projektoreja on hyvin saatavilla.	○	○	○	○	○

Internet-yhteydellä varustettuja tietokoneita on hyvin saatavilla.	○	○	○	○	○
Internet on hyvin saatavilla.	○	○	○	○	○
Langaton verkko on hyvin saatavilla.	○	○	○	○	○

18a. Arvioi kuinka helppoa/vaikeaa on soveltaa TVT:tä kotitalousopetuksessa.

- ○ Hyvin vaikeaa
- ○ Vaikeaa
- ○ En osaa sanoa
- ○ Helppoa
- ○ Hyvin helppoa

18b. Perustele vastauksesi kysymyksessä 18a.

_____

_____

19. Mitä muuta haluaisit vielä kertoa liittyen TVT:n käyttöön kotitalousopetuksessa?

_____

_____

20. Sähköpostiosoitteesi:_____

Appendix B. Scales used in Publication I and II[22]

Use of different types of ICT[23] (13 items)

Applications and digital content (6 items)

Knowledge source (image or material from websites, e.g., Arktiset aromit, Ruokatieto, Terveyttä kasviksilla, Martha)
Video clips
Online games (e.g., Kahoot, Secondlife)
Online presentation tools (Prezi or PowerPoint)
Digital recipes
Cloud storage services (e.g., iCloud, Google Drive, Dropbox or the school's own cloud storage service).

Tools for online teaching (4 items)
Online assessment (online graded assignments and tests)
Virtual learning platforms (e.g., Fronter, Google Classroom, Moodle)
Online homework assignments
Distance teaching (e.g., Moodle, Fronter)

Social media (3 items)
Blogs (run by students themselves)
Blogs (used e.g., for communication or as an information bank)
Social media (e.g., Facebook, Instagram, Twitter)

Purpose of ICT use[24] (10 items)

ICT for cooperation (4 items)

To create materials with other colleagues.
To share materials with other colleagues.
To cooperate with my colleagues in HE.
To cooperate with other school subjects.

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[22] The scale items have been translated from Swedish for presentation in English in this thesis.
[23] Note. A three-factor model (applications and digital content; tools for online learning; and social media) was identified for the scale "Use of different types of ICT) in Publication I.

[24] *Note.* A three-factor model (ICT for cooperation, ICT for facilitating pupils' learning, ICT for administration and lesson planning) was identified for the scale "Purpose of ICT use" in Publication I and was further used in Publication II.

ICT for facilitating pupils' learning (4 items)

In teaching for students to communicate with each other.
In teaching to diversify teaching.
In teaching to present a topic in a structured way (e.g., food cultures, personal finance).
In teaching for students' information searches.

ICT for administration and lesson planning (2 items)

For lesson planning.
For administrative tasks.

Perceived usefulness of ICT in HE[25] (37 items)

General perceived usefulness (22 items)

Integration of ICT enhances student's understanding of the potential of technology in everyday life and at home.
Integration of ICT enhances the student's understanding of the potential of ICT at work.
Integration of ICT promotes the development of student's knowledge of the functioning of different ICT tools.
Integration of ICT promotes the development of student's creativity and innovation skills.
Integration of ICT promotes the development of student's problem-solving skills.
Integrations of ICT promotes the development of student's ability to search for, collect and process information.
Integration of ICT promotes the development of critical information management skills.
Integration of ICT promotes the development of skills needed to produce and present information.
Integration of ICT promotes the student's ability to manage different computer applications such as spreadsheets, databases, and word processing software.
Integration of ICT promotes the student's ability to access and use different web-based services.
Integration of ICT promotes the student's ability to manage potential risks online.
Integration of ICT promotes the student's understanding of the importance

[25] *Note.* The scale "Perceived usefulness of ICT in HE" is in Publication II composed of two separate constructs, general perceived usefulness and beliefs about the importance of using ICT to achieve learning objectives within HE including in total 37 items. In Publication I, a three-factor model is used for the scale "beliefs about using ICT to achieve learning objectives within HE" (see Publication I).

of ethical principles and the credibility and reliability of information.
Integration of ICT promotes the student's ability to share information and communicate online.
Integration of ICT promotes the student's ability to produce and present information.
Integration of ICT promotes the student's ability to cooperate.
Integration of ICT makes students more engaged in their learning.
Integration of ICT in home economics increases the student's interest in the subject.
ICT helps me to apply new teaching methods and innovations in the teaching.
ICT facilitates assessment work.
ICT facilitates communication between student and teacher.
ICT facilitates repetitive work (e.g., maintenance of lists).
Students evaluate the teaching more positively when ICT is integrated into teaching.

Beliefs about using ICT to achieve learning objectives within HE[26] (15 items)

For developing cooking and baking skills.
To plan meals.
To reflect on food choices and eating habits based on nutritional recommendations.
To reflect on food choices and eating habits from a food safety perspective.
To reflect on food choices and eating habits based on food knowledge.
To reflect on food choices and eating habits based on knowledge of the food chain (from farm to table).
To reflect on food choices and eating habits based on economics.
To reflect on food choices and eating habits from an ethical point of view.
To develop skills needed in the household and in everyday life, (e.g., selecting appropriate cleaning products, appliances, equipment and practices in cleaning, textile and material care).
To develop environmental awareness in everyday life.
To develop cost awareness in everyday life.
To learn how to behave in accordance with good manners.
For students to learn how to evaluate housing and household related services.
For students to make responsible decisions and use reliable information as a basis for their choices.
For students to solve problems related to household finances.

ICT self-efficacy (1 item)

[26] *Note.* This scale is titled "teacher's beliefs" in Publication I.

How do you view your ability to use ICT in teaching?

Digital competence (9 items)

I have sufficient knowledge of how the different ICT tools work.
I can use ICT in a creatively and innovatively
I can use ICT to solve different problems.
I can use ICT to find, gather and process information.
I can use ICT to produce and present information..
I know how to access and use different online services.
I can deal with potential information risks online.
I can exchange information and communicate online.
I can search for information in different databases.

ICT infrastructure (8 items)

There is good access to desktop computers.
There is good access to laptops.
There is good access to mobile devices (e.g., tablets).
There is good access to interactive whiteboards.
There is good access to data projectors.
There is good access to computers with an internet connection.
There is good access to the internet.
There is good access to a wireless network.

Support (10 items)

I have received enough technical support from the school to be able to use ICT in education.
I have received enough pedagogical support from the school to be able to use ICT in teaching.
I have received enough support from my subject colleagues to be able to use ICT in teaching.
I have received enough support from other colleagues to be able to use ICT in teaching.
I have received enough support from the school management to be able to use ICT in teaching.
I have received sufficient support from the school's ICT plan to use ICT in teaching.
There is a sufficient supply of in-service teacher training courses in ICT in general.
There is an adequate supply of in-service teacher training courses in ICT in home economics.
I have received enough support from in-service teacher training courses to use ICT in teaching.
I have received enough support from in-service teacher training courses in home economics to use ICT in teaching.

Background variables

Age

How old are you?
Coding: 1 = Under 30; 2 = 31–45; 3 = 46–60; 4 = Over 60

Teaching qualification

What kind of educational background do you have?

Master of Education/Åbo Akademi University
Master of Education/University of Helsinki
Master of Education/University of Eastern Finland

0 = No professional qualifications
1 = professionally qualified

Appendix C. Original Interview Guide in Swedish

Intervjufrågor

* The questions used in Publication III are marked with an asterisk (*)

Bakgrund *

Berätta lite om din bakgrund.*

- Typ av skola?
- Utbildning?
- Hur länge har du jobbat som ämneslärare?

Erfarenheter av IKT-användning*

Vad har du för erfarenheter av att använda IKT i skolsammanhang?*
Vad har du för erfarenheter av att använda IKT i läroämnet huslig ekonomi?*
I vilken omfattning eller utsträckning har du tillämpat IKT?

Användning av IKT*

På vilket sätt använder du IKT i undervisningen?*
Vad har du för syfte med att använda IKT i undervisningen?*
Vad skulle du säga om din roll som lärare när du tillämpar IKT i undervisningen?
Använder du IKT för att främja eleven att uppnå lärandemålen?

- Om ja, på vilket sätt?

Använder du IKT för att främja digital kompetens?

- Om ja, på vilket sätt?

Använder du IKT för att främja kritiskt tänkande?

- Om ja, på vilket sätt?

Använder du IKT för att främja kommunikation och samarbete?

- Om ja, på vilket sätt?

Använder du IKT för att främja innovation?

- Om ja, på vilket sätt?

Använder du IKT för att främja problemlösande förmåga?

- Om ja, på vilket sätt?

Lärarens syn på nyttan med IKT*

Hur ser du på betydelsen av att använda IKT i huslig ekonomi?*

- Fördelar?
- Nackdelar?

Hur ser du på betydelsen av att använda IKT för att uppnå lärandemålen i huslig ekonomi?*
Hur ser du på betydelsen av att använda IKT för att utveckla elevens digitala kompetens?
Hur ser du på betydelsen av att använda IKT för att utveckla elevens kritiska tänkande?
Hur ser du på betydelsen av att använda IKT för att utveckla elevens samarbete och kommunikation?
Hur ser du på betydelsen av att använda IKT för att utveckla elevens innovationsförmåga?
Hur ser du på betydelsen av att använda IKT för att utveckla elevens problemlösningsförmåga?

Syn på ämnet och dess relation till IKT-användning

Beskriv, enligt din syn, vad som kännetecknar huslig ekonomi?

- Motivera!

Vilka ämnesinnehåll vill du gärna täcka i undervisningen i huslig ekonomi?

- Vad tror du inverkar på ert val att prioritera dessa ämnesinnehåll i undervisningen?

Finns det enligt din syn någon koppling mellan samhällets utveckling och de kunskaper, färdigheter och attityder som eleverna ska lära sig i huslig ekonomi?

- Om ja, förklara och ge exempel!

Hur skulle du resonera kring din egen användning av IKT i förhållande till din syn på ämnet?

Syn på syftet med huslig ekonomi

Vad anser du är viktigt för eleven att lära sig i huslig ekonomi?
Enligt din syn, vad är det viktigaste syftet med undervisningen i huslig ekonomi?
Hur skulle du resonera kring din egen användning av IKT i förhållande till din syn på syftet med huslig ekonomi?

Förutsättningar för användning*

Vad skulle du säga att påverkar ditt sätt att använda IKT i undervisningen i huslig ekonomi?*
Finns det något som hindrar dig att använda IKT i undervisningen? Om ja, vad?*

Finns det något som skulle göra lättare för dig att använda IKT i undervisningen?*

Förutsättning: Förmågan att använda IKT*

Hur upplever du din förmåga att använda IKT i undervisningen?*

Förutsättning: Stöd*

Hur upplever du det tekniska stödet från skolan?*
Hur upplever du det pedagogiska stödet från skolan?*
Har du deltagit i fortbildningar?*

- Om ja, hur upplever du dessa fortbildningar?
- Vad önskar du att dessa fortbildningar skulle behandla?

Förutsättning: IKT-infrastruktur*

Hur upplever du IKT-infrastrukturen?*

Övrigt*

Har du annat att tillägga?*

Appendix D. Original Interview Guide in Finnish

Haastattelukysymykset

* The questions used in Publication III are marked with an asterisk (*)

Tausta*

Kerro hieman taustastasi.*

- Koulu?
- Koulutus?
- Kauanko olet toiminut aineenopettajana?

Kokemuksia TVT:n käyttämisestä*

Millaisia kokemuksia sinulla on TVT:n käyttämisestä koulu-ja opetustyössä yleensä?*
Millaisia kokemuksia sinulla on TVT:n käyttämisestä koulu-ja opetustyössä yleensä?*
kotitalousopetuksessa?*
Missä laajuudessa olet hyödyntänyt TVT:tä kotitalousopetuksessa?

TVT:n käyttäminen

Millä tavoin käytät TVT:tä opetuksessa?*
Millaisen roolin katsot itselläsi olevan käyttäessäsi TVT:tä opetuksessa?
Millaiseen tarkoitukseen käytät TVT:tä opetuksessa?*
Käytätkö sitä edistämään opiskelijan oppimistavoitteiden saavuttamista?

- Jos kyllä, millä tavoin?

Käytätkö TVT:tä parantamaan digitaalista osaamista?

- Jos kyllä, millä tavoin?

Käytätkö TVT:tä edistämään kriittistä ajattelua?

- Jos kyllä, millä tavoin?

Käytätkö TVT:tä edistämään kommunikointia ja yhteistyötä?

- Jos kyllä, millä tavoin?

Käytätkö TVT:tä edistämään innovointia ja luovuutta?

- Jos kyllä, millä tavoin?

Käytätkö TVT:tä edistämään ongelmanratkaisukykyä?

- Jos kyllä, millä tavoin?

Opettajien kokema IKT:n hyödyllisyys

Millaisena näet TVT:n merkityksen kotitalousoppiaineessa ja sen opettamisessa?*

- Etuja?
- Haittoja?

Millaisena näet TVT:n merkityksen kotitalousoppiaineen oppimistavoitteiden saavuttamisen kannalta?*
Millaisena näet TVT:n merkityksen kehitettäessä opiskelijan digitaalista osaamista?
Millaisena näet TVT:n merkityksen kehitettäessä opiskelijan kriittistä ajattelua?
Millaisena näet TVT:n merkityksen kehitettäessä opiskelijan kommunikointia sekä yhteistyötä?
Millaisena näet TVT:n merkityksen kehitettäessä opiskelijan innovointikykyä?
Millaisena näet TVT:n merkityksen kehitettäessä opiskelijan ongelmanratkaisuvalmiuksia?

Näkemyksiä kotitalousaineesta ja sen suhteesta TVT:n käyttöön.

Mikä on mielestäsi ominaista kotitaloudelle?

- Motivoi!

Mitä ainekokonaisuuksia käsittelet mieluiten opetuksessasi?

- Minkä uskot vaikuttavan valintaasi priorisoida juuri nuo aineet opetuksessa?

Onko mielestäsi jokin yhteys yhteiskunnan kehittymisellä ja niillä tiedoilla ja valmiuksilla sekä asenteilla, joita kotitalousaineen opiskelijat oppivat?

- Selitä! Anna esimerkki!

Millaisena kokisit oman TVT-käyttösi suhteessa näkemykseesi kotitalousaineesta?

Näkemyksiä kotitalous oppiaineen tavoitteista

Mitä asioita on mielestäsi tärkeää oppia kotitaloudessa?
Mitkä ovat mielestäsi tärkeimmät kotitalousaineen opettamisen tavoitteet?
Millaisena kokisit oman TVT-käyttösi (opetuksessasi?) suhteessa näkemykseesi kotitalousaineen tavoitteesta?

Edellytykset*

Minkä asioiden katsot vaikuttavan tapaasi käyttää TVT:tä kotitalousaineen opetuksessa?*

- Jos kyllä, mitä?

Onko jotain, mikä estää sinua käyttämästä TVT:tä opetuksessa?* Jos kyllä, mitä?

- Jos kyllä, mitä?

Onko jotain, mikä helpottaisi sinua käyttämään TVT:tä opetuksessa?*

- Jos kyllä, mitä?

TVT minäpystyvyys*

Millaisena näet omat kykysi käyttää TVT:tä opetuksessa?*

Tuki*

Miten koet koulun tarjoaman teknisen tuen?*
Miten koet koulun tarjoaman pedagogisen tuen?*
Oletko osallistunut TVT-jatkokoulutukseen?*

- Jos kyllä, millaisina koit nuo jatkokoulutustilaisuudet?
- Millaisia asioita toivoisit jatkokoulutuksen käsittelevän?

TVT:n infrastruktuuri*

Millaisena pidät TVT:n infrastruktuuria?*

Muu*

Onko sinulla muuta kerrottavaa liittyen TVT:n käyttämiseen kotitalousopetuksessa?*

The Publications

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Finnish subject teachers' beliefs and use of information and communication technology in Home Economics

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Abstract
The importance of using information and communication technology (ICT) is being increasingly highlighted in education and curriculum frameworks in European countries. However, little attention has been given to using ICT in relation to the school subject of Home Economics (HE). Thus, the aim of this study is to explore Finnish subject-teachers' use of ICT in HE, specifically focusing on frequency, purpose of use, and teachers' beliefs. The data was collected through an online questionnaire, and the sample comprises 161 subject-teachers in HE in grades 7–9. The results revealed three dimensions of ICT use among HE teachers. Further, the K-means cluster analysis identified three distinct ICT-user profiles among subject-teachers in HE: infrequent ICT users (n = 60), specific ICT users (n = 43), and frequent ICT users (n = 58). Infrequent ICT users are characterized by low ICT use and neutral beliefs regarding the use of ICT in HE. Specific ICT users mainly focus on using ICT for administration and lesson planning and hold negative beliefs regarding the use of ICT. Frequent ICT users are the most common and positive ICT users and are also most confident about using ICT in HE. This study aims to provide a better understanding of subject-teachers' use of ICT in HE in lower secondary education in Finland. The results suggest a relationship between teachers' beliefs and purpose of use in terms of facilitating pupils' learning. When identifying the three ICT user profiles, it became even more evident that the use of ICT for learning purposes was rather infrequent among HE teachers. In order to enhance teaching in HE, subject-teachers should be supported to use ICT for instructional purposes in a manner that will benefit pupils' learning.

