

This is an electronic reprint of the original article. This reprint may differ from the original in pagination and typographic detail.

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

Sundqvist, Karin; Korhonen, Johan; Eklund, Gunilla

Published in:
Nordic Journal of Digital Literacy

DOI:
[10.18261/issn.1891-943x-2020-03-06](https://doi.org/10.18261/issn.1891-943x-2020-03-06)

Published: 01/01/2020

Document Version
Publisher's PDF, also known as Version of record

Document License
CC BY

[Link to publication](#)

Please cite the original version:
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. <https://doi.org/10.18261/issn.1891-943x-2020-03-06>

General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

Take down policy

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.



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

Karin Sundqvist

PhD student, Faculty of Education and Welfare Studies, Åbo Akademi University
karin.sundqvist@abo.fi

Johan Korhonen

Associate professor, Faculty of Education and Welfare Studies, Åbo Akademi University

Gunilla Eklund

Associate professor, Faculty of Education and Welfare Studies, Åbo Akademi University

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-Piironen, 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-Piironen 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, Hinos-troza, 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 Hoepfner, 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, η^2 , 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 ($\chi^2 (45) = 789.4, p < 0.001$).

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 ($\chi^2 (66) = 1013.17, p < 0.001$).

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 ($\chi^2 (78) = 651.56, p < 0.001$). The three factors (Appendix 4) were based on 13 items and labelled *applications 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* ($n = 58$).

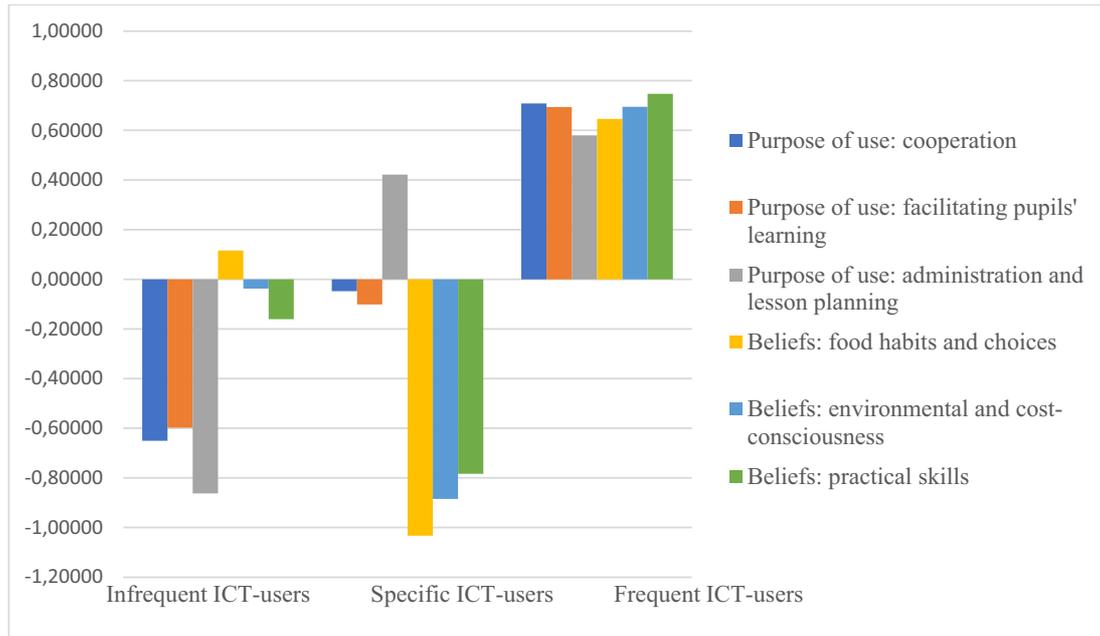


Figure 1 Profiles based on mean z-scores on the scales purpose of ICT use and teachers' beliefs

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-Piironen 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-Piironen 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.

