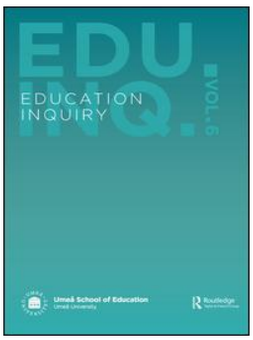

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Predicting Finnish subject-teachers' ICT use in Home Economics based on teacher- and school-level factors

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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).

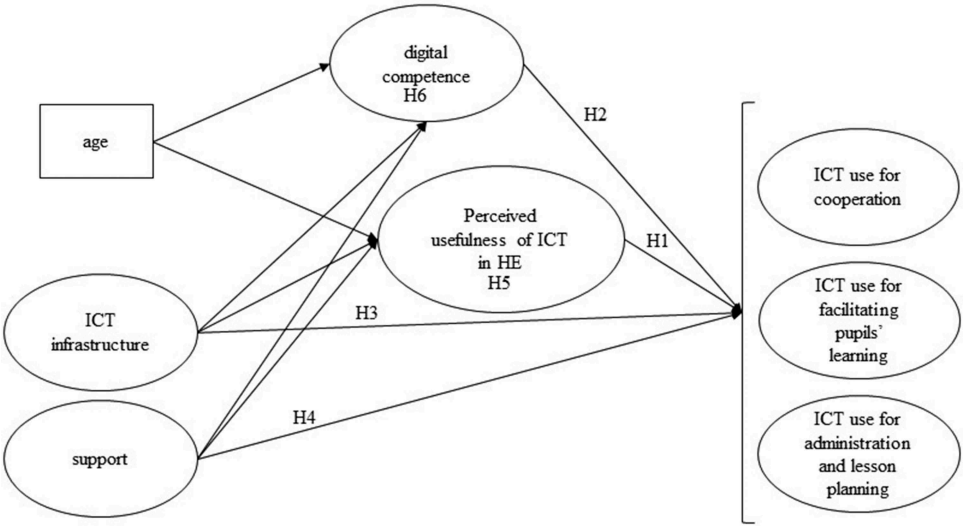

Figure 1. The hypothesised research model of factors predicting subject-teachers' ICT use in HE

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 ≥.90; TLI ≥ .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 ($\chi 2(681) = 1027.875$; $p < .001$; 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 ($\chi 2(719) = 1059.059$; $p < 0.001$; 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.

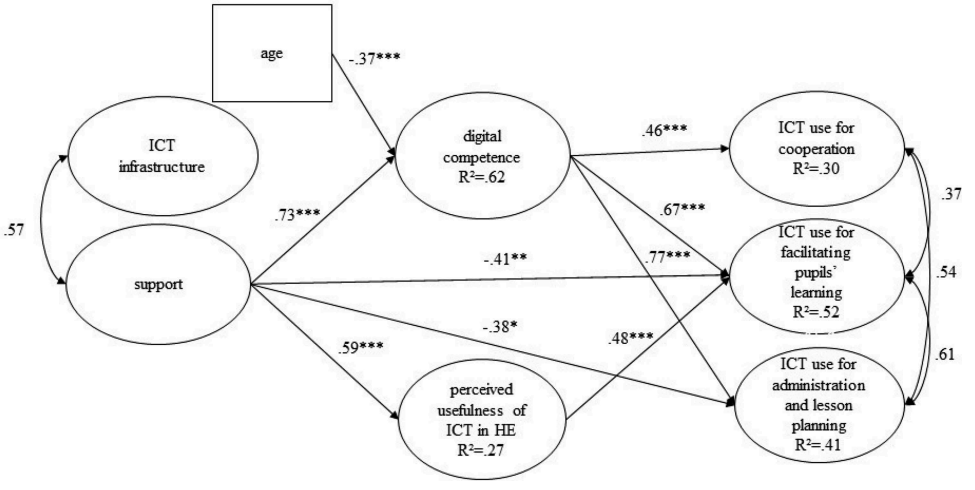

Figure 2. Standardised estimates for direct effects between the variables in the research model
***Significant at level p <.001 **Significant at level p <.01 *Significant at level p <.05

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.