Keywords
ICT use, home economics, cluster analysis, teachers' beliefs, teachers' practice

Introduction
The use of information and communication technology (ICT) is increasing worldwide, and education is no exception (Eurostat, 2017; ITU, 2017; OECD, 2016; Statista, 2018). As society is becoming increasingly digitized, there has been a growing demand for schools to provide opportunities for the development of twenty-first century skills among students, which includes critical thinking and problem-solving, creativity and innovation, and communication and collaboration. Further, ICT skills and competencies have become a natural part of

curriculums, thereby requiring the use of ICT by teachers in different school subjects (Council recommendation of 22 May 2018 on key competences for lifelong learning, 2018; Ministry of Transport and Communication, 2010; Finnish National Board of Education, 2016.) However, despite the controversial results of the Programme for International Student Assessment (PISA) 2012 regarding technology use and learning, OECD (2015) studies have reported several advantages of using ICT in learning processes at several educational levels. Teachers' ICT use can improve efficiency and educational effectiveness (George & Sanders, 2017), support students' motivation and student-centred learning (Ferrari, Cachia, & Punie, 2009), provide opportunities for creative learning and innovative teaching (Balanskat, Bannister, Hertz, Sigilló, & Vuorikari, 2013), and enable collaboration in knowledge creation (OECD, 2015). Although a range of benefits have been reported, a change in teacher practice is required in order to ensure the contribution of ICT is a positive one (George & Sanders, 2017; OECD, 2016). The manner in which ICT is integrated into learning environments by teachers is also influenced and challenged by a number of factors, particularly teachers' beliefs with regard to teaching and learning, which is one of the aspects discussed in this article (Eickelmann & Vennemann, 2017; Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur, & Sendurur, 2012; Inan & Lowther, 2010; Petko, 2012).

In this study, the focus is on subject-teachers' use of ICT in Home Economics (HE) in lower secondary education in Finland. HE is a compulsory subject for pupils in grade 7, and optional in grades 8 and 9. HE provides opportunities for pupils to develop the knowledge, skills, and attitudes needed to manage everyday life. (Finnish National Board of Education, 2016)

In the twentieth century, there was a great awareness of the relationship between household hygiene practices and mortality rates, and HE education was only intended to develop women's cooking skills and improve households' financial position and peoples' health. The content of HE became broader in 1910 and 1914, when the term 'Home Economics' was coined. This enabled the subject to be associated not only with cooking, but also with other aspects of home care (Sysiharju, 1995; Tomes, 1997).

Today, HE is considered a multidisciplinary school subject with a broad core content, including food knowledge, skills and food culture, housing, and living together as well as consumer and financial skills at home. The ability to handle everyday life is a competence that permeates the entire subject (Finnish National Board of Education, 2016; Haverinen, 1996; IFHE, 2008) and several learning objectives of HE are in line with the development of lifelong learning (Finnish National Board of Education, 2016; IFHE, 2008; Ma & Pendergast, 2010; Pendergast, 2012). Further, the ever-increasing digitization of daily life means that pupils in HE are expected to learn to use ICT for household activities, such as meal and budget planning (Casimir, 2011; Finnish National Board of Education, 2016; IFHE, 2008). However, the development of teaching and learning is a major area of interest within the field of HE, and there is an increased concern with regard to whether HE can keep up with technological changes (Sundqvist, 2016; Hölttä, 2014; Poirier, Remsen, & Sager, 2017). The changing society, the complexity of everyday life and the broad nature of the subject are all factors that are recognized as making it challenging to understand what type of knowledge is fundamental for learning about and managing everyday life (IFHE, 2008; Turkki & Vincenti, 2008).

To date, there have been very few previous studies that investigate teachers' use of ICT in HE in Finland. In a recent study by Veeber, Taar, Paas, and Lind (2017), Handicraft and Home Economics (HHE) teachers' understanding of the possibilities of ICT usage is discussed. However, since the study was conducted in Estonia, the findings can contribute to

the understanding of subject-teachers' ICT use in Finland to only a limited extent. There has furthermore been few quantitative or qualitative studies on the use of ICT and teachers' beliefs in HE; thus, this study makes an important contribution to research in the field.

The aim of this study is to identify ICT user profiles among Finnish subject-teachers in HE in lower secondary education, and to explore dimensions of ICT usage in HE. The subject-teachers in HE are classified into homogenous groups on the basis of two measurements – purpose of ICT use and teachers' beliefs – in other words, teachers are grouped together if they have the same way of using ICT and have similar beliefs regarding the importance of using ICT to support pupils in achieving learning objectives in relation to the core content in HE. The study also examines how the clusters differ in terms of demographics, age, and education, perceived ICT self-efficacy, and use of different types of ICT. The following research questions are addressed:

1. What are the dimensions of ICT usage among subject-teachers in HE?
2. What kind of ICT user profiles can be identified among subject-teachers in HE?
3. What kind of differences can be found among the user profiles with regard to subject-teachers' demographics (age, teaching qualification), perceived ICT self-efficacy, and use of different types of ICT?

Theoretical background

Teachers' ICT practice

Blurton (2002, p. 1) defined ICT as a 'diverse set of technological tools and resources used to communicate, and to create, disseminate, store and manage information'. Desktop and laptop computers, followed by document cameras and data projectors, were the most frequently used devices across a number of educational levels in Finland in 2013 (Sairanen, Vuorinen, & Viteli, 2014). In addition, the use of mobile phones is on the rise for studying all school subjects, including artistic and practical subjects (Tanhua-Piiroinen, Viteli, Syvänen, Vuori, Hintikka, & Sairanen, 2016). With regard to the use of ICT in HE, a study by Veeber et al. (2017) showed an increased interest in the use of tablets and smartphones in HHE in Estonia. However, when exploring subject-specific ICT use in Finland, teachers in artistic and practical subjects use digital content less frequently as compared to other subject teachers. Further, pupils in these subjects also use less ICT in class (Tanhua-Piiroinen et al., 2016.). The textbook was the most frequently used teaching material among the subject-teachers in HE in 2014 (Finnish Education Evaluation Centre, 2015). Taken together, these studies indicate a rather low use of ICT in HE. However, as digitalization of education and learning have become key priorities in Finnish educational policies and national curricula, the importance of ICT has been emphasized in recent years (Koskinen, 2017).

Studies reveal that teachers use ICT for different tasks in relation to their work. Van Braak, Tondeur, and Valcke (2004) divide ICT usage into supportive computer use and class use. The first includes using computers mainly for preparation, administration, and other tasks outside the learning environment. The second refers to using computers in class for learning and teaching purposes. In the same vein, Howard, Chan, Mozejko, and Caputi (2015) categorize teachers' technology practices into professional and instructional practices. Professional practices include preparation, delivery, interaction, and communication, while instructional practices refer to activities in which teachers require students to work in different ways by using technology. The same view is partially supported by Ibieta, Hinostroza, Labbe, and Claro (2017), who distinguish between teachers' ICT use outside and within the classroom. Further, Meneses, Fábregues, Rodríguez-Gómez, and Ion (2012) sug-

gest two types of ICT use: supportive use including planning and preparation tasks, and management internet use, which primarily includes collaboration and communication. Thus, it is evident from the abovementioned studies and manner of categorizing teachers' use of ICT that there is no established way of categorizing teachers' ICT usage. There are also no clear directions regarding whether teachers' and students' ICT use should be measured separately or combined (Hsu, 2011). Existing research concludes that teachers tend to use ICT more frequently for tasks outside the class for administration, lesson planning, and information retrieval (Ibieta et al., 2017; Sipilä, 2014).

Use of ICT across school subjects

Research indicates that ICT can be used differently across school subjects (e.g., Howard et al., 2015), which may be due to differences in culture and paradigms (Erixon, 2010; Ertmer & Ottenbreit-Leftwich, 2010). Howard et al. (2015) reported clear differences regarding the nature of ICT teaching practices between the school subjects of English, Science, and Mathematics. Comi, Argentin, Origo, and Pagani (2017) also found large differences in how ICT was implemented in teaching practices by teachers of Italian and Mathematics. A qualitative study in Estonia (Veeber et al., 2017) revealed that HHE teachers mainly use ICT to simplify their tasks as well as for creating and organizing, archiving, and sharing learning materials, providing pupils with tools to present their work, search information, create content, perform tasks, and communicate. In another study, Erixon (2010) found that teachers of more practical studies, such as Sloyd (woodwork and metalwork, textile handicraft) and HE, are afraid that increased ICT use may cause the practical nature of their subjects to be lost. In contrast, teachers of subjects such as geography, history, and religion are more positive towards the use of ICT in the classroom. This may be related to the varied focus of different school subjects. In another study (Fraillon, Ainley, Schulz, Friedman, & Gebhardt, 2014), ICT usage was the lowest among subjects categorized as 'others' and in practical and vocational studies. Further, the findings from the national evaluation of learning outcomes in HE (Finnish Education Evaluation Centre, 2015) showed that that subject-teachers in HE in Finland greatly emphasised pupils' cooking skills when evaluating and grading pupils, which may be a reason for the limited use of ICT in the subject.

ICT use and teachers' beliefs

It is crucial to understand the factors affecting teachers' choices, as it is the teacher that provides opportunities for student learning in a classroom setting, for example, by integrating ICT in the learning environment. Several factors, at both school and teacher levels, have been identified as affecting teachers' use of ICT in education. With regard to school-level factors, both ICT infrastructure and support have been associated with teachers' ICT use (Inan & Lowther, 2010). Teachers' attitudes, beliefs, perceived usefulness, perceived ease of use, ICT self-efficacy, digital competence, professional development needs, teacher collaboration, age, gender, and years of teaching are additional teacher-level factors that have been proven to have a direct or indirect effect on teachers' intention to use ICT or on actual ICT use (Gil-Flores, Rodríguez-Santero & Torres-Gordillo, 2017; Hatlevik & Hatlevik, 2018; Scherer, Siddiq & Teo, 2015; Teo, 2009; Inan & Lowther, 2010; Petko 2012; cf. Håkansson, 2016). Further, there are also other approaches towards dividing the complex list of factors affecting teachers' ICT use (Bilbao-Osorio & Pedró, 2009). This study focuses in particular on teachers' beliefs, including self-efficacy beliefs, which have been assumed to be one of the strongest predictors of teachers' ICT use (Inan & Lowther, 2010; Scherer et al., 2015).

Richardson (2003, p. 2) defines beliefs as one's 'understandings, premises, or propositions about the world that are felt to be true'. A number of studies suggest that in order to understand teaching practices, it is important to examine teachers' pedagogical beliefs – in other words, teachers' beliefs about teaching and learning (Ertmer & Ottenbreit-Leftwich, 2010; Howard et al., 2015; Kim, Kim, Spector, & De Meester, 2013). According to Pajares (1992), pedagogical beliefs are difficult to conceptualize, but include teacher efficacy beliefs, epistemological beliefs, beliefs about causes of teachers' and students' performance, self-efficacy beliefs, beliefs about self-concept and self-esteem, and beliefs about subject matter or disciplines. In this study, we examine subject-teachers' beliefs with regard to the importance of ICT in HE for supporting learning objectives as well as self-efficacy beliefs in teaching using ICT. Earlier studies indicate that there is a positive relationship between teachers' pedagogical beliefs and teachers' ICT use (Berger, Girardet, Vaudroz, & Crahay, 2018; Ertmer et al., 2012; Kim et al., 2013). However, the relationship between beliefs and technology use is considered to be bi-directional. Teachers' beliefs enable technology implementation; simultaneously, technology promotes a change in teachers' beliefs (Tondeur, van Braak, Ertmer, & Ottenbreit-Leftwich, 2016). There are also contradictory results in the literature. A study by Eickelmann and Vennemann (2017) shows that teachers with the most positive beliefs about ICT for learning were not the most frequent users of ICT for instructional purposes. Taken together, a shift in teachers' practices and teachers' beliefs, focusing on utilizing ICT to support meaningful and student-centred learning, is necessary (cf. Ertmer & Ottenbreit-Leftwich, 2010).

ICT self-efficacy has also been commonly studied in relation to teaching practices and technology acceptance; a positive relationship has been found between these variables (Hatlevik & Hatlevik, 2018; Teo, 2009). Bandura (1986, p. 391) defines perceived self-efficacy as 'a judgement of one's capability to accomplish a certain level of performance…'. Hatlevik and Hatlevik (2018) found a positive relation between teachers' ICT self-efficacy and instructional tasks. However, research indicates that examining self-efficacy beliefs is not sufficient for understanding teachers' ICT use (Ertmer & Ottenbreit-Leftwich, 2010; Kim et al., 2013). There are a number of studies that indicate that teachers' beliefs and use of technology is also a matter of different school subjects, their characteristics, learning objectives and content (Erixon, 2010; Ertmer & Ottenbreit-Leftwich, 2010; Howard et al., 2015; Karaseva, Siibak, & Pruulmann-Vengerfeldt, 2015). In line with these findings, in this study we explore the relationship between teacher practice and teachers' beliefs with regard to the importance of using ICT for achieving learning objectives within the core content in HE.

Methods

Participants and procedure

The sample comprised 161 subject-teachers in HE; 58.4% of the teachers were between 46 and 60 years of age, and 78.3% fulfilled the qualification requirements for teaching HE. The data in this study was collected in March 2016 through an email survey in collaboration between Åbo Akademi University and the University of Helsinki. The survey was intended to collect information on teachers' demographics, ICT use, and beliefs in order to examine the relationship between ICT teaching practices and beliefs. The variables used in this study are reported in Appendix 1.

The participants were selected through a combination of random and convenience sampling (Piazza, 2010; Sue & Ritter, 2012). A total number of 2494 email invitations along with

a cover letter were sent to potential participants. The purpose of the letter was to inform the respondents about research background, objectives, the principle of voluntary participation and anonymity. However, it was difficult to obtain information regarding the absolute number of subject-teachers in HE, although according to a study by Kumpulainen (2014), with a response rate of 88.1% in 2013, a total number of 936 teachers were working as subject-teachers in HE in Finland. Limited information on the respondents and the use of convenient sampling may have led to duplications in the email invitations. A pilot study with five teachers in HE was conducted in order to check the validity and practicality of the instrument, and the questionnaire was evaluated by two experts in the academic field of HE. The study was conducted according to the ethical guidelines published by the Finnish Advisory Board on Research Integrity (2012), and a data management plan was developed to support data integrity (Finnish Social Science Data Archive, 2016).

Measures

Use of different types of ICT

In order to provide a description of teachers' ICT use, both the frequency and the dimensions of ICT use were measured, as suggested by Kikis, Scheuermann, and Villalba, (2009) and UNESCO (Mominó & Carrere, 2016). Using a 21-item Likert scale ranging from 1 (never) to 5 (very often), subject-teachers were asked to estimate the frequency of their use of different types of ICT in HE, taking into account both their own and pupils' ICT use. The classification of ICT was adapted from that given by the Finnish National Agency for Education (Ilomäki, 2013).

Purpose of ICT use

In terms of the utilization indicator (Pandolfini, 2016), ICT use by both pupils and teachers was taken into account, which is similar to Howard et al. (2015). Using a five-point Likert-scale ranging from 1 (never) to 5 (very often), teachers were asked to mark how frequently they use ICT for different educational purposes based on 14 items.

Teachers' beliefs

In the questionnaire, teachers were asked to estimate the importance of using ICT within different core contents of HE in order to achieve subject-specific learning objectives. A five-point Likert-scale was used, with the following representations of scores: (1) Strongly disagree, (2) partially disagree, (3) neither/nor, (4) partially agree, (5) and completely agree.

ICT Self-efficacy

There is no universal scale that can be used to measure self-efficacy; therefore, such a scale must be tailored to the study. Participants must be able to rate their ability to perform a specific task through several items. (cf. Bandura, 2006.) However, a study by Hoeppner, Kelly, Urbankost, and Slaymaker (2011) revealed that a single-item measure of self-efficacy can be utilized in research instead of a multiple-item measure. In this study, teachers rated their ability to use ICT in teaching on a five-point Likert scale ranging from 1 (very poor) to 5 (excellent).

Demographics

Age and teaching qualification (TQ) are included as background variables in this study. In the questionnaire, the teachers were asked to provide details of their educational background and degree.

Data analysis

Exploratory factor analysis and reliability test

The survey data was analysed using Statistical Package for Social Science (SPSS Statistics 25). An exploratory factor analysis (EFA), with maximum likelihood (ML) extraction and varimax orthogonal rotation method, was used to examine the construct validity of the measures *purpose of ICT use* and *teachers' beliefs* used in CA (Costello & Osborne, 2005; Lani, 2010; Metsämuuronen, 2005). The factors were selected on the basis of identified intercorrelations between items, Kaiser-Meyer-Olkin (KMO) test value above 0.06, determinant of the correlation matrix value greater than 0.0001, Barlett's test of sphericity value less than 0.05, eigenvalues greater than or near 1, and sufficiently explained common variance (Huck, 2012; Tabachnick & Fidell, 2007; Watson, 2017). The number of items included in a factor is selected on the basis of communality values between 0.04 and 1.0 and factor loadings greater than 0.035 (Hair, Black, Babin, & Anderson, 2010; Huck, 2012; Watson, 2017). Items that strongly load on two or more factors were deleted (Watson, 2017). Cronbach's alpha (Huck, 2012; Tavakol & Dennick, 2011) was used to assess the internal consistency of the measures. Since there were some problems with normality (Watson, 2017), an EFA – with principal axis factoring extraction and varimax orthogonal rotation method – was conducted to examine the construct validity of the measure *use of different types of ICT*. The same criteria were used as those mentioned above.

K-means cluster analysis

The procedure of a standard K-means algorithm cluster analysis (KCA) was selected to cluster the data. The two scales used were standardized to z-scores (Everitt, 1993; Hair et al., 2010). K-means is a non-hierarchical clustering algorithm that attempts to group the data into pre-selected clusters based on their similarity, minimizing within-group and maximizing between-group variance (Hair et al., 2010). There is no single method that can be applied to derive the best cluster solution (Hair et al., 2010; Kodinariya & Makwana, 2013), and the researcher decides the optimum numbers of clusters and how to make sense of the data (Everitt & Dunn, 1991; Lani, 2010). First, the results from the KCA were validated based on rule of thumb (Kodinariya & Makwana, 2013) by comparing and evaluating different cluster schemes. Only solutions where clustering variables differ among clusters have been considered. Second, cluster solutions were visualized through the elbow method for guidance. The sum of squared distance was calculated for each k from 2 to 10 and plotted on a scatterplot (Bholowalia & Kumar, 2014; Kassambara, 2017). Third, the final cluster solution was validated by examining significant differences among the clusters based on external variables not included in the cluster analysis and supported by prior research (Hair et al., 2010).