Acknowledgements: This study was supported by grant from Åbo Akademi University Foundation, Åbo, Finland.

References

- Balanskat, A., Bannister, D., Hertz, B., Sigilló, E. & Vuorikari, R. (2013). *Overview and analysis of 1:1 learning initiative in Europe*. Joint Research Centre Institute for Prospective Technological Studies.
- Bandura, A. (1986). *Social foundations of thought and actions: a social cognitive theory*. Englewood Cliffs, NJ: Prentice-Hall.
- Bandura, A. (2006). Guide for constructing self-efficacy scales. In F. Pajares & T. Urdan (Eds.), *Self-efficacy Beliefs of Adolescents* (pp. 307–337). Greenwich: Information Age Publishing.
- Berger, J.-L., Girardet, C., Vaudroz, C. & Crahay, M. (2018). Teaching experience, teachers' beliefs, and self reported classroom management practices: A coherent network. *Sage Open*, 8(1), 1–12.
<https://doi.org/10.1177/2158244017754119>
- Bholowalia, P. & Kumar, A. (2014). EBK-Means: A Clustering Technique based on Elbow Method and K-Means in WSN. *International Journal of Computer Applications*, 105(9), 17–24.
- Bilbao-Osorio, B. & Pedró, F. (2009). A conceptual framework for benchmarking the use and assessing the impact of digital learning resources in school education. In F. Scheuermann & F. Pedro (Eds.), *Assessing the Effects of ICT in Education. Indicators, Criteria and Benchmarks for International Comparisons* (pp. 107–118). Luxembourg: European Commission, OECD, Joint Research Centre.
- Blurton, C. (2002). *New Directions of ICT-Use in Education*. Retrieved from <https://doi.org/10.2788/27419>
- Blurton, C. (2002). *New Directions of ICT-Use in Education*. Retrieved from <http://www.unesco.org/education/lwf/dl/edict.pdf>
- Casimir, G. (2011). Interaction of societal development and communication technology. *International Journal of Home Economics*, 4(1), 3–13.
- Comi, S.L., Argentin, G., Gui, M., Origo, F. & Pagani, L. (2017). Is it the way they use it? Teachers, ICT and student achievement. *Economics of Education Review* 56, 24–39. <https://doi.org/10.1016/j.econedurev.2016.11.007>
- Costello, A.B. & Osborne, J.W. (2005). Best practices in exploratory factor analysis: Four recommendations for getting the most from your analysis. *Practical Assessment, Research & Evaluation*, 10(7), 1–9.
- Council recommendation of 22 May 2018 on key competences for lifelong learning. (2018). Official Journal of the European Communities, C 189/1–13. Retrieved 1.11.2018 from:
<http://data.consilium.europa.eu/doc/document/ST-9009-2018-INIT/en/pdf>
- Eickelmann, B. & Vennemann, M. (2017). Teachers' Attitudes and Beliefs Regarding ICT in Teaching and Learning in European Countries. *European Educational Research Journal*, 16(6), 733–761.
<https://doi.org/10.1177/1474904117725899>
- Erixon, P.-O. (2010). School subject paradigms and teaching practice in lower secondary. Swedish schools influenced by ICT and media. *Computers & Education* 54(4), 1212–1221.
<https://doi.org/10.1016/j.compedu.2009.11.007>
- Ertmer, P. & Ottenbreit-Leftwich, A. (2010). Teacher technology change: how knowledge, confidence, beliefs and culture intersect. *Journal of Research on Technology in Education*, 42(3), 255–285.
<https://doi.org/10.1080/15391523.2010.10782551>
- Ertmer, P., Ottenbreit-Leftwich, A., Sadik, O., Sendurur, E. & Sendurur, P. (2012). Teacher beliefs and technology integration practices: A critical relationship. *Computer & Education* 59, 423–435.
<https://doi.org/10.1016/j.compedu.2012.02.001>
- Eurostat. (2017). *Being young in Europe today – digital world*. Retrieved 18.09.2018 from: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Being_young_in_Europe_today_-_digital_world
- Everitt, B.S. (1993). *Cluster Analysis*. London: Edward Arnold.
- Everitt, B.S. & Dunn, G. (1991). *Applied multivariate data analysis*. London: Edward Arnold.
- Ferrari, A., Cachia, R. & Punie, Y. (2009). *ICT as a driver for creative learning and Innovative teaching*. Luxembourg: Institute for Prospective Technological Studies, Directorate-General Joint Research Center.
- Finnish Advisory Board on Research Integrity. (2012). *Responsible conduct of research and procedures for handling allegations of misconduct in Finland*. Helsinki: Finnish Advisory Board on Research Integrity.