Analysis of variance

One-way analysis of variance (ANOVA) was conducted to determine the variables that are significantly different among the profiles. ANOVA is also used as a supporting technique to describe the distinguishing characteristics of each cluster and identify differences in self-efficacy and use of different types of ICT. (Janssens, Wijnen, de Pelsmacker, & Kenhove, 2008.) Further, chi-square test of independence was used to examine if there are any differences in demographics, age, and qualification (Sprinthall, 2014). The effect sizes for the main effects are assessed with partial eta squared, , where 0.01 indicates small effects, 0.06 medium effects, and 0.14 large effects. The effect size of Cohen's d is also reported to interpret the magnitude of the differences in the pairwise comparisons. It is suggested that d=.2 is considered as small effect size, .5 is classified as medium effect size, and .8 as large effect size (Huck, 2012).

Findings

Dimensions of ICT usage among subject-teachers in HE

The first research question was to explore the dimensions of ICT usage among subject-teachers in HE. An EFA was conducted to explain different types of ICT usage in order to assess the dimensionality of the scale purpose of ICT use. A three-factor model (Appendix 2) was found to be the best solution for describing subject-teachers' ICT usage in HE. ICT was primarily used for *cooperation*, ($\alpha = 0.86$), *facilitating pupils' learning* ($\alpha = 0.80$), and *administration and lesson planning* ($\alpha = 0.66$). The three-factor solution explained 72.2% of the shared variance among 10 items. Four items were excluded because of low communality values (<0.03), low intercorrelations, and cross-loadings. The KMO measure of sampling adequacy fell at 0.85. The Bartlett's test of sphericity was satisfied (χ_2 (45) = 789.4, $p < 0.001$).

Validation of scales to measure teachers' beliefs and use of ICT

EFA was also conducted in order to evaluate the dimensionality of the scales of teachers' beliefs and teachers' use of different types of ICT. A three factor-model (Appendix 3) was confirmed to be the best solution for teachers' beliefs regarding the importance of using ICT for achieving learning objectives within the core content in HE: *food habits and choices* ($\alpha = 0.90$), *environmental and cost-consciousness* ($\alpha = 0.82$), and *practical skills* ($\alpha = 0.75$). The final structure comprised 12 items and accounted for 69.3% of the shared variance among items. Four items were eliminated due to low communality values (< 0.03) and cross-loadings. The KMO value at 0.91 indicates sample adequacy, and the Bartlett's test of sphericity produced satisfactory values (χ_2 (66) = 1013.17, $p < 0.001$).

An EFA with PAF extraction was performed and a three-factor solution was found to best fit the observed correlations in the data for the measure *use of different types of ICT*. The model explained 57% of the total variance. The KMO coefficient of sampling adequacy was 0.84, and Bartlett's test of sphericity was significant (χ_2 (78) = 651.56, $p < 0.001$). The three factors (Appendix 4) were based on 13 items and labelled a*pplications and digital content* ($\alpha = 0.81$)*, tools for online teaching* ($\alpha = 0.77$), and *social media* ($\alpha = 0.59$). Of the 21 items, 2 were deleted from the scale because of cross-loading. While focusing only on software, all hardware was also eliminated, which accounted for six items.

ICT user profiles among subject-teachers in HE

The second research question was to identify ICT-user profiles among subject-teachers in HE. The optimum cluster solution was found to comprise three clusters. The more clusters the solution contained, the less the significant differences among groups with regard to the variables used in the cluster analysis. When comparing results and graphs of different solutions from two- to ten-cluster solutions, a three-cluster solution was most distinct, made most sense, and consisted of almost equally sized clusters. The three-cluster groups are depicted in Figure 1 and are labelled *infrequent ICT-users* (n = 60)*, specific ICT-users* (n = 43) and *frequent ICT-users* (n = 58).

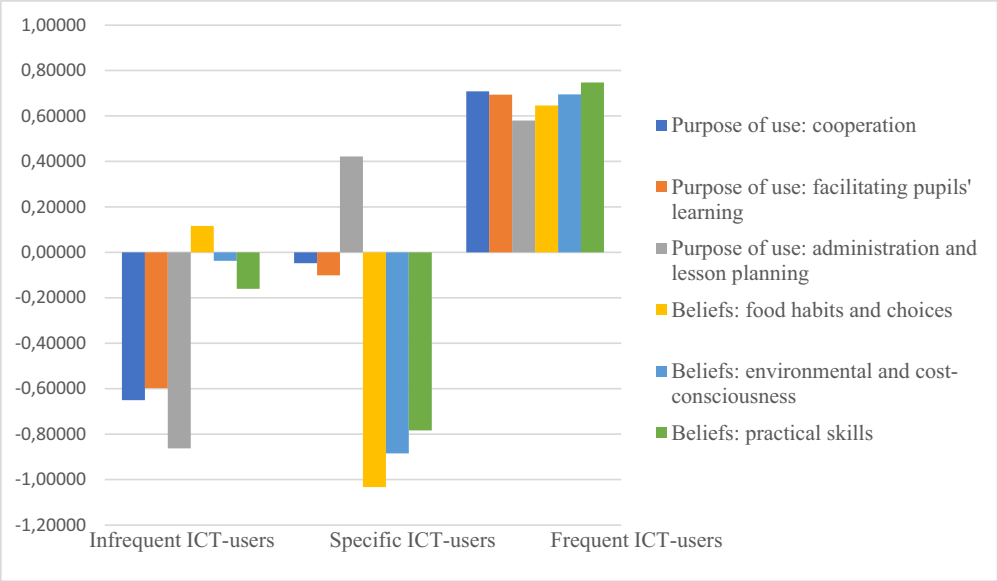

Figure 1 Profiles based on mean z-scores on the scales purpose of ICT use and teachers' beliefs

The differences among the ICT user profiles in terms of purpose of use and teachers' beliefs are presented in Table 1. One-way ANOVAs showed significant between-group differences in all measurements. The effect-size measures indicate large effect sizes ($\eta_p^2 > 0.14$).

Table 1 Differences in purpose of ICT use and teachers' beliefs by cluster

Variable	ICT user profiles					
	Infrequent ICT users	Specific ICT users	Frequent ICT users			
	N = 60	N = 43	N = 58			
	M(SD)	M(SD)	M(SD)	F	p	η_p^2
Purpose of ICT use						
Cooperation	9.83 (2.99)	12.21 (3.20)	15.20 (3.45)	40.95	<0.001	.34
Infrequent ICT users		d = 0.77	d = 1.66			
Specific ICT users			d = 0.90			
Facilitating pupils' learning	11.30 (2.76)	12.86 (2.50)	15.41 (2.73)	35.68	<0.001	.31
Infrequent ICT users		d = 0.60	d = 1.51			
Specific ICT users			d = 0.98			
Administration and lesson planning	6.83 (1.64)	9.12 (1.10)	9.40 (1.11)	64.29	<0.001	.45
Infrequent ICT users		d = 1.64	d = 1.83			
Specific ICT users			d = 0.25			

Variable	ICT user profiles					
	Infrequent ICT users	Specific ICT users	Frequent ICT users			
	N = 60	N = 43	N = 58			
	M(SD)	M(SD)	M(SD)	F	p	η_p^2
Teachers' beliefs						
Food habits and choices	19.00 (2.29)	14.74 (3.23)	20.91 (2.82)	62.88	<0.001	.44
Infrequent ICT users		d = 1.51	d = 0.76			
Specific ICT users			d = 2.03			
Environmental and cost- consciousness	14.52 (2.11)	12.00 (2.73)	16.70 (2.26)	49.68	<0.001	.39
Infrequent ICT users		d = 1.03	d = 0.99			
Specific ICT users			d = 1.87			
Practical skills	7.82 (2.18)	6.07 (1.74)	10.36 (2.57)	47.85	<0.001	.38
Infrequent ICT users		d = 0.89	d = 1.07			
Specific ICT users			d = 1.96			

Scheffe's post-hoc tests showed moderate to large differences between all groups in the mean score of all the areas of purpose of ICT use ($p < 0.05$) and teachers' beliefs ($p < 0.01$), except for ICT use for administration and lesson planning between specific ICT users and frequent ICT users ($p = 0.578$).

Cluster 1. Infrequent ICT users

Infrequent ICT users were characterized by low ICT use and neutral beliefs about using ICT in HE. Despite the lowest ICT use ($p < 0.05$), they do not have a negative attitude towards the use of ICT for achieving learning objectives within the core content in HE. Compared to specific ICT users, teachers in this cluster perceive using ICT to be more important; however, compared to frequent ICT users, teachers in this cluster considered using ICT to be less important for achieving learning objectives within the core content ($p < 0.001$).

Cluster 2. Specific ICT users

Specific ICT users primarily focus on using ICT for administration and lesson planning. Compared to infrequent ICT users, the teachers in this cluster use ICT significantly more for cooperation ($p = 0.001$, $d = 0.77$), facilitating pupils' learning ($p < 0.05$, $d = 0.60$), and administration and lesson planning ($p < 0.001$, $d = 1.64$). Compared to frequent ICT users, they use ICT significantly less frequently for cooperation ($p < 0.001$, $d = 0.90$) and facilitating pupils learning ($p < 0.001$, $d = .98$). However, they place less importance on using ICT in HE compared to both infrequent ICT users ($p < 0.001$) and frequent ICT users ($p < 0.001$).

Cluster 3. Frequent ICT users

The third cluster, frequent ICT users, are the most common users of ICT for different educational purposes in HE. However, ICT use for administration and lesson planning was not found to be significantly higher ($p = 0.578$) than ICT use among specific ICT users. Teachers in this cluster use ICT specially to collaborate with other colleagues and school subjects as well as to facilitate students' learning in various ways. Compared to infrequent ICT users ($p < 0.001$) and specific ICT users ($p < 0.001$), teachers in this group place more importance on using ICT in HE.

Differences in the ICT-user profiles among subject-teachers in HE

In order to answer the third research question, differences in the ICT-user profiles based on demographics, perceived ICT self-efficacy and use of different types of ICT, are explored. Chi-square tests were conducted to compare the demographic characteristics, age, and TQ among the clusters. The results showed no significant demographic differences in age [χ^2 (7,013), df = 6, p = 0.320] or TQ [χ^2 (1,403), df = 2, p = 0.496] among the clusters (Appendix 5).

Further, one-way ANOVAs with post-hoc testing were conducted in order to investigate group differences in perceived ICT self-efficacy and use of different types of ICT. As showed in Table 2, the results indicated significant mean differences among the profiles with regard to their perceived ICT self-efficacy [F(2, 158) = 17.66, p < 0.001, $\eta_p^2 > 0.14$]. Scheffe's post-hoc test revealed no significant differences between infrequent ICT users and specific ICT users (p = 0.381), while frequent ICT users have significantly higher ICT self-efficacy compared to both infrequent ICT users (p < 0.001) and specific ICT users (p < 0.01).

Table 2 Cluster characteristics based on ICT self-efficacy and use of different types of ICT

Variable	**Infrequent ICT-users**	**Specific ICT-users**	**Frequent ICT-users**			
	n = 60	**n = 43**	**n = 58**			
	M (SD)	**M (SD)**	**M (SD)**	**F**	**p**	η_p^2
ICT self-efficacy	2.70 (1.08)	2.98 (1.04)	3.76 (0.87)	17.66	<0.001	.18
Infrequent ICT users		d = 0.26	d = 1.08			
Specific ICT users			d = 0.82			
Use of ICTs						
Applications and digital content	15.35 (4.36)	16.70 (4.64)	22.10 (3.96)	39.65	<0.001	.33
Infrequent ICT users		d = 0.30	d = 1.62			
Specific ICT users			d = 1.25			
Tools for online teaching	5.25 (1.98)	5.63 (2.25)	7.55 (3.56)	11.80	<0.001	.13
Infrequent ICT users		d = 0.18	d = 0.80			
Specific ICT users			d = 0.65			
Social media	4.22 (1.60)	4.60 (1.89)	6.45 (2.60)	18.72	<0.001	.19
Infrequent ICT users		d = 0.22	d = 1.03		’	
Specific ICT users			d = 0.81			

One-way ANOVAs also showed that there were significant between-group differences in the use of different types of ICT with medium- and large-effect sizes (Table 2). According to Scheffe's post-hoc tests, frequent ICT users scored significantly higher on all three different types of ICT uses compared to the other groups (p < 0.01), which was also expected. However, there were no between-group differences between teachers in the infrequent ICT users and specific ICT users groups.

Finally, we also conducted ANOVAs to investigate differences in the use of the ICT devices between the three cluster groups. Interestingly, specific ICT users did not display

lesser use of laptop computers and data projectors ($p > 0.05$) than frequent ICT users (Table 3). As showed in Table 3, the effect size for laptop computers was small ($\eta_p^2 = 0.048$) but large ($\eta_p^2 = 0.14$) for data projectors.

Table 3 Cluster characteristics based on use of different ICT devices

Variable	Infrequent ICT users	Specific ICT users	Frequent ICT users			
	n = 60	n = 43	n = 58			
	M (SD)	M (SD)	M (SD)	F	p	η_p^2
Desktop computers	3.03 (1.61)	3.19 (1.55)	3.52 (1.55)	1.449	0.238	
Infrequent ICT users		d = 0.10	d = 0.31			
Specific ICT users			d = 0.21			
Laptop computers	2.55 (1.57)	2.67 (1.38)	3.31 (1.65)	3.965	<0.05	.048
Infrequent ICT users		d = 0.08	d = 0.47			
Specific ICT users			d = 0.42			
Tablets	2.18 (1.32)	2.02 (1.06)	2.00 (1.46)	8.600	<0.001	.098
Infrequent ICT users		d = 0.13	d = 0.59			
Specific ICT users			d = 0.77			
Mobile- and smartphones	2.90 (0.93)	3.02 (1.08)	3.78 (1.03)	12.603	<0.001	.138
Infrequent ICT users		d = 0.12	d = 0.89			
Specific ICT users			d = 0.71			
Whiteboards	1.37 (1.06)	1.84 (1.48)	1.90 (1.37)	2.881	0.059	
Infrequent ICT users		d = 0.37	d = 0.43			
Specific ICT users			d = 0.04			
Data projectors	3.03 (1.66)	3.95 (1.27)	4.31 (1.26)	12.837	<0.001	.140
Infrequent ICT users		d = 0.63	d = 0.88			
Specific ICT users			d = 0.28			

Discussion

The aim of the study was to identify ICT user profiles among subject-teachers in HE that had a common way of using ICT in their work and specific beliefs regarding the importance of using ICT for pupils to achieve learning objectives within the core content in HE. The study identified three different ways of using ICT in HE and three different user profiles among subject-teachers in HE. Based on these findings, a relationship was found between the beliefs of subject-teachers and ICT teaching practice in HE. Further, the findings indicate a low ICT usage in the school subject of HE.

According to the first research question, the following three dimensions of ICT use in HE were found: cooperation, facilitating pupils' learning and administration and lesson planning. These findings support previous research that distinguishes between professional and instructional ICT use (Howard et al., 2015), supportive and class use (van Braak et al.,

2004), and ICT use outside and within the classroom (Ibieta et al., 2017). Accordingly, cooperation and administration and lesson planning can be considered professional ICT use outside the class and facilitating pupils' learning can be considered instructional ICT use within the class. Categorizing cooperation and administration and lesson planning as professional tasks is similar to Meneses et al. (2012) and their division of professional tasks into supportive and management ICT use.

In relation to the second research question, three different types of ICT-user profiles among subject-teachers in HE were identified: infrequent ICT users, specific ICT users, and frequent ICT users. These findings can be related to previous research and confirm a relationship between teachers' beliefs with regard to the importance of using ICT for students' learning and ICT use (Eickemann et al., 2017; Ibieta et al., 2017; Inan & Lowther, 2010; Pajares, 1992; Petko, 2012). These results support Ibieta et al. (2017), who found that the perception of impact on student learning affected teachers' ICT use in class.

In this study, frequent ICT users, who used ICT most frequently for both instructional and professional tasks, also had the most positive beliefs regarding the use of ICT for pupils' learning. Interestingly, infrequent ICT users did not have the most negative beliefs. Thus, this profile can be compared to the partial doubters, who express some hope (Eickelmann & Vennemann, 2017). The most negative beliefs regarding the use of ICT for achieving pupils' learning objectives were represented by specific ICT users, whose ICT use was mainly limited to administration and lesson planning. This is consistent with Mama and Hennessy's (2013) results, who identified a teacher group in which teachers used ICT mainly for administrative tasks and held the beliefs that ICT facilitates administrative activities. Based on the results of this study, ICT is considered to be used to a certain extent in HE. This also confirms the results of previous studies where ICT use is reported to be low in artistic and practical subjects (Erixon, 2010; Tanhua-Piiroinen et al., 2016; Veeber et al., 2017). ICT is also most frequently used for professional purposes, which also confirms the results of previous research (Ibieta et al., 2017; Sipilä, 2014; Veeber et al., 2017).

With regard to the third research question, the study did not show any significant differences between the profiles in terms of demographics, age, and TQ. These results are in line with the findings by Gil-Flores et al. (2017), Hermans et al. (2008), and Inan and Lowther (2010), who reported no significant association between age and use of ICT. However, with regard to TQ, the findings did not support the study by Håkansson (2016), who showed that unqualified HE teachers have a lower intention to transfer norms and values within the curriculum than qualified HE teachers. Since frequent ICT users reported the highest ICT self-efficacy, there is a confirmed relationship between perceived ICT self-efficacy, ICT use, and ICT teaching practices, which is in accordance with previous research (Hatlevik & Hatlevik, 2018; Teo, 2009). This also highlights the importance of supporting teachers' confidence in using ICT, particularly for supporting instructional use of ICT.

The post-hoc tests showed that frequent ICT users used different types of ICT more frequently than the other profiles. When examining only the use of ICT devices, it was also evident that specific ICT users used data projectors almost as often as frequent ICT users. Data projectors were the most frequently used tool among all subject-teachers in HE. This result is contrary to previous studies, which reported desktop and laptop computers as being the most frequently used devices (Sairanen, et al., 2014). However, this study confirms that the use of mobiles and smartphones is an increasingly popular trend among subject-teachers in HE, while it finds that tablets are used to a small extent, which is contrary to prior findings (cf. Tanhua-Piiroinen et al., 2016; Veeber et al., 2017).

Conclusion

The results of this study indicate the differences between the identified profiles based on the teachers' purpose of ICT use and beliefs about the importance of using ICT for supporting pupils' learning within the core content in HE. Since the effect sizes were large, these findings show that both teachers' beliefs and self-efficacy beliefs are important factors for ICT usage in HE, particularly for the instructional use of ICT. As the data projector is the most used device, there is a need to further investigate other elements of pedagogical beliefs in order to obtain better insight into whether the subject-teachers in HE have utilized ICT in a meaningful manner, supporting pupils' learning (Comi et al., 2017; George & Sanders, 2017; Prestridge, 2017). In order to use ICT in an appropriate manner, HE teachers need a better understanding of how to apply ICT in a subject-specific manner (Ertmer & Ottenbreit-Leftwich, 2010; Howard et al., 2015). Further research could be conducted to explore other factors influencing subject-teachers' ICT use in HE. Further, as was evident in our study, only one-third of the teachers used ICT for instructional purposes. According to Inan and Lowther (2010), teachers' beliefs are affected by perceived support and computer availability. Thus, it would be fundamental to explore the factors affecting the negative beliefs held by HE subject-teachers.

In conclusion, this study provides a deeper understanding of subject-teachers' use of ICT in HE in lower secondary education in Finland. The results revealed three dimensions of ICT use among HE teachers, and a crucial relationship between teachers' beliefs and purpose of use in terms of facilitating pupils' learning. When identifying the three ICT-user profiles, it was further clarified that the use of ICT for instructional purposes was rather infrequent among HE teachers. In order to enhance the teaching in HE, it is thus important to explore what actions should be taken to support subject-teachers to implement ICT in teaching for benefitting pupils' learning.

Limitations

The present study has a few limitations. This study was conducted in 2016, which implies that the data may not correspond to the current situation. Moreover, the sample size (n = 161) is rather small, which can affect the generalisability of the results. It is difficult to determine if the sample size is adequate when using CA since it needs to be sufficiently large to enable representations of the relevant groups identified in the CA (cf. Hair et al., 2010). Further, factor analysis can be sensitive to sample size (Tabachnic & Fidell, 2007), and the use of non-probability sampling is a weakness that must be noted (Sue & Ritter, 2012). The study did not measure the ICT use of teachers and pupils separately. However, a strong relationship has been reported between teachers' and students' ICT use (Hsu, 2011). The use of a single-item measure for perceived ICT self-efficacy can be further criticized for having little predictive value (Bandura, 2006). In addition, the results of this study showed three well-defined clusters. Based on the results obtained from the elbow method, a four-cluster solution could also have been an appropriate solution. However, when considering other criteria, the size of the clusters, and significant differences, the three-cluster solution was found to be the best one.

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Appendix

Appendix 1 Overview of included variables

Variables	Question	Coding	Example of items
Age	How old are you?	1 = Under 30 2 = 31–45 3 = 46–60 4 = Over 60	
Teaching qualification	What kind of educational background do you have?	0 = lack of subject competence 1 = subject competent	
Purpose of ICT use (10 items)	On a scale of 1–5, rate how often you use ICT for the following purposes.	5-point Likert scale (1 = never, 5 = very often)	For lesson planning. For sharing material with other colleagues. In teaching to facilitate information searching by pupils.
Teachers' beliefs about the importance of using ICT for achieving learning objectives (12 items)	How important is it to apply ICT within the following core contents of home economics?	5-point Likert scale (1 = not important, 5 = very important)	For planning meals. In order for pupils to solve problems related to the use of money in households. For considering food choices and habits from the viewpoint of food safety.
Use of different types of ICT (13 items)	On a scale of 1–5, rate how often you use the following ICT tools in home economics education.	5-point Likert scale (1 = never, 5 = very often)	Laptop computer Digital recipes Digital presentation tools Cloud storage services
ICT self-efficacy (1 item)	How would you grade your own ability to use ICT in teaching?	5-point Likert scale (1 = very poor, 5 = excellent)	

Appendix 2 Item content, factor loadings, communalities, Cronbach's alpha, mean, and standard deviation for identifying the purpose of ICT use based on 10 items.

Item	F1	F2	F3	Commu-nality	Mean(SD)
Cronbach's alpha	**0.86**	**0.80**	**0.66**		
For creating material with other colleagues.	0.91			0.88	3.01(1.26)
For sharing material with other colleagues.	0.79			0.74	3.53(1.2)
For cooperating with my colleagues in home economics.	0.68			0.51	2.75(1.07)
For cooperating with other school subjects.	0.51			0.39	2.75(1.07)
In teaching to present a subject area in a structured manner (e.g. food culture, private finances).		0.84		0.77	3.57(1.07)
In teaching to vary learning methods.		0.75		0.74	3.63(1.05)
In teaching for pupils' information searching.		0.61		0.42	4.07(0.95)
In teaching for pupils to communicate with each other.		0.48		0.39	1.91(1)
For planning the lessons.			0.53	0.63	4.27(0.86)
For administrative tasks.			0.74	0.60	4.09(1.17)

Note. F1 = Cooperation, F2 = Facilitating pupils' learning, F3 = Administration and lesson planning.

Appendix 3 Item content, factor loadings, communalities, Cronbach's alpha, mean, and standard deviation for measuring teachers' beliefs based on 12 items.

Items	F1	F2	F3	Commu-nality	Mean (SD)
Cronbach's alpha	**0.90**	**0.82**	**0.75**		
For considering food choices and habits from the viewpoint of food knowledge and skills.	0.79			0.73	3.67(0.9)
For considering food choices and habits from the viewpoint of the food production chain.	0.78			0.70	3.75(0.85)
For considering food choices and habits from the viewpoint of food safety.	0.73			0.61	3.7(0.9)
For considering food choices and habits from the viewpoint of ethic.	0.67			0.61	3.66(0.88)
For considering food choices and habits from the viewpoint of economical choices.	0.66			0.65	3.76(0.812)
For developing cost-consciousness in everyday life.		0.73		0.63	3.69(0.89)
In order for pupils to solve problems related to the use of money in households.		0.66		0.64	3.58(0.95)
For developing environmental consciousness in everyday life.		0.55		0.52	3.67(0.85)
In order for pupils to learn to assess services related to housing and the household.		0.54		0.44	3.69(0.98)
For development of food preparation and baking skills.			0.68	0.54	2.5(1.21)
For learning good manners.			0.65	0.49	2.55(1.15)
For developing skills related to living together and housing (e.g. cleaning and caring for textiles and materials with appropriate substances, appliances, equipment and working practices).			0.59	0.53	3.22(1.07)

Note. F1 = Food habits and choices, F2 = Environmental and cost-consciousness, F3 = Practical skills

Appendix 4 Item content, factor loadings, communalities and Cronbach's alpha for measuring use of different types of ICT based on 13 items.

Items	**F1**	**F2**	**F3**	**Communality**
Cronbach's alpha	**0.81**	**0.77**	**0.59**	
Source of knowledge (picture, material from webpages, e.g. Arktiset aromit, Ruokatieto, Terveyttä kasviksilla, Martha)	0.81			0.66
Videos	0.71			0.59
Games (e.g. Kahoot, Secondlife)	0.65			0.50
Digital presentation tools (Prezi or PowerPoint)	0.64			0.47
Digital recipes	0.61			0.48
Cloud storage services (e.g. iCloud, Google Drive, Dropbox or schools own cloud storage service)	0.56			0.54
Online assessment (assignments and exams assessed online)		0.83		0.71
Virtual learning platforms (e.g. Fronter, Google Classroom, Moodle)		0.81		0.69
Homeworks online		0.70		0.57
Distance teaching (e.g. Moodle, Fronter)		0.59		0.39
Blogs (that pupils run themselves)			0.77	0.71
Social media (e.g. Facebook, Instagram, Twitter)			0.70	0.53
Blogs (used for communication or as an informational website)			0.69	0.69

Note. F1 = Applications and digital content, F2 = Tools for online teaching, F3 = Social media

Appendix 5 Cluster characteristics based on demographics, age, and education

Variable	**ICT user profiles**			
	Infrequent ICT users	**Specific ICT users**	**Frequent ICT users**	
	n = 60	**n = 43**	**n = 58**	**p**
Demographics	n (%)	n (%)	n (%)	
Age				0.320
Under 31	3 (5.0)	3 (7.0)	5 (8.6)	
31–45	17 (28.3)	10 (23.3)	22 (37.9)	
46–60	35 (58.3)	29 (67.4)	30 (51.7)	
Over 60	5 (8.3)	1 (2.3)	1 (1.7)	
Education				0.496
Qualified	44 (74.6)	33 (78.6)	46 (83.6)	
Not qualified	15 (25.4)	9 (21.4)	9 (16.4)	

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Predicting Finnish subject-teachers' ICT use in Home Economics based on teacher- and school-level factors

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ABSTRACT
This survey-based study (N = 161) investigates the direct and indirect effects of teacher- and school-level factors on subject-teachers' use of ICT in Home Economics (HE). Structural equation modelling was used to test the hypothesised relationships between perceived usefulness of ICT in Home Economics, age, digital competence, ICT infrastructure, support and the three dimensions of ICT use: for cooperation, for facilitating pupils' learning and for administration and lesson planning. Taking account of both direct and indirect effects, the main analysis reveals that the most important predictors of HE teachers' ICT use are the teacher-level factors of digital competence, and perceived usefulness of ICT in HE, as well as the school-level factor of support. The results also indicate a specific relationship between perceived usefulness of ICT in HE and ICT use for facilitating pupils' learning. Taken together, these findings highlight the relevance of teacher- and school-level factors in explaining the different dimensions of teachers' ICT use. They further highlight the importance of providing HE teachers with the necessary support to develop their digital competence and increase their awareness of ICT's potential value in enriching and supporting student learning in HE.

KEYWORDS
ICT use in education; home economics; home economics teachers; structural equation modelling; path model analysis; secondary education

1. Introduction

As digitalisation pervades all areas of society, information and communication technology (ICT) is increasingly used to support everyday tasks (Casimir, 2011; Eurostat, 2018a; Hölttä, 2014). Digital technology has influenced for example consumption patterns and has become a natural part of children's lives (Chaudron, Di Gioia, & Gemo, 2018; Eurostat, 2018b; Parastoo, Nasrin Razavian, & Behrooz, 2016). However, growing up in a digital world does not automatically provide the skills needed to meet new everyday demands or to use ICT responsibly (Kirschner & De Bruyckere, 2017; OECD, 2018) as growing consumption and increased use of resources puts further pressure on the environment (Akenji et al., 2015; European Commission, 2012). Rapid technological development has also brought fundamental changes in education, requiring teachers to employ ICT as part of teaching practice, which has transformed both teaching and learning (George & Sanders, 2017; UNESCO, 2018, 2019; Valencia-Molina et al., 2016). In the case of the school subject of Home Economics (HE), pupils should be given opportunities to develop capabilities needed to master the complex issues in daily life, which in turn requires using ICT. Using ICT in HE is thus not

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fully recognised and is seen as a challenge that HE pedagogics face. (Elorinne, Arai, & Autio, 2017; Finnish National Board of Education, 2014; cf. International Federation of Home Economics, 2008; Pendergast, 2006; Venäläinen & Metsämuuronen, 2015).

Set in a Finnish context, the present study provides important insights into the use of ICT in HE. The focus is specifically on HE teachers' teaching with ICT, and not on teaching about ICT. According to the Finnish core curriculum, the task of the subject of HE is to "develop the knowledge, skills, attitudes, and readiness required to master everyday life and to adopt a sustainable way of living that promotes well-being" (Finnish National Board of Education, 2014, p. 438). Utilising digital environments and ICT is set in the context of life skills development in general (e.g. making responsible and informed household decisions) and especially the development of consumer and financial skills, as well as well-being (Finnish National Board of Education, 2014). The quest for sustainable living has also long been a key feature and strength of HE (International Federation of Home Economics, 2008; Turkki, 2008). To become sustainable consumers, individuals need to engage with the issues and alter their behaviour in relation to energy and water consumption, transportation, diet, waste and disposal. To shift to these more sustainable patterns, individuals need to be better informed, with better access to information on which to base their choices. In this context, ICT can be an important support tool (Akenji et al., 2015). Shaping and preparing citizens as future consumers has further become central and the requisite competences to make safe and sustainable choices now include assured use of digital tools (cf. Brečko & Ferrari, 2016; Gisslevik, Wernersson, & Larsson, 2017; TemaNord, 2010). However, previous studies have shown that subject-teachers in HE use ICT mainly for professional tasks and less frequently for teaching and learning purposes (Sundqvist, Korhonen & Eklund, in review; Venäläinen & Metsämuuronen, 2015; cf. Veeber, Taar, Paas, & Lind, 2017).

Understanding what drives teachers' use of ICT is a complex issue. From a Finnish perspective, despite considerable investment in ICT infrastructure and highly equipped schools, ICT use seems to be quite infrequent compared to other European countries, especially among students (European Schoolnet & University of Liége, 2012). There is evidence that teachers still encounter several barriers, including negative attitudes, lack of digital competence, lack of support, lack of ICT training and lack of digital learning resources (Hietikko, Ilves, & Salo, 2016; Tanhua-Piiroinen et al., 2016; Wastiau et al., 2013). A growing number of studies have investigated the factors that affect ICT acceptance and use among teachers, but little research has explored this issue in the context of HE as a school subject (cf. Hatlevik & Hatlevik, 2018; Kreijns, Vermeulen, Kirschner, van Buuren, & Van Acker, 2013). However, a study by Sundqvist et al. (in review) indicates that HE subject-teachers' use of ICT relates to their beliefs. The present study further addresses this research gap by exploring the factors that influence HE teachers' use of ICT in order to identify relevant support measures.

2. Literature review

2.1. *Dimensions and impacts of teachers' ICT use*

Previous research has reported several advantages of ICT use at both individual and collective levels. At an individual level, ICT use is thought to increase motivation and

engagement, both of which are central to student learning and achievement (Reeve, 2012). Teachers can support student motivation by using ICT to improve visualisation and to highlight important content (Fransson, Lindberg, & Olofsson, 2018). To facilitate student engagement, teachers should take account of the individual's knowledge and learning processes to support participation in learning activities (Bergdahl, Fors, Hernwall, & Knutsson, 2018). ICT also enables teachers to provide direct feedback on students' knowledge and learning (Håkansson Lindqvist, 2015). By improving access to learning resources, ICT can also enhance differentiated and individualised learning (McKnight et al., 2016). At a collective level, technology can be used to support collaborative learning and to enhance communication, sharing and exchange of knowledge (Lindberg & Olofsson, 2017; Redecker, Ala-Mutka, Bacigalupo, Ferrari, & Punie, 2010).

Providing opportunities for students to learn and develop key skills for a digital world requires corresponding changes in teaching processes (McKnight et al., 2016; OECD, 2016). There are several conditions affecting teachers' implementation of ICT in teaching practices (Teo, 2018). However, there is evidence that teachers may not be exploiting the full potential of ICT to support student knowledge construction and effective learning (Fransson et al., 2018; George & Sanders, 2017). In this regard, several studies have emphasised the importance of factors related to subject matter and curriculum, as values and norms vary across different subject areas (Howard, Chan, Mozejko, & Caputi, 2015; Tamim, Bernard, Borokhovski, Abrami, & Schmid, 2011; Wikan & Molster, 2011). Studies exploring the dimensions of ICT-related teaching practices have distinguished between professional and instructional uses of ICT; in general, the former refers to tasks outside the classroom while the latter refers to tasks inside the classroom (Howard et al., 2015; Ibieta, Hinostroza, Labbé, & Claro, 2017; van Braak, Tondeur, & Valcke, 2004). However, little is known about what kinds of ICT teaching practice support student learning, and further research is needed on the conditions that affect different type of ICT use, especially in relation to differences between subject areas (Comi, Argentin, Gui, Origo, & Pagani, 2017; Howard et al., 2015). This study seeks to identify factors affecting three distinct dimensions of ICT use among subject-teachers in HE: ICT for cooperation; ICT for facilitating pupils' learning; and ICT for administration and lesson planning.

2.2. *Factors affecting teachers' ICT use*

As research on teachers' frequency of ICT use does not address frequency of use for learning purposes, it is important to identify the factors that influence the different dimensions of ICT use. Teachers' ICT use and acceptance is influenced by several interacting factors, and path models such as the Integrative Model of Behavioural Prediction (IMBP) (Fishbein, 2000) and the Technology Acceptance Model (TAM) (Davis, 1986; Teo, 2012) have been used to trace the direct and indirect effects of these (Kreijns et al., 2013).

Further, there are also path models exploring factors influencing teachers' different types of ICT use (Ibieta et al., 2017; van Braak et al., 2004). The interacting factors can be related to a teacher-level, a school-level and a system-level. Teacher-level factors include beliefs, digital competence and demographic variables (e.g. age). School-level factors include technological or material issues such as ICT infrastructure and support.

System-level factors often relate to national and local contexts and how ICT implementation in schools is affected by curriculum development and strategies, policies and initiatives (Anderson et al., 2006; Gil-Flores, Rodríguez-Santero, & Torres-Gordillo, 2017). The present study explores the indirect and direct effects of teacher-level and school-level factors on the three dimensions of ICT use among HE subject-teachers.