- Finnish Education Evaluation Centre. (2015). *Inlärningsresultaten i huslig ekonomi i slutskedet av den grundläggande utbildningen 2014*. [Learning outcomes in Home Economics at the final stage of basic education 2014]. Helsinki: The Finnish Education Evaluation Centre.
- Finnish National Board of Education. (2016). *National core curriculum for basic education 2014*. Helsinki: Finnish National Board of Education.
- Finnish Social Science Data Archive, Data Management Planning (2016, august 24). Retrieved 15.8.2018 from <https://www.fsd.uta.fi/aineistonhallinta/en/data-management-planning.html>
- Fraillon, J., Ainley, J., Schulz, W., Friedman, T. & Gebhardt, E. (2014). *Preparing for life in a digital age – The IEA International Computer and Information Literacy Study International report*. Amsterdam: IEA.
- George, A. & Sanders, M. (2017). Evaluating the potential of teacher-designed technology-based tasks for meaningful learning: Identifying needs for professional development. *Educ Inf Technol*, 22(6), 2871–2895. <https://doi.org/10.1007/s10639-017-9609-y>
- Gil-Flores, J., Rodríguez-Santero, J. & Torres-Gordillo, J-J. (2017). Factors that explain the Use of ICT in secondary-education classrooms: The role of teacher characteristics and school infrastructure. *Computers in Human Behavior*, 68(2017), 441–449. <https://doi.org/10.1016/j.chb.2016.11.057>
- Hair, J.F., Black, W., Babin, B. & Anderson, R.E. (2010). *Multivariate data analysis. A Global perspective*. New Jersey: Pearson Education.
- Hatlevik, I.K.R. & Hatlevik, O.E. (2018). Examining the Relationship Between Teachers' ICT Self-Efficacy for Educational Purposes, Collegial Collaboration, Lack of Facilitation and the Use of ICT in Teaching Practice. *Frontiers in Psychology*, 9(935), 1–8. <https://doi.org/10.3389/fpsyg.2018.00935>
- Haverinen, L. (1996). Arjen hallinta kotitalouden toiminnan tavoitteena. Kotitalouden toiminnan filosofista ja teoreettista tarkastelua. [Mastery of everyday life as a vision of the activities in households. Philosophical and theoretical inquiries of household activities]. (Doctoral dissertation). Helsinki: Helsinki University, Department of Teacher Education. <https://helda.helsinki.fi/bitstream/handle/10138/20066/arjenhal.pdf>
- Hermans, R., Tondeur, J., van Braak, M. & Valcke, M. (2008) The impact of primary school teachers' educational beliefs on the classroom use of computers. *Computer & Education*, 51(4), 1499–1509. <https://doi.org/10.1016/j.compedu.2008.02.001>
- Hoepfner, B., Kelly, J., Urbankoski, K. & Slaymaker, V. (2011). Comparative utility of a single-item vs. multiple-item measure of self-efficacy in predicting relapse among young adults. *J Subst Abuse Treat*, 41(3), 305–312. <https://doi.org/10.1016/j.jsat.2011.04.005>
- Howard, S., Chan, A., Mozejko, A. & Caputi, P. (2015). Technology practices: Confirmatory factor analysis and exploration of teachers' technology integration in subject areas. *Computers & Education* 90, 24–35. <https://doi.org/10.1016/j.compedu.2015.09.008>
- Hsu, S. (2011). Who assigns the most ICT activities? Examining the relationship between teacher and student usage. *Computer & Education* 56(3), 847–855. <https://doi.org/10.1016/j.compedu.2010.10.026>
- Huck, S.W. (2012). *Reading Statistics and Research*. Boston: Pearson International Edition.
- Håkansson, A. (2016). Intentions of formally qualified and unqualified teachers to transfer norms and values in home economics teaching. *International Journal of Consumer Studies*, 40(2016), 268–275. <https://doi.org/10.1111/ijcs.12251>
- Hölttä, M. (2014). Tieto- ja viestintäteknikka kotitalousopetuksessa. [Information- and communication technology in Home Economics]. In H. Kuusisaari, & L. Käyhkö (Eds.), *Tutki, kehitä, kehity: Kotitalous yhteiskunnallisena oppiaineena* [Explore, develop, develop: Home Economics as a social school subject] (pp. 67–78). Helsinki: BoD-Books on Demand.
- Ibieta, A., Hinostroza, E., Labbé, C. & Claro, M. (2017). The role of the internet in teachers' professional practice: activities and factors associated with teacher use of ICT inside and outside the classroom. *Technology, Pedagogy and Education*, 26(4), 425–438. <https://doi.org/10.1080/1475939X.2017.1296489>
- Ilomäki, L. (2013). Olika e-läromedel. [Different e-learning materials] In L. Ilomäki (Ed.), *Med kvalitet i fokus. E-läromedlen i undervisning och lärande* [With quality in focus. E-learning materials in teaching and learning] (pp. 7–11). Helsinki: Agency for Education.