Teacher-level factors

While previous path model studies have concluded that teachers' attitudes and beliefs strongly or moderately predict ICT integration, these studies addressed differing beliefs (Farjon, Smits, & Voogt, 2019; Teo, 2012, 2018), originating from different kind of experiences (Richardson, 1996). Pajares (1992) account of belief as a messy construct serves to explain the difficulty of understanding the structure of teachers' beliefs. Perceived usefulness and equivalent terms used (Scherer, Siddiq, & Teo, 2015; Teo, 2018) are known to be key determinants of ICT use, although there seems to be no clear consensus concerning the definition of perceived usefulness. Studies based on the TAM model (cf. Teo, 2009, 2018) commonly operationalise perceived usefulness in terms of Davis' definition as the extent to which an individual believes that using a particular system would enhance job performance (1986, p. 26). In contrast, Scherer et al. (2015) focused on the potential of ICT for teaching and learning. Regardless of any differences of approach, perceived usefulness of ICT and similar beliefs seem to have a positive direct effect on teachers' intended or actual use (Ibieta et al., 2017; Inan & Lowther, 2010; Teo, 2018).

Another teacher-level factor identified as a moderate or strong predictor of teachers' ICT use is teachers' digital competence. This suggests that the more highly teachers rate their digital competence, the more they will use ICT. However, researchers have defined digital competence in different ways (Hatlevik, 2017; Knezek & Christensen, 2016) – usually seen as an evolving concept that is continuously revised, especially when referring to teachers (Almerich, Orellana, Suárez-Rodríguez, & Díaz-García, 2016; Ilomäki, Paavola, Lakkala, & Kantosalo, 2016). In line with the Council Recommendation of 22 May 2018 on key competences for lifelong learning (2018/C189/01), digital competence can be defined as "confident, critical and responsible use of, and engagement with, digital technologies for learning, at work and for participation in society". According to the DigCompEdu proposal for a European framework for the digital competence of educators (Redecker & Punie, 2017), teachers' digital competence should be assessed in six areas, including use of digital tools to enhance and innovate pedagogy and assessment and to empower learners and facilitate their digital competence. As compared to previous definitions, this places much less emphasis on technological skills. In this study, digital competence is defined in accordance with the Recommendation of the European Parliament and of the Council of 18 December 2006 on key competences for lifelong learning (2006/962/EC).

The available evidence suggests that while Finnish teachers' level of technological competence is quite good, there is a need for pedagogical competence development (Hietikko et al., 2016; Tanhua-Piiroinen et al., 2016) – that is, teachers need to more fully understand how to implement ICT to improve teaching and learning (cf. Haydn, 2014; Sipilä, 2014). Looking more closely at differences between subject-teachers, it seems that those who teach artistic and practical subjects are less skilled than other subject-teachers in utilising digital teaching materials (Tanhua-Piiroinen et al., 2016). According to Inan and

Lowther (2010), age was negatively and indirectly related to ICT use through computer proficiency, which is similar to the concept of digital competence suggesting that computer proficiency decreases with age. However, although lower perceived usefulness of ICT has been linked to older age (Scherer et al., 2015), this background variable has been shown to have no significant effect in the case of teachers (Drossel, Eickelmann, & Gerick, 2017; Gil-Flores et al., 2017). Other significant predictors of teachers' ICT use (not included in this study) are experience of ICT use and teacher collaboration (Drossel et al., 2017; Gil-Flores et al., 2017; van Braak et al., 2004).

School-level factors

From a school-level perspective, ICT infrastructure is a weak predictor for teachers' ICT use (Drossel et al., 2017; Farjon et al., 2019). However, there are studies stressing the importance of teachers' access to computers, resources and internet (Petko, 2012) as well as to educational software (Gil-Flores et al., 2017). Recent research further indicate that ICT-infrastructure has an indirect link to ICT use through computer proficiency and teachers' beliefs (Inan & Lowther, 2010). Despite considerable investments in ICT infrastructure in Finnish schools, teachers still experience the equipment and internet connection to be insufficient (Tanhua-Piiroinen et al., 2016). In the context of the school-subject HE, previous research has also reported that ICT tools are used rather infrequently by HE teachers, which partly due to lack of ICT infrastructure (Venäläinen & Metsämuuronen, 2015).

Support is another school-level factor that has been reported to have a small and moderate indirect effect on teachers' ICT use, mediated by computer proficiency and teachers' beliefs (Inan & Lowther, 2010). The definition of support differs across studies. While Inan and Lowther (2010) distinguish between overall support in terms of administration, peers, parents, and community and technical support, Teo (2018) refers to facilitating conditions including technical support, skills training and computer access. Regarding the importance of support, ICT training is reportedly an essential predictor for ICT use (Gil-Flores et al., 2017), although this seems to vary across countries (Gerick, Eickelmann, & Bos, 2017). In a German context, pedagogical support is emphasised as a particularly important predictor for teachers' ICT use (Gerick et al., 2017) while technical support is generally seen as a weak predictor (Drossel et al., 2017). It is also evident that lack of technical and pedagogical support and lack of training inhibit ICT use in Finnish schools (Ilomäki & Lakkala, 2018; Tanhua-Piiroinen et al., 2016), and subject-teachers in HE recognise the need for further ICT training (Venäläinen & Metsämuuronen, 2015).

2.3. *Aim and research framework*

As well as promoting sustainable living and consumption, one of the core tasks of HE is to support pupils' readiness for daily life in a digital world (Finnish National Board of Education, 2014). Yet although this clearly entails ICT use, little is known about the factors affecting subject-teachers' use of ICT in HE. In that context, the present study explores the impact of teacher- and school-level factors on three dimensions of Finnish subject-teachers' use of ICT in HE. To that end, the study addresses four research questions by testing six associated hypotheses (see Figure 1).

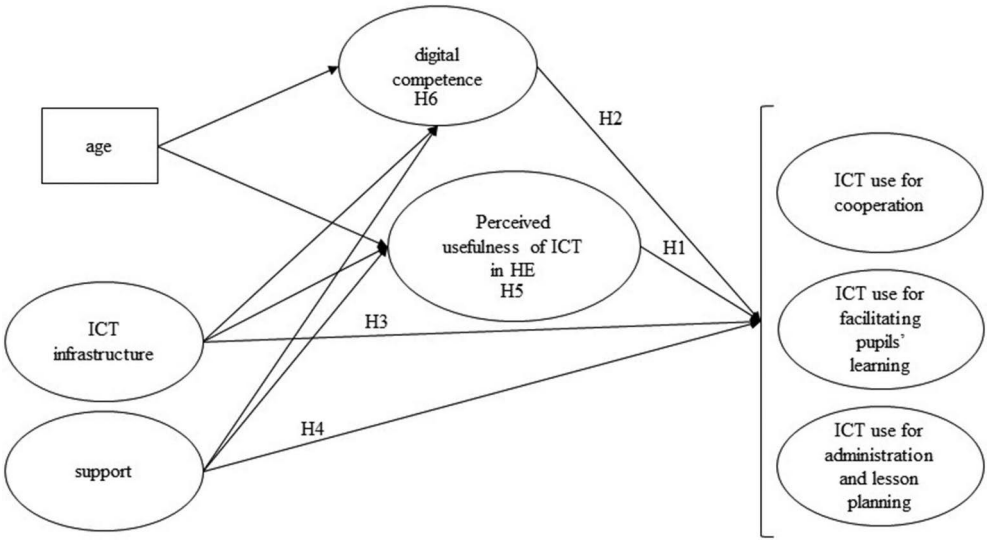

Figure 1. The hypothesised research model of factors predicting subject-teachers' ICT use in HE

RQ1. To what extent do teacher-level factors (perceived usefulness of ICT in HE and digital competence) explain subject-teachers' use of ICT in HE?

Previous research (Hatlevik, 2017; Ibieta et al., 2017; Teo, 2018) has reported a positive relationship between perceived usefulness, digital competence and ICT use. On that basis, we hypothesised that these two factors would have a positive effect on subject-teachers' use of ICT (H1, H2).

RQ2. To what extent do school-level factors (ICT infrastructure and support) explain subject-teachers' use of ICT in HE?

Drawing on previous evidence of a positive relationship between ICT infrastructure, support and teachers' ICT use (Gerick et al., 2017; Gil-Flores et al., 2017; Inan & Lowther, 2010; Petko, 2012), we hypothesised that ICT infrastructure and support would have a direct positive effect on subject-teachers' use of ICT (H3, H4).

RQ3. To what extent does perceived usefulness of ICT in HE mediate the indirect effects of age, ICT infrastructure and support on subject-teachers' use of ICT in HE?

Inan and Lowther (2010) demonstrated that ICT infrastructure and support, mediated by teachers' beliefs, have a positive effect on teachers' ICT use. Additionally, age has shown to have a negative effect on perceived usefulness (Scherer et al., 2015). Accordingly, we hypothesised that ICT infrastructure and support would positively affect subject-teachers' use of ICT in HE through perceived usefulness of ICT in HE while age would have a negative effect (H5).

RQ4. To what extent does digital competence mediate the indirect effects of age, ICT infrastructure and support on subject-teachers' use of ICT use in HE?

According to Inan and Lowther (2010) ICT infrastructure and support are positively related to digital competence or computer proficiency while age is negatively related. Based on these findings, we hypothesised that digital competence would mediate the indirect effects on ICT use of ICT infrastructure, support and age (H6).

3. Methodology

3.1. *Context of the study*

In Finnish primary schools, HE is a compulsory subject for all grade 7 pupils and is optional in grades 8 and 9 (Statsrådets förordning om riksomfattande mål för utbildningen enligt lagen om grundläggande utbildningen och om timfördelningen i den grundläggande utbildningen, 422/2012). HE is characterised as a broad subject with dimensions of multiplicity and diversity (International Federation of Home Economics, 2008). According to the core curricula, the key content areas include food knowledge, skills and food culture, housing and living together, consumer and financial skills at home, supporting development of the multiple skills needed to master daily life and to make sustainable choices. The curricula acknowledge the digitalisation of everyday life to the extent that several of the learning objectives should require ICT use in HE teaching and learning. (Finnish National Board of Education, 2014.) However, the importance of developing digital competence and using ICT in HE is not fully recognised in HE, partly because the disciplinary and interdisciplinary diversity of HE has not been fully valued in the curricula (Elorinne et al., 2017; Turkki, 2008).

A study by the IFHE Think Tank Committee (2013) made it clear that when HE professionals, teachers and students hear the term "HE", cooking is one of the first things that comes to mind. An evaluation of HE learning outcomes in Finland showed that teachers emphasise content related to nutrition and food culture more than other areas. Furthermore, pupils experienced that they master practical cooking skills, while they have a decreased insight in consumer issues (Venäläinen & Metsämuuronen, 2015). This weak identity is of concern because the significance of HE education does not seem to be fully understood (Harden, Hall, & Pucciarelli, 2018). This may also relate to the history of HE education, which was originally intended to develop women's cooking skills and to improve household finances (cf. Richards, 2000; Sysiharju, 1995;). In that context, it again seems useful to examine the influences on HE subject-teachers' use of ICT, including the influence of their own beliefs.

3.2. *Participants and data collection*

A total of 161 HE subject-teachers from several secondary schools in Finland participated in this study. The participants were divided into four age categories: under 31 (n = 11), 31–45 (n = 49), 46–60 (n = 94) and older than 60 (n = 7). Using a self-report

survey instrument, the data were collected during March 2016 in a collaboration between two universities. The participants were recruited through random and convenience sampling (Piazza, 2010; Sue & Ritter, 2012). The survey has been sent to 198 randomly selected subject teachers in HE in Finland using a register on all Finnish primary schools. Additionally, the survey has been sent to all 74 subject teachers in HE in Swedish Finland, all members of an association and two subject groups on Facebook. A total number of 2494 email invitations were sent to potential participants, both qualified and unqualified teachers working as subject-teacher in HE. However, since there is limited information on the respondents, the use of convenient sampling may have led to duplications in the email-invitations. There is no absolute data on the total amount of subject-teachers in HE; however according to a study with a response rate of 88.1%, 936 teachers worked as subject-teachers in HE in Finland in 2013 (Kumpulainen, 2014). Before the main study, the validity of the questions and the practicality of the instrument were evaluated in a pilot study and by experts in the HE academic field, and amendments were made to ensure correctness and clarity. The research conforms to the ethical principles of the Finnish Advisory Board on Research Integrity (2012).

3.3. *Measurement scales*

A self-reported survey instrument was developed in order to measure the variables used in this study. The three outcome variables – ICT for cooperation (4 items); ICT for facilitating pupils' learning (4 items); and ICT for administration and lesson planning (2 items) – refer to the frequency of teachers' ICT use for different educational purposes (Sundqvist et al., in review). Items addressing ICT for cooperation (e.g. "For sharing material with other colleagues") are inspired from the Teacher Technology Practices (TTP) scale presented by Howard et al. (2015) and the scale of van Braak et al. (2004). The construct of ICT for facilitating pupils' learning (e.g. In teaching for students to search information) and ICT for administration and lesson planning (e.g. "For administrative tasks") are measured by items partly adapted from the scale of van Braak et al. (2004). The variables were measured on a five-point Likert scale ranging from 1 (*never*) to 5 (*very often*).

To simplify the research model we used item parcels of (1) general perceived usefulness (22 items, α =.95) and (2) beliefs about using ICT to achieve learning objectives within HE (15 items, α = .92) as factor indicators instead of individual items. In relation to general perceived usefulness, teachers were asked to what extent they believed that using ICT would enhance their teaching and support students' learning, based on a five-point scale ranging from 1 (*strongly disagree*) to 5 (*completely agree*). Of the 22 items (e.g. "ICT facilitates assessment work," "Integrations of ICT promotes student's ability to search, collect and process information"), 15 items were inspired and 5 adapted from the scale of Hernándes-Ramos, Martínez-Abad, García Peñalvo, Herrera García, and Rodríguez-Conde (2014), and further two items were based on the scale of Scherer et al. (2015). In relation to beliefs about using ICT to achieve learning objectives, teachers were asked to what extent they believed that using ICT would support pupils' achievement of learning objectives within the core content of HE (e.g. "For planning meals", "For developing cost-consciousness in everyday life.")

This was measured on a five-point scale ranging from 1 (*not important at all*) to 5 (*very important*). Beliefs about using ICT to achieve learning objectives relate to subject matter, which has previously been highlighted as a key issue when exploring teachers' ICT use (Ertmer & Ottenbreit-Leftwich, 2010; Pajares, 1992).

The digital competence scale, consisting of nine items (e.g. "I can critically assess the value of information online") was developed based on the definition of digital competence in the Recommendation of the European Parliament and of the Council of 18 December 2006 on key competences for lifelong learning (2006/962/EC). Teachers were asked to assess their digital competence in 9 different areas, using a five-point scale ranging from 1 (*strongly disagree*) to 5 (*completely agree*). Age was the only background variable used in this study, and teachers were asked to self-report their age group. The ICT infrastructure scale was partly based on Bilbao-Osorio and Pedró (2009) and comprised 8 items. Teachers rated their access to computers and internet on a five-point scale ranging from 1 (*strongly disagree*) to 5 (*completely agree*). The support scale consisted of 10 items, five items modified from the Teacher Technology Questionnaire (TTQ) of Inan and Lowther (2010) and five items from the survey questionnaire used by European Commission (2013). Teachers rated adequacy of support (technical, pedagogical, from administration, from colleagues and in-service ICT training) on a five-point scale ranging from 1 (*strongly disagree*) to 5 (*completely agree*).

3.4. *Data analysis*

Structural equation modelling (SEM) with weighted least square mean and variance adjusted (WLSMV) estimator was applied to test both direct and indirect effects in the hypothesised path model (see Figure 1) (Brown, 2006; Huck, 2012). SEM analysis was performed using Mplus statistical software, version 8.2 (Muthén & Muthén, 2017). Bootstrapping was used to estimate the standard errors and confidence intervals of estimated indirect and total effects (Kline, 2005). The confidence intervals (95%) for indirect effects were calculated using 1000 bootstrap draws. The Statistical Package for the Social Sciences (SPSS Statistics 25) was applied to prepare the raw data file used for SEM. The fit of the research model was evaluated using the root mean square error of approximation (RMSEA), comparative fit index (CFI) and Tucker-Lewis index (TLI), based on the recommended values (RMSEA $< .06$; CFI $\geq .90$; TLI $\geq .90$) (Marsh, Hau, & Wen, 2004).

4. Results

4.1. *Preliminary analysis*

The results from confirmatory factor analysis (CFA) confirmed good construct validity. All items had a factor loading greater than 0.5 and fell within the acceptable range (Hair, Black, Babin, & Anderson, 2010; Huck, 2012). The model was found to achieve good fit to the data ($\chi2(681) = 1027.875$; $p < .001$; CFI = .95; TLI = .95; RMSEA = .06) (Marsh et al., 2004). The results indicate that a one-factor structure is acceptable for the measures perceived usefulness of ICT in HE, digital competence, ICT infrastructure and support (see Table A1 in Appendix). Correlations, descriptives and internal consistencies for all measures are presented in Table 1.

Table 1. Correlations, descriptives and internal consistencies for all measures (n = 161).

Variables	Cronbach's alpha (α)	Mean (SD)	Skewness/ Kurtosis	ICT for cooperation	ICT for facilitating pupils' learning	ICT for administration and lesson planning	Perceived usefulness of ICT in Home Economics	Digital competence	Age	ICT infrastructure	Support
ICT for cooperation	.86	12.40 (3.94)	.001/-.589	1							
ICT for facilitating pupils' learning	.80	13.19 (3.21)	−.214/.023	.502**	1						
ICT for administration and lesson planning	.66	8.37 (1.78)	−.954/.035	.481**	.499**	1					
Perceived usefulness of ICT in Home Economics	.95	135.07 (21.34)	−.438/1.761	.290**	.425**	.190*	1				
Digital competence	.90	28.98 (8.14)	−.345/-.418	.445**	.476**	.444**	.393**	1			
Age	-	2.6 (.68)	−.616/.171	−.217**	−.228**	−.178*	−.141	−.387**	1		
ICT-infrastructure	.82	25.13 (7.86)	−.105/-.884	.158*	.092	.091	.119	.355**	−.138	1	
Support	.91	25.21 (9.28)	.164/-.612	.361**	.260**	.194*	.322**	.660**	−.192*	.520**	1

**Correlation is significant at level p <.01 *Correlation is significant at level p <.05

4.2. *Main analysis*

To investigate how perceived usefulness of ICT in HE, digital competence, age, ICT infrastructure and support might predict teachers' ICT use in HE, we fitted the full model to the data (Figure 2). The model achieved good fit ($\chi2(719) = 1059.059$; $p < 0.001$; CFI = .95; TLI = .95; RMSEA = .05 (Marsh et al., 2004). Based on the results from the SEM analysis, the research model accounted for 30% of the variance in ICT for cooperation, 52% of the variance in ICT for facilitating pupils' learning and 41% of the variance in ICT for administration and lesson planning.

In relation to RQ1 and RQ2, it was hypothesised that all variables except age would have a direct impact on HE teachers' ICT use (H1, H2, H3, H4). However, only perceived usefulness of ICT in HE and digital competence were found to have a direct positive significant effect on ICT use. Perceived usefulness of ICT in HE had a moderate effect (β = .48) on teachers' ICT use, but only for teachers' ICT use for facilitating pupils' learning. Digital competence had the most substantial direct effect (β = .46–.77) on all three dimensions of ICT use. Support had a moderate negative effect on teachers' use of ICT for facilitating pupils' learning (β = −.41) and for administration and lesson planning (β = −.38). Based on these findings, H1 is partly supported; H2 is fully supported, and H3 and H4 are rejected. Additionally, the research model explains 27% of the variance in perceived usefulness of ICT in HE, which is strongly and significantly affected by support (β = .59). Furthermore, age (β = −.37) and support (β = .73) explain 62% of the variance in digital competence.

Indirect effects on subject-teachers' ICT use in HE

In relation to RQ3 and RQ4, it was hypothesised that perceived usefulness of ICT in HE (H5) and digital competence (H6) would mediate the indirect effects of age, ICT infrastructure and support. However, we found that perceived usefulness of ICT in HE mediated only the indirect effects of support (β = .28, 95% CI = [.119, .581]) with a small regression weight on subject-teachers' ICT use in relation to teachers' ICT use for facilitating pupils' learning. These results partly support H5, indicating that the better the support received by HE teachers, the more they will believe that ICT enhances teaching and pupils' achievement of learning objectives. This in turn promotes more frequent use of ICT for facilitating pupils' learning.

As predicted, the findings confirm that digital competence mediates subject-teachers' ICT use for all variables except ICT infrastructure. Mediated by digital competence, age had a moderate and small negative indirect impact on all three dimensions of ICT use: ICT for cooperation (β = −.17, 95% CI = [−.293, −.071]), ICT for facilitating pupils' learning (β = −.25, 95% CI = [−.377, −.143]) and ICT for administration and lesson planning (β = −.29, 95% CI = [−.417, −.167]). The results suggest that older teachers rate their digital competence lower than younger teachers, leading to lower use of ICT. Support was found to have a moderate and large indirect effect on all three dimensions of ICT use: ICT for cooperation (β = .34, 95% CI = [.171, .566]), ICT for facilitating pupils' learning (β = .49, 95% CI = [.277, .751]) and ICT for administration and lesson planning (β = .56, 95% CI = [.353, .853]). This means that the greater the perceived adequacy of support, the higher the estimated digital competence and greater frequency of all three dimensions of ICT use in HE. These findings indicate partial support for H6. The results of hypothesis testing are shown in Table 2.

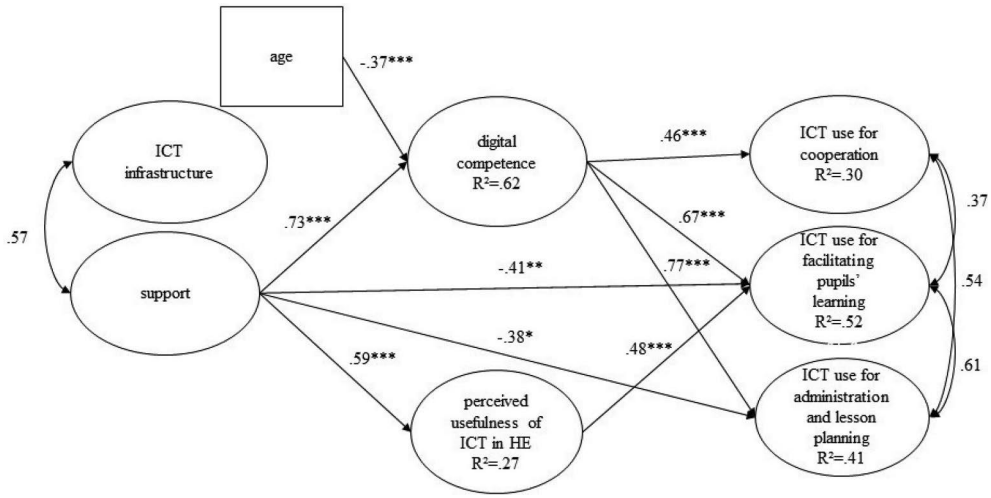

Figure 2. Standardised estimates for direct effects between the variables in the research model
***Significant at level p <.001 **Significant at level p <.01 *Significant at level p <.05

Table 2. Results of hypothesis tests.

Hypothesis	Paths	Supported or rejected
H1	Perceived usefulness of ICT in HE → use of ICT	Partly supported
H2	Digital competence → use of ICT	Supported
H3	ICT infrastructure → use of ICT	Rejected
H4	Support → use of ICT	Rejected
H5	ICT self-efficacy, age, ICT infrastructure, support → **Perceived usefulness of ICT in HE** → use of ICT	Partly supported
H6	Age, ICT infrastructure, support → **Digital competence** → use of ICT	Partly supported

Overall, these results do not fully meet our expectations regarding the factors that influence subject-teachers' ICT use in HE (see Table 2). However, looking at total effects, we can conclude that teachers' digital competence is the most useful predictor and mediator of all three dimensions of ICT use among HE teachers and perceived usefulness of ICT in HE had the second strongest total effect on ICT for facilitating pupils' learning. In addition, even though the direct effect between support and ICT for facilitating pupils' learning and ICT for administration and lesson planning were found to be negative, the results confirm the need to support HE teachers' ICT use. Support was predictive of digital competence and perceived usefulness of ICT in HE and had the second strongest total effect on ICT for cooperation (β = .44, 95% CI = [.239, .629]) and also moderate respective small total effect on ICT for facilitating pupils' learning (β = .36, 95% CI = [.174, .584]) and ICT for administration and lesson planning (β = .29, 95% CI = [.048, .529]). This again confirms the key role of perceived usefulness of ICT in HE in HE teachers' ICT use.

5. Discussion

The main content areas of HE in Finland are food knowledge, skills and food culture, housing and living together and consumer and financial skills at home (Finnish

National Board of Education, 2014). According to previous research, ICT use in HE is fairly infrequent, which may partly explain why pupils do not master all life skills according to the core curriculum equally (Venäläinen & Metsämuuronen, 2015). The aim of the present study was to explore the direct and indirect effects of teacher- and school-level factors on the three dimensions of ICT use among Finnish HE subject-teachers. A research model comprising six hypotheses was developed to test the relationships between perceived usefulness of ICT in Home Economics (HE), age, digital competence, ICT infrastructure, support and the three dimensions of ICT use: for cooperation, for facilitating pupils' learning and for administration and lesson planning (see Figure 1).

In relation to RQ1, it was hypothesised that the teacher-level factors of perceived usefulness of ICT in HE (H1) and digital competence (H2) would directly affect the three dimensions of ICT use. In line with previous research (Hatlevik, 2017), the present findings confirm that digital competence is a major determinant of HE teachers' ICT use on all dimensions. In addition, teachers' beliefs about the usefulness of ICT are associated with teachers' frequency of ICT use (Ibieta et al., 2017; Inan & Lowther, 2010). Interestingly, however, we found that perceived usefulness of ICT in HE had a significant influence on teachers' ICT use only in relation to facilitating pupils' learning, perhaps reflecting the subject paradigm and history of HE (cf. Howard et al., 2015; Sysiharju, 1995). The teachers emphasised the practical nature of HE, which may explain some teachers' hesitation for using ICT in order to enhance pupils' learning (cf. Erixon, 2009; cf. Venäläinen & Metsämuuronen, 2015). Significantly, these findings also highlight the role of teachers' digital competence and their awareness of the potential impact of ICT on teaching and learning (cf. Haydn, 2014; Ibieta et al., 2017; Sipilä, 2014).

With regard to RQ2, we hypothesised that the school-level factors of ICT infrastructure (H3) and support (H4) would have a positive direct effect on subject-teachers' ICT use. Contrary to the findings of Gil-Flores et al. (2017) and Petko (2012), ICT infrastructure was found to have no direct effect on HE teachers' ICT use. These results may relate to reports that ICT infrastructure is a weak predictors of ICT use (Drossel et al., 2017; Farjon et al., 2019). Surprisingly, support was found to have a negative direct effect on HE teachers' ICT use for facilitating pupils' learning and for administration and lesson planning. These findings may be explained by the fact that HE teachers who receive support may have poorer digital skills and therefore use ICT less. Support, on the other hand, had a moderate and large indirect effect on HE teachers' ICT use through perceived usefulness of ICT in HE and digital competence. These findings may reflect that with more support teachers see greater benefits with ICT, which in turn increases the use of ICT. These results also indicate the importance of offering support measures that leads to better perceived usefulness of ICT and development of HE teachers' digital competence.

RQ3 sought to determine the mediating effect of perceived usefulness of ICT in HE on the relationship between age, ICT infrastructure, support and ICT use (H5). In line with previous research (Inan & Lowther, 2010; Scherer et al., 2015) and partly supporting H5, perceived usefulness of ICT in HE was found to mediate the positive relationship between support and ICT use in relation to facilitating pupils' learning. As noted above, it seems crucial to support HE teachers if they are to value

the use of ICT for teaching and learning. As the support scale used here included technical and pedagogical support, as well as support from administration and colleagues and in-service ICT training, it is not possible to identify which elements were most influential in supporting teachers' perceived usefulness of ICT in HE. However, a large percentage of the total variance in perceived usefulness of ICT in HE remains unexplained. Teachers' ICT experience, which is not addressed in this study, may contribute to their beliefs about the usefulness of ICT in HE (cf. van Braak et al., 2004; Richardson, 1996). Contrary to our prediction (see also Inan & Lowther, 2010; Scherer et al., 2015), perceived usefulness of ICT in HE did not mediate the negative effect of age or the positive effect of ICT infrastructure on ICT use.

Regarding RQ4, aligning partly with Inan and Lowther (2010), the findings indicate that digital competence mediates the effects of all variables except ICT infrastructure on the three dimensions of teachers' ICT use. The results further confirm the negative relationship between age, digital competence and ICT use (Inan & Lowther, 2010). With regard to total effects, these results confirm the need to support subject-teachers' development of digital competence, especially among teachers in older age groups.

ICT infrastructure had no significant direct or indirect influence on HE teachers' ICT use and is therefore a weak predictor of ICT use (Drossel et al., 2017; Farjon et al., 2019). One possible explanation is that because of Finland's considerable investment in ICT infrastructure (European Schoolnet and University of Liége, 2012), HE teachers may not see any need for better ICT infrastructure. Another possible explanation is that HE teachers do not see the need to improve the ICT infrastructure in order for achieving the learning objectives in the content areas of food knowledge, skills and food culture, which are most often emphasised by teachers (Venäläinen & Metsämuuronen, 2015; cf. Tanhua-Piiroinen et al., 2016).

Overall, our results align with earlier path model analyses that identified the teacher-level factors of perceived usefulness, age and digital competence as significant predictors of ICT use, along with the school-level factor of support (Inan & Lowther, 2010; Teo, 2018). In addition, our findings offer novel insights into the relevance of these factors for the different dimensions of ICT-based teaching practice.

One limitation of the study is the relatively small sample size, which may have influenced the complexity of the model when using SEM techniques (Kline, 2005). Nevertheless, the study results are meaningful at a 95% confidence interval. One source of weakness in this study may also be affected by not including the variable "perceived ease of use", which is in addition to "perceived usefulness" an important variable in the TAM model, mediating the influence of external variables on technology usage behaviour (Davis, 1986). It must also be noted that ICT teaching practices in HE may have changed since the data were collected in 2016.

In this study, we were able to identify different effects of school- and teacher-level factors on HE teachers' three dimensions of ICT use. Both digital competence and perceived usefulness were found to be important determinants of HE teachers' ICT use, also for facilitating pupils' learning, which especially was of interest in this study. However, as 48% of the variability in ICT use for facilitating pupils' learning remains unexplained, there might be other significant factors related to teachers'

ICT use. Further the study instrument needs to be developed to include more variables in the research model, with a larger sample size. Extensive further research is needed to deepen the understanding of the factors affecting subject-teachers' ICT use in HE, especially digital competence and perceived usefulness since they were found to be important determinants for the HE teachers' ICT use. As teaching practice is guided by a range of educational beliefs, a qualitative approach can provide deeper insights. It would also be useful to assess the extent to which the paradigm and history of the subject affect HE teachers' use of ICT, given its traditional roots in women's education and the development of life skills such as cooking (Sysiharju, 1995). Another important practical implication would be to involve HE teachers in curriculum development in Finland and raise awareness of how ICT can enhance teaching and learning in HE.

6. Conclusion

One of the core tasks of HE is to support pupils' ability to deal with everyday life, make sustainable choices and act sustainably as a consumer. However, pupils in HE experience that they master the consumer awareness skills at least, and it is thus a content area that should be supported by ICT. The study's main contribution is the finding that digital competence is a significant influence on HE teachers' ICT use. By implication, a supportive environment seems essential for developing HE teachers' digital competence and their perceived ability to use ICT for teaching and learning purposes, especially among older teachers. The findings also highlight the significant relationship between teachers' beliefs and ICT teaching practice and the consequent need to support HE teachers if they are to recognise the potential of ICT to enrich pupils' learning. In sum, HE teachers need to improve their awareness of ICT's potential to help pupils achieve learning objectives.

Disclosure statement

No potential conflict of interest was reported by the authors.

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Appendix

Table A1. Confirmatory factor analysis.

Construct	Mean	SD	Factor loadings
ICT for cooperation			
Item1	3.53	1.199	.953
Item2	3.01	1.260	.889
Item3	3.11	1.160	.718
Item4	2.75	1.067	.746
ICT for facilitating pupils' learning			
Item1	3.63	1.047	.947
Item2	3.57	1.065	.828
Item3	4.07	.952	.615
Item4	1.91	.977	.765
ICT for administration and lesson planning			
Item1	4.27	.859	.962
Item2	4.09	1.172	.675
Perceived usefulness of ICT in HE			
General perceived usefulness	82.37	14.426	.744
Beliefs about using ICT to achieve learning objectives within HE	52.70	9.805	.734
Digital competence			
Item1	2.54	1.299	.889
Item2	2.41	1.232	.864
Item3	2.84	1.233	.817
Item4	3.91	1.100	.772
Item5	3.65	1.185	.844
Item6	2.89	1.377	.881
Item7	2.89	1.284	.574
Item8	3.90	1.125	.796
Item9	3.94	1.050	.549
ICT infrastructure			
Item1	2.66	1.475	.527
Item2	2.63	1.544	.693
Item3	2.75	1.614	.776
Item4	2.08	1.500	.627
Item5	3.93	1.428	.580
Item6	3.47	1.549	.821
Item7	3.93	1.253	.878
Item8	3.68	1.420	.825
Support			
Item1	2.8	1.331	.797
Item2	2.52	1.240	.929
Item3	2.5	1.314	.658
Item4	2.89	1.273	.759
Item5	2.86	1.364	.870
Item6	2.48	1.189	.814
Item7	2.52	1.280	.776
Item8	2.06	1.080	.590
Item9	2.35	1.190	.866
Item10	2.23	1.080	.764

Perceived usefulness of ICT in HE is composed of two separate constructs, general perceived usefulness and beliefs about using ICT to achieve learning objectives within HE including in total 37 items.

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Home Economic teachers' ICT use in Finland seen from a lens of reciprocal determinism.

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III

IFHE INTERNATIONAL FEDERATION FOR HOME ECONOMICS

PEER-REVIEWED RESEARCH PAPER

Home Economic Teachers' ICT Use in Finland Seen From a Lens of Reciprocal Determinism

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Abstract

This study aims to investigate Finnish home economic (HE) teachers' use of information and communications technology (ICT) and uses triadic reciprocal causation as a means to enhance understanding of it. The study also aims to provide new insight into how HE teachers should be supported in their use of ICT to enhance student learning. Data were collected through semi-structured interviews with 12 HE teachers in 2019 and further examined through an abductive approach to content analysis. The findings show that HE teachers used ICT in a variety of ways, although they had trouble expressing their goals for its use. The findings further show that HE teachers' use of ICT not only depends on their goals, but also on several influences identified at both environmental and personal level in Bandura's model of triadic reciprocal determinism. Based on these findings, HE teachers need to be given support in settings goals for their ICT use. These goals are important because, in combination with performance feedback, they enable teachers to specify the conditions for successful ICT use. Furthermore, the study shows the need for HE teachers to develop digital skills and to have sufficient ICT infrastructure, on-hand pedagogical and technical support, shared practices, collegial support and follow-up teacher training that focuses on their individual requirements. Based on the results, we found Bandura's model to be useful for enhancing our understanding of the influences related to HE teachers' ICT use and their goals for its use.

KEYWORDS: **HOME ECONOMICS; ICT; SECONDARY EDUCATION; RECIPROCAL DETERMINISM**

Introduction

The significance of using information and communications technology (ICT) in teaching has been extensively discussed globally over the past decade (OECD, 2019) and studies have expressed many ways in which it can benefit students' learning. In Finland, the potential for students to use ICT for learning has been emphasised in the country's national core curriculum in relation to all school subjects (Finnish National Board of Education, 2014). Despite the marked importance and benefits of using ICT, various academic subjects have responded differently in how they implement ICT as a tool for students to learn (Erixon, 2010; Howard et al., 2015).

In home economics (HE), the integration of ICT in teaching is essential, although doing so remains a challenge (Elorinne et al., 2017; Sundqvist et al., 2020a; Tanhua-Piiroinen et al., 2016). HE is strongly linked to societal development, and the internet and a number of online services form an essential part of household management today (Hölttä, 2014; Poirier et al., 2017). According to the Finnish core curriculum, HE students should "form an understanding of the increasingly technological nature of daily life" (Finnish National Board of Education, 2014). There are several learning objectives in HE that require the use of ICT and development of related competences, especially those concerned with the development of consumer and financial skills. HE is also an important subject for preparing students for mastering complex issues in daily life, and there is no doubt that dealing with these multi-dimensional tasks requires effective skills in communication, collaboration, information-seeking and management, as well as the ability to use technology effectively (Lewin & McNicol, 2015;

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Poirier et al., 2017). Teachers have an important role to play in using ICT to support their students' learning (Finnish National Board of Education, 2014; OECD, 2019). Consequently, HE teachers are in a prime position for enhancing their students' achievement of learning objectives related to ICT.

This study is the third part of a Finnish project on ICT use by HE teachers. The first part of the project (Sundqvist et al., 2020a) revealed three dimensions of ICT use among HE teachers and suggests a relationship between teachers' beliefs and ICT use. The second part of the project (Sundqvist et al., 2020b) confirmed a relationship between HE teachers' ICT use and different factors, such as support, digital competence and perceived usefulness of ICT. Despite significant and meaningful determinants in the second part of the project, its findings could not fully describe HE teachers' ICT use. Based on these previous studies, and by adopting a qualitative research design, we explore this further in this third part of the project. More precisely, our aim is to investigate Finnish HE teachers' use of ICT in lower secondary education, using social cognitive theory and drawing on the model of triadic reciprocal causation to enhance understanding of it. The following research question is proposed: how can Finnish HE teachers' use of ICT, their goals and their influences be understood through the lens of reciprocal determinism?

Previous research on ICT use

Students, learning providers and educators are all encouraged to take advantage of ICT in order to support students' embrace of essential 21st century skills, such as critical thinking, creativity, communication skills and digital competence. However, successful use of ICT requires teachers to be provided with sufficient support to adapt to technological change and integrate ICT into their classes to improve quality of teaching and learning. Changes to how teaching is conducted have involved a shift from traditional classroom settings, where the teacher is seen as the source of information, to student-centred learning (SCL) (European Commission, 2019; Lewin & McNicol, 2015; McKnight et al., 2016). SCL gives students greater opportunity to actively participate in classroom practices, while the teacher's role has changed to become a facilitator for students to learn (Crumly, 2014; Starkey, 2019). Using ICT for student-centred classroom activities is thus in line with the recommended learning environments and working methods for HE in Finland (Elorinne et al., 2017; Finnish National Board of Education, 2014). Previous studies have shown that the adoption of ICT helps both students' learning outcomes and the development of 21st century skills in SCL practices (Chen & Yang, 2019; Wong & Li, 2011). Thus, successful use of ICT for educational purposes depends on several different conditions and requires teachers to be provided with professional training and opportunities for collegial exchange and sharing of ICT practices (Wong & Li, 2011; Zhang et al., 2021).

ICT in HE has been investigated internationally, in countries such as Hong Kong, Nigeria and Estonia. It was found mainly to be used in a teacher-directed way and less for supporting students active use (Bridget, 2016; Lau & Albion, 2010; Veeber et al., 2017). A qualitative study (Veeber et al., 2017), reported Estonian HE teachers' potential uses, as for example for illustrating purposes, for students' presentations, and for source of information and communication. Although the aim of use was not in focus, the study revealed that ICT was used for facilitating teachers' own work and for supporting students' motivation. In a Norwegian study, HE teachers used digital tools mainly to introduce variety to classes and, to lesser extent, increase motivation, creativity and cooperation. Studies have also confirmed that wikis can be utilised in HE to foster communication and collaboration, and podcasting to support creativity in the kitchen (Lai & Lum, 2012; Surgenor et al., 2016). In the Finnish context, previous studies have shown that HE teachers use ICT quite infrequently to support pupils' learning (Sundqvist et al., 2020a; Tanhua-Piiroinen et al., 2016). A quantitative study (Sundqvist et al., 2020a) of ICT use by Finnish HE teachers, identified three purposes of use: for cooperation, for facilitating pupils' learning, and for administration and lesson planning. Although the literature recognises the importance of ICT in everyday life (Haveri, 2009; Hölttä, 2014; Poirier et al., 2017), there are still few published studies about its use in HE.

Despite this, numerous studies and several approaches have investigated factors influencing teachers' ICT use in general. Quantitative studies have used causal models to reveal relationships between ICT use and factors such as ICT infrastructure, support, demographics, digital competence, teachers' attitudes, beliefs, and between-school differences (Drossel et al., 2017; Farjon et al., 2019; Gerick et al., 2017; Gil-Flores et al., 2017; Hatlevik, 2017; Inan & Lowther, 2010; Vanderline et al., 2014). Studies on the role of beliefs towards ICT use have shown it to be a quite complex subject, although quantitative studies have noted the role of these in ICT practice. Alignments have further been

identified between pedagogical and ICT-related beliefs and ICT integration practices (Ding et al., 2019; Kim et al., 2013).

ICT use is seen as a complex process (OECD, 2019), and during the last decade there have been various qualitative studies that aim to present a more descriptive and nuanced understanding of its use by teachers (Lawrence & Taar, 2018). A study by Razak et al. (2018) found that successful ICT use relied on several conditions related to the ICT tools available, division of labour and school rules and regulations that shape ICT culture. Some researchers have also taken a teacher's perspective and analysed their beliefs and perceptions in relation to their use of ICT. Teachers' perceptions of the challenges of ICT use further relate to aspects of competence, ICT infrastructure, learning materials, time, curricula, policies and the subject being taught (Erixon, 2010; Lindberg et al., 2017; Tallvid, 2016). Overall, these studies clearly indicate that teachers' ICT use is influenced by various factors; but still, little is evident about its use by HE teachers.

Social cognitive theory

To get a better understanding of HE teachers' ICT use, social cognitive theory (SCT) drawing on the model of triadic reciprocal causation (Figure 1) is used as a lens in this study. This theory focuses on human development and addresses knowledge acquisition and the regulation of human behaviour (Bandura, 1986). Human behaviour is explained in terms of triadic reciprocal causation, meaning that behaviour is part of a triadic system in which behavioural, personal and environmental determinants mutually influence each other. Translating this theory into the field of ICT in education, the way teachers use ICT is part of a constant interplay between personal and environmental influences. Personal factors refer to cognitive, affective and biological elements such as personal characteristics, skills, expectations, beliefs, self-perception, goals and intentions (Bandura, 1986, 1989). Environmental factors are created by human activity and can include both physical and social environments. Within SCT, environment is emphasised as a non-fixed entity, which means that some aspects of it will always have an influence on the individual at some level, while other aspects will have an influence only when they are activated by a specific behaviour. Environment can thus have a role both as an inhibiting and an encouraging factor on a person's development and functioning. The strength of these influences on behaviour varies depending on the individual and circumstances. In some cases, an environmental component functions as a strong barrier to a specific behaviour; in others, personal factors have a predominant influence on behaviour (Bandura, 1986).

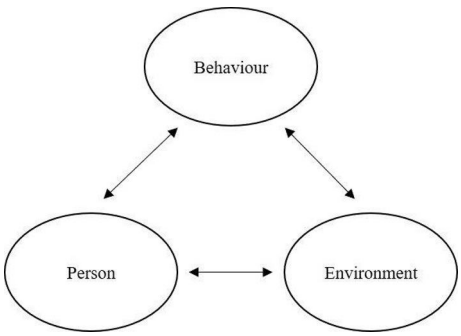

Figure 1 **Theoretical Research Model Adapted From Bandura's Model of Triadic Reciprocal Determinism (Bandura, 1986, p. 24)**

In regard to behavioural patterns and their interactive relations to environmental events and personal regulators, SCT acknowledges that humans are not passive objects shaped by different factors. The influences are conditional of each other and do not function autonomously. Further, Bandura emphasised self-regulatory mechanisms as an important element of causal processes and set them at the base of the theory of triadic reciprocal determinism. Within this mechanism, people have the capability to exercise some control over their own thoughts, feelings and behaviour, for instance through activities requiring forethought such as goal setting (Bandura, 1986, 1991). People set goals and engage in activities that most likely lead to positive outcomes. This leads to a motivation to act and creates beliefs in the effect of an action. However, goals do not directly guide behaviour. Instead, they activate self-influences, which in turn are affected by the characteristics of the goals. People who set no goals for themselves will have difficulty monitoring their own behaviour. Conversely,

people who set themselves challenging goals have more interest and motivation to take strides to fulfil them. Such efforts mean shaping cognitive and environmental conditions to fit one's own purposes (Bandura, 2001). Bandura also emphasised the role of performance feedback. Without knowing how one is performing, a goal would simply not have a motivational effect on one's actions. The same behaviour can serve different goals, and it should not be analysed by excluding goals (Bandura, 1986, 1991). This study is limited to the analysis of HE teachers' use of ICT, their goals through using it and factors that have influenced this adoption. SCT enables emphasis to be placed on the bidirectional notion of interactions, since teachers are provided with opportunities to both reflect on factors associated with their ICT use and on their actions and practices, which in turn allow other influences to emerge.

Methodology

Research design

In this study, we employ an abductive research approach (Kirppendorff, 2004) that moves back and forth between inductive and deductive approaches. In the initial phase, deductive reasoning enables the development of an interview instrument by considering facts and observations from previous research and by formulating a research question based of the theory of triadic reciprocal determinism. In the analysis phase, an inductive approach allows discovery of new dimensions of importance, while a deductive approach provides a more descriptive understanding of well-known factors influencing HE teachers' use of ICT. In the final phase, we assess and discuss the results through the lens of Bandura's triadic reciprocal causation model to provide new insights.

Participants and data collection

The sample consisted of 12 qualified HE teachers (11 women, 1 man) working in lower secondary education in Finland. One teacher had less than 5 years' teaching experience, 3 teachers had 5–10 years' experience and 8 had more than 10 years' experience. Purposeful stratified sampling methods were applied to provide rich information and major variations in cases (Patton, 2002). The HE teachers were randomly selected based on three pre-identified profile groups (frequent ICT users, specific ICT users, infrequent ICT users) with similar characteristics of ICT use (Sundqvist et al., 2020a). Semi-structured interviews were performed online via Zoom (n = 10) or face-to-face at the teachers' workplace (n = 2). Both in advance and at the beginning of their interviews, the participants were provided details about the aims of the study, how the data would be processed and the ethical principles guiding the research (Finnish National Board on Research Integrity TENK, 2019). The interview questions encouraged the informants to discuss important research issues in a conversational, loose but focused manner (Adams, 2015). Each interview started with background questions, which were followed by questions about the participant's use of ICT, goals and influences. Further, the interview included elements noted by previous studies in the field (Sundqvist et al., 2020a, 2020b) as being significant for a deep understanding of HE teachers' ICT use. Three pilot studies were conducted and, as a result, some minor changes were made to the interview questions. The interviews, which were audio-recorded, lasted about 40–70 minutes and were transcribed by the researcher verbatim (Kvale & Brinkmann, 2009).

Data analysis

The data were analysed by adopting an abductive approach to qualitative content analysis with Nvivo12 software (Elo & Kyngäs, 2008; Kirppendorff, 2004). During the analysis, some of the main steps suggested by Erlingsson and Brysiewicz (2017) were followed in cycles. The first phase involved familiarisation with the data, and the transcribed text was read closely several times over to provide a sense of its insight. A deductive approach was applied to create themes based on the three-fold research question. The next two phases involved dividing up the text into meaning units and formulating codes. The text was broken down into these meaning units and labelled with preliminary codes that were derived directly and inductively from the text. The researchers carefully compared the codes to identify similarities and differences. The final phase involved the development of categories and themes. The codes were grouped together to develop sub-categories and main categories. The results were interpreted, and to ensure the trustworthiness and quality of the process, the data were rechecked several times and the categories were continuously cross-checked by another author. At the end of the process, the results were reflected against the model of triadic reciprocal determinism to provide a deep understanding of HE teachers' ICT use.

Results

The findings were reported in relation to the three-fold research question—use of ICT, goals for its use, and influences for its adoption. The inductive analysis is based on HE teachers' responses to both open-ended questions and more direct questions on their perception of the usefulness of ICT, their digital competence and the support they receive. These responses were illustrated with extracts from the raw data and translated by the authors from Swedish and Finnish into English, correcting for grammatical errors without losing the original meaning.

Goals for use

In the interviews, the teachers were asked about their goals for ICT use. However, two teachers did not respond to the question after it had been missed out by the researcher. The HE teachers' ICT use was categorised into two main categories and five sub-categories (Table 1).

Table 1 Goals for Use

Categories	Teachers (*n* = 10)	Sub-categories	Teachers (*n* = 10)
Supporting students' learning	8	Increasing students' attention, motivation and interest	7
		Supporting students' understanding of concepts and topics	3
		Supporting students' engagement and self-awareness	3
Supporting teachers' work	2	Supporting teachers' instructional work	1
		Increasing teachers' motivation	1

Supporting students' learning

The goal of supporting students' learning was shared by eight teachers. Most commonly, teachers said they use ICT to increase their students' attention, motivation and interest. One teacher briefly explained the relationship between learning and use of ICT to increase attention:

> It grabs their attention. If I just talked and they did not see pictures, a lot of the teaching would pass them by. (Interview 6)

Some teachers said they use ICT to support their students' understanding of difficult concepts and topics by enabling visualisation techniques such as videos and illustrative programs. ICT is also used to enhance students' engagement and self-awareness, while some teachers talked about the importance of using it to empower their students to take greater responsibility and learn to use the knowledge that they themselves have gathered.

Supporting teachers' work

Only two teachers explicitly spoke about using ICT to support their own work. One felt that ICT has a motivational impact on his work, while the other one stated that:

> The aim of ICT is to facilitate our everyday lives; that is, I have used ICT to our advantage completely … All the material is in one place. As a teacher, I do not have to search for and wonder where something is. (Interview 9)

This view is thus related to the aim of using ICT for supporting teachers' instructional work.

ICT use

Closely related to the goals of ICT use, teachers were also asked about their experience of using ICT in teaching HE, and further to explain how they had implemented it. As a result of the analysis, three main categories and six sub-categories were identified (Table 2).

Table 2 ICT Use

Categories	Teachers (n = 12)	Sub-categories	Teachers (n = 12)
Students' active use	12	Searching and creating content	12
		Formative assessment	6
		Communication and interaction	4
Teacher-directed use	11	Presenting and visualising information	11
		Archiving and providing learning materials	8
		Summative assessment	5
Cross-curricular use	3		

Students' active use

All the teachers said they give their students the opportunity to actively use ICT to varying degrees and provide them with tools to create, search for, manage and store content. Most teachers utilise ICT in this way between once a month and once a year, which indicated quite infrequent use. The tools provided, and the content created, also differ greatly among them. Most commonly, students create different kinds of presentations using applications such as Sway, PowerPoint, OneNote, Keynote or Pages. One teacher described this as follows:

> Chromebooks are first picked up and then, in International Cooking, for instance, the students in pairs search for information about a country of their choice and then share it via OneDrive. (Interview 1)

The teachers also use ICT to create other types of content, such as video learning materials, comics, animations and posters, while it is less common for students to utilise ICT for home assignments. Six teachers said they use formative assessment methods such as quizzes and diaries, allowing students to reflect on and evaluate their own learning. Finally, some teachers use ICT for students' communication and interaction, for example through Instagram, while others use it for mediated student content interaction, for example with QR codes and digital learning platforms.

Teacher-directed use

Almost all teachers said they use ICT in a teacher-directed way, and most of them do so for presenting and visualising information and learning materials. Video clips are utilised to visualise different practice-orientated tasks, such as cooking and cleaning processes, while digital presentations and slides are used to deliver practical instructions and transmit learning content to students in a traditional way. Eight teachers said they use ICT for archiving and providing students with learning materials, and a variety of platforms are used, such as blogs, web pages, e-books and cloud storage infrastructure offered by the school. For example, one teacher explained her use of Teams in teaching:

> I post documents that the students need and test answers, and if they are rehearsing for an exam, they read the documents on Teams… Also, when students have created presentations, I collect them all there. (Interview 10)

Some teachers give students access to materials at home. When learning material is not accessible from home, the teachers make it available in class. In the latter case, students have booklets or folders in which all essential material is stored. Finally, some teachers use online tools such as Google Forms and Socrative for summative assessment, although some view it as problematic for various reasons.

Cross-curricular use

Three teachers said they have implemented cross-curricular use of ICT to enable students' participation in multidisciplinary projects between school subjects:

> Two years ago, a multidisciplinary learning unit team planned modules so that the seventh, eighth and ninth graders had their own themes. The seventh graders had fish as their theme, which include the subjects of biology, chemistry and home economics… Every subject had its own tasks that were completed during class time. Based on these tasks, the students compiled different info packages or studies, which were then uploaded to OneNote. (Interview 11)

To support this type of work, teachers and students use different Office 365 applications and digital devices such as laptops, mobile phones and Chromebooks.

Influences

The dimensions of influences associated with HE teachers' ICT use are presented in Table 3 and described in the text below. The inductive analysis resulted in six main categories and 20 sub-categories.

Table 3 Influences

Categories	Teachers (n = 12)	Sub-categories	Teachers (n = 12)
ICT infrastructure	11	Tool availability	11
		Application software	4
		Internet access	4
Organisational factors	11	Technical and ethical safety issues	6
		Time constraints	4
		Financial resources	3
		Instructional facilities	3
Support	9	Shared practices and collegial support	5
		Support from school	4
		ICT teacher training	3
Teaching factors	12	Teachers' digital skills	10
		Personal interest and motivation	8
		Teachers' beliefs	6
		Teachers' own time and effort	5
		Teacher characteristics	2
Subject culture	4	Students' expectations	3
		Curriculum	1
		Status of the subject	1
Student factors	3	Students' ICT behaviour	2
		Students' ICT skills	1

ICT infrastructure

Eleven teachers acknowledged ICT infrastructure to be either a barrier or facilitator for use, or both. The teachers who highlighted sufficient ICT infrastructure as an important facilitator for use, focus especially on digital tools. One teacher, for instance, reflected on digital tools in relation to usefulness of such tools for their own work, while others mentioned the important role of internet access and functional applications. This is how one teacher stressed the importance of digital devices:

> All teachers who wanted them got their own Chromebooks, and this has facilitated work and note-taking enormously. (Interview 11)

Teachers who said they experience ICT infrastructure as a barrier face challenges with poor internet connectivity and scarcity of working devices and software. The ability to book out devices is also a challenge faced by some teachers. Planning their use far in advance, managing the iPad cart and keeping track of cables were said to be challenging and time consuming. Further, some teachers face difficulties in the use of applications when teaching; when this problem goes unsolved, the applications remain unused.

Organisational factors

Multiple organisational influences were put forward by the teachers, who identified various technical and ethical safety issues that have a negative influence on their ICT use and an indirect link to their level of interest in it and motivation to adopt it:

> I do not like using tablets in HE… For example, today we made buns. What would the tablets have looked like after doing all that baking? (Interview 7)

In addition to the risky use of devices in the kitchen, ICT raises other issues, such as cyberbullying and sharing inappropriate content, while time constraints were highlighted by four teachers as another drawback for using ICT in HE. They touched on the limited amount of lesson time given over to HE and the length of lessons. In addition, three teachers said that inadequate instructional facilities are also a major barrier. One felt that the use of ICT in the classroom is too clumsy and impractical, and the available devices and cables cannot be organised in a practical and functional way. Finally, lack of financial resources was identified as an organisational factor that has negatively influenced their adoption of ICT by limiting equipment procurement and training.

Support

Most teachers noted the importance of collegial support and shared practices, availability of support from schools and the provision of ICT training for teachers. Some variously touched on the benefits of planning joint ICT use with colleagues and their desire to share ICT practices with other colleagues, although a lack of this type of collaboration was noted. One teacher voiced approval for the support they had received from their school, which had provided a digital tutor, although another had felt overwhelmed by the amount of information on ICT provided. Teachers who had received enough technical and pedagogical support when they needed it were especially satisfied. In contrast, some teachers touched on schedule difficulties and time constraints obstacles to taking advantage of the support provided by their schools. One teacher also pointed out that prolonged resistance from colleagues and school management would eventually lead to declining interest in ICT. Another emphasised the relationship between support provided, skills gained and increased personal interest towards ICT use:

> After all … it also been [my] desire to learn. Ever since our municipality started offering ICT teacher training, I have grasped the opportunity. This is one thing that needs to be mastered. (Interview 9)

The teachers noted a variety of considerations that need to be made when providing teacher training in ICT, such as adjusted levels of difficulty, the provision of follow-up training and content relevant to teachers' wishes. Most teachers wanted training to address practical and pedagogical means to implement ICT in HE by taking into account their lesson structures, and also how different devices and applications should be used.

Teaching factors

The teachers stated that their own digital skills had an impact on their use of ICT. In analysing HE teachers' perception of their digital skills, the result show that five teachers perceive having great digital skills, four teachers of having basic digital skills and two of having poor digital skills. Eight teachers also highlighted their personal interest and motivation as being important indirect influences for their ICT adoption. They pointed out that these factors might be linked to their age, background of ICT use and ability to develop ICT skills. However, lack of interest and motivation may lead to devices being left unused in the classroom and the decision not to spend time on skills development. Some teachers talked about the nature of HE and highlighted the importance of preserving the practical nature of the subject, which also meant emphasising traditional hands-on skills instead of increasing ICT use:

> I would rather stick with these traditional, hands-on and collaborative skills and teach without having to keep an eye on Chromebooks. (Interview 1)

This again revealed an interplay between teachers' beliefs and technical and ethical safety issues. Some teachers recognised ICT use as being a life skill, and also noted the importance of using it in HE teaching and learning. Belief in the usefulness of ICT was also recognised as being important in this way. For instance, one teacher expressed her view that ICT is not particularly important in HE, and pointed to her own limited use of it. When specifically asked about their perceived usefulness of ICT in HE, the teachers said that it supported both their own work and their students' learning; however, some did not see is relevance in helping them to achieve their learning objectives, relative to their view that HE should remain a practical subject. Teachers' available time and the effort required also hinder their ICT use. They felt that they lacked time and energy to plan meaningful ICT use and participate in training. Characteristics of age, prior experience and education were also voiced as important influences when discussing ICT use.

Subject culture

Several aspects linked to subject culture emerged as being of important for HE teachers' ICT use. These included students' expectations, subject priority settings and breadth of the curriculum. For some teachers, students' expectations are so important that they influence how much they prioritised ICT use:

> The students would be extremely disappointed if we spent two hours on the computer and did nothing practical. I prefer to keep this as a practical subject, instead of one focused on theory." (Interview 7)

The general perception of HE as a low-priority subject was something one teacher pointed out as being a factor limiting the purchase of resources. Another stated that the curriculum is so broad that teaching can be influenced by one's own personal interests.

Student-level factors

Student-level factors were related to students' ICT behaviour and skills. Two teachers felt frustrated about the behaviour of some of their students who have been found using devices to play games and surf on the internet during class. For example, one teacher said:

> Some of the boys are not on the right page to do the tasks; instead they are on another website… The biggest problem is the fact that that it immediately happens when you turn your back… They are faster at using ICT and computers than me. (Interview 8)

Students' lack of digital skills also partly influenced one teacher's ICT adoption, saying that it would take a great deal of time for their students even to turn on their computers.

Discussion

The aim of this study is to investigate Finnish HE teachers' use of ICT, using social cognitive theory and drawing on the model of triadic reciprocal causation to enhance understanding of it. Further, the study sets out to provide new insight into how HE teachers' use of ICT should be supported as a means to support student learning.

First, we will discuss findings related to HE teachers' goals and ICT use through Bandura's goal-setting concept through the model of reciprocal determinism (Figure 2), which is treated as a personal factor and one of self-regulating mechanisms that functions as a mediator between external influences and behaviour. Although the function of self-set goals cannot be distinguished as a main element in the three-point model itself, Bandura states that these can have a self-motivating influence on behaviour. Further, people who set goals for themselves also find it easier to monitor behaviour by clarifying conditional requirements (Bandura, 1986, 1991). When HE teachers were asked to report their goals through ICT, they primarily reflected on using it to support students' learning, and to some extent to support their own work. They especially highlighted students' attention, motivation and interest. These results are partly supported by previous research, such as the study by Veeber et al. (2017) and Beinert et al. (2020). However, we noted that HE teachers had difficulty in expressing their own goals, often repeating the way that ICT is used, instead of describing their aims. Some misalignments between aims of use and actual use were also found. While HE teachers' goals for the main part targeted student learning, they reported implementing it in both student- and a teacher-directed

ways. More specifically, ICT was adopted for students' active use, teacher-directed use and cross-curricular use, with the first two consistent with the study of Veeber et al. (2017). All HE teachers used ICT for students' active use, which is in line with the recommended approach of SCL to teaching (Crumly, 2014; Starkey, 2019). However, supporting active learning was not at the core of HE teachers' goals. This indicates that their ICT use is not entirely goal-directed, and in relation to the self-regulating concept of goalsetting (Bandura, 1986), they may have difficulty in self-observing and evaluating their own performance. Thus, limited awareness of what one is doing makes it difficult to set goals for one's actions. The goals themselves are important for adapting behaviour by specifying the conditions required to use ICT in a way that brings positive outcomes. HE teachers who expressed their goal was to support students' engagement and self-awareness would more likely make greater efforts to create conditions for implementing ICT that would achieve this aim. Many of these conditions were identified in this study and should be further discussed in relation to Bandura's model of triadic reciprocal determinism.

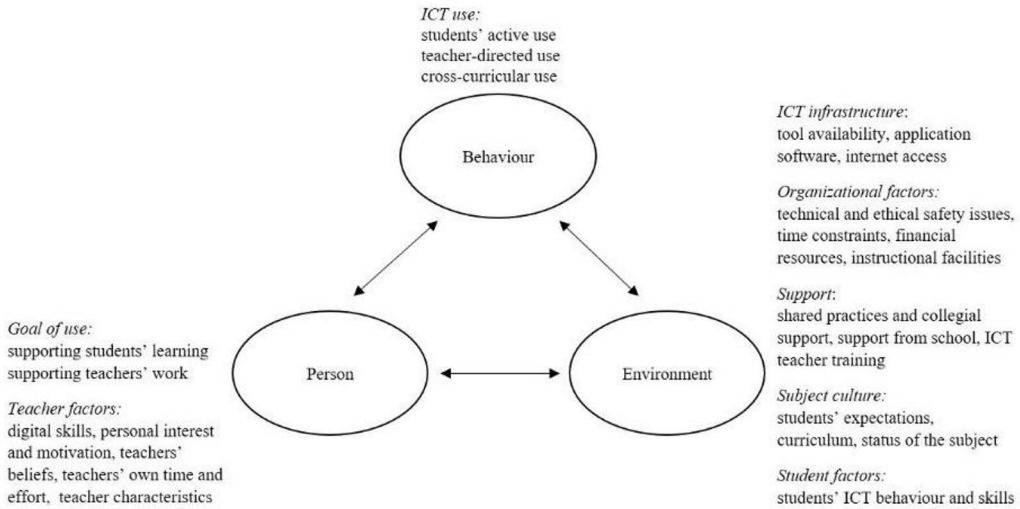

Figure 2 Results Related to Bandura's Model of Triadic Reciprocal Determinism

Because personal, behavioural and environmental influences function as reciprocal determinisms of each other, it is not appropriate to discuss these separately. Therefore, the identified influences positioned in the environmental and personal levels in Bandura's model (Figure 2) are mostly discussed as conditional of each other. We start by discussing the influences related to HE teachers' use, positioned as *environmental factors* in the model (Figure 2) and also supported by previous research (Drossel et al., 2017; Gerick et al., 2017; Gil-Flores et al., 2017; Inan & Lowther, 2010; Lindberg et al., 2017; Razak et al., 2018; Tallvid, 2016).

A majority of HE teachers noted the importance of ICT infrastructure, and more specifically, the availability of devices, software and internet access. Issues in booking devices is one unexpected barrier that some HE teachers encountered, although this was also observed in the study by Erixon (2010). HE teachers are thus still in need of adequate software and digital devices that are readily available for their classes. In terms of organisational factors, challenges with time limitations and perceptions that HE classrooms are not suitable for digital tools are two factors that stand out. The latter is linked to teachers' interest, motivation and beliefs. A fear of damaging a device in the kitchen is, for instance, associated with reduced motivation for using it. Reticence towards using ICT further relates to the importance of preserving the practical nature of HE. This relates to the bidirectional causality in personal and environmental factors in Bandura's model and his statement that environment does not directly impinge on people's behaviour. Environmental influences operate alongside cognitive and personal influences such as beliefs and competencies (Bandura, 1986). These

findings therefore show the relevance of analysing subject-specific beliefs and other cognitive influences related to ICT use (Ding et al., 2019).

In relation to the environmental factor of support, the findings are in line with the study of Sundqvist et al. (2020b), who found a link between HE teachers' use of ICT and the support they are given to implement it. HE teachers value collegial support and wish for opportunities to share practices, which are important factors contributing to teachers' successful ICT use in implementing student-centred instructional practices (Wong & Li, 2011; Zhang et al., 2021). Even though various forms of support have been highlighted in previous work (cf. Inan & Lowther, 2010), it is important to specify the delivery and content of such support. In accordance with our findings, HE teachers should be offered subject-specific teacher training focused on pedagogical ICT practices, tips and concrete ideas with opportunities to follow-up. Support should further be offered immediately as a problem arises, for example by a tutor at the school. The findings also showed that support is connected to HE teachers' motivation, interest and digital skills, which further show a relation between environmental, personal and behavioural influences (cf. Sundqvist et al., 2020b). Teachers participate in ICT training to develop their skills when they are interested and motivated. Having enough time, effort, motivation and interest either hindered or facilitated most of the teachers' ICT use. This again shows how the complexity of several interactional influences can influence behaviour according to Bandura's model. HE teachers' lack of interest and motivation in participating in ICT training and developing their digital skills leads to more limited use of ICT and a feeling of lack of support. This relates to Bandura's (1989) statement that behaviour changes environmental conditions and is further changed by the conditions it creates. Subject culture and student factors were also identified as environmental factors. Subject culture focuses mostly on students' expectations, but also on the breadth of curriculum and low status of the subject. Aspects related to subject culture also appeared in the study by Erixon (2010), who found that HE teachers are afraid that the subject will lose its attraction if more ICT were applied. Although this study does not address mechanisms of cultural change, these are further important aspects to address.

We will now discuss influences positioned as *personal factors* in Banduras model. We have already touched upon influences such as digital skills, personal interest and motivation, and to some extent teachers' beliefs, time availability and willingness to apply effort. In relation to their beliefs, and consistent with previous research (Sundqvist et al.,, 2020a), the perceived usefulness of ICT in HE is identified as an influence. A belief that ICT does not play a major role in achieving the learning objectives of HE is also related to a viewpoint that HE should remain practical. This finding is supported by Erixon (2010), who stated that HE teachers wish to retain the practical nature of the subject, instead of incorporating ICT into teaching. Conversely, HE teachers who perceive ICT as an everyday skill find more use for ICT. The alignment between subject-specific beliefs, perceived usefulness and ICT use is partly in line with the results of Ding et al. (2019), who found a relationship between content-specific pedagogical beliefs and ICT practices. This again raises the importance of cognitive functioning and attitudes guiding behaviour (Bandura, 1986).

Limitations and further research

Our understanding of HE teachers' ICT use is mostly based on analysing use, goals and influences in separate phases; meanwhile, Bandura's (1986) notion of reciprocal determinism is based on behavioural, personal and environmental factors that exert mutual influences onto each other. Limited analysis of the multiplicity of interactions between these influences is therefore a weakness in this study. Another weakness is our ambition to address only the forethought perspective of goalsetting, while Bandura (2001) reported other perspectives of importance, such as outcome expectations. Consequently, further research utilising other methodological and analytical approaches could be useful for investigating relationships between the influences identified in this study and teachers' ICT use. Since goals also partly direct behaviour, and a misalignment between HE teachers' aims of use and actual use appeared in this study, it could be interesting to explore the extent to which HE teachers' goals mediate the environmental and personal influences on their use. However, we did not find Bandura's model useful for understanding all forms of influence, especially those of subject culture and teachers' beliefs. Further research is thus needed to understand HE teachers' beliefs when teaching and the extent to which beliefs and culture influence HE teachers' use of ICT.

Conclusions

In this study, we looked through the lens of Bandura's theory of reciprocal determinism to enhance our understanding of the influences related to HE teachers' ICT use and their goals for its use. The results show that their ICT use not only depends on their goals, but also on influences identified at the environmental and personal level of Bandura's model. The interplay between these influences is, however, complex and difficult to grasp. The findings from their expressed aims indicate that HE teachers need to be supported in setting goals for their ICT use. According to Bandura (1986, 1991), people need to be aware of and pay attention to the role of their own performance in influencing motivation towards a specific behaviour. Being aware of one's own performance supports goal setting which in turn increases determination to achieve self-set goals. Further, this also means that support should be organised in a way that feedback is provided on how teachers are using ICT, thereby helping them to set goals in this regard. This, in turn, increases teachers' motivation and interest in developing their adoption of ICT by clarifying conditional requirements. Based on the results of this study, this means making efforts to provide HE teachers with support to develop their digital skills, demand proper ICT infrastructure and support shared practices between colleagues and finally follow-up teacher training that focuses on the teachers' requirements.

Disclosure Statement

No potential conflict of interest was reported by the authors.

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Karin Sundqvist

Digitalisation Meets Home Economics Teachers:

A Mixed-Methods Study of the Conditions Related to Finnish Home Economics Teachers' Use of Information and Communication Technologies

This thesis aims to deepen the understanding of home economics (HE) teachers' use of ICT and gain insights into the conditions that inhibit and facilitate their use. The three publications in the thesis combine elements of a quantitative survey study and qualitative interview study using a mixed-methods research design. To answer the overarching aim of this thesis, the findings from these three publications have been integrated and are discussed through the lens of Bandura's triadic theory of reciprocal determinism.

The findings show that HE teachers use ICT rather infrequently to facilitate student learning. When used for this purpose, ICT is used to support both affective and cognitive learning outcomes, but with less focus on the development of students' digital competencies. The most obvious finding to emerge in this thesis is the variety of conditions at the personal and environmental levels that hindered and facilitated the use of ICT by HE teachers. Their ICT use was more specifically influenced by personal conditions such as digital competence, interest and motivation, domain-specific epistemological beliefs, ICT self-efficacy, perceived usefulness of ICT and different teacher characteristics. The environmental conditions included, for example, different forms of support, ICT infrastructure, organisational factors and subject culture, the latter referring to, for example, the breadth of the curriculum and the status of the subject. A significant finding is the key influence on HE teachers' ICT use of the self-regulatory systems of forethought (perceived usefulness) and self-reflectiveness (ICT self-efficacy), which also relate to whether teachers engage in activities that support their ICT use, such as developing their own digital skills and taking advantage of the available support and ICT infrastructure.

Furthermore, this thesis provides suggestions of various forms of support for HE teachers' ICT use to strengthen their motivation to use ICT and their agency to overcome challenges.

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