- Inan, F.A. & Lowther, D.Æ. (2010). Factors affecting technology integration in K-12 classrooms: a path model. *Educational Technology Research and Development*, 58(2), 137–154. <https://doi.org/10.1007/s11423-009-9132-y>
- IFHE. (2008). *IFHE Position Statement–Home Economics in the 21st Century*. International Federation for Home Economics. Retrieved 02.10.2018 from: <https://www.ifhe.org/publications/ifhe-special-publications/ifhe-position-statement-on-home-economics/>
- ITU. (2017). *ICT facts and figures 2017*. International Telecommunication Union. Retrieved 14.09.2018 from: <https://www.itu.int/en/ITU-D/Statistics/Documents/facts/ICTFactsFigures2017.pdf>
- Janssens, W., Wijnen, K., De Pelsmacker, P. & Von Kenhove, P. (2008). *Marketing research with SPSS*. Harlow: Pearson Education Limited.
- Karaseva, A., Siibak, A. & Pruulmann-Vengerfeldt, P. (2015). Relationships between teachers' pedagogical beliefs, subject culture and mediation practices of students' use of digital technology. *Cyberpsychology: Journal of Psychosocial Research on Cyberspace*, 9(1). <https://doi.org/10.5817/CP2015-1-6>
- Kassambara, A. (2017). *Practical guide to cluster analysis in R: Unsupervised machine learning*. STHDA.
- Kikis, K., Scheuermann, F. & Villalba, E. (2009). A framework for understanding and evaluating the impact of information and communication technologies in education. I F. Scheuermann & F. Pedro (Eds.), *Assessing the Effects of ICT in Education. Indicators, Criteria and Benchmarks for International Comparisons* (pp. 69–82). Luxembourg: European Commission, OECD, Joint Research Centre. <https://doi.org/10.2788/27419>
- Kim, C., Kim, M.K., Lee, C., Spector, J.M. & DeMeester, K. (2013). Teacher beliefs and technology integration. *Teaching and Teacher Education*, 29(2013), 76–85. <https://doi.org/10.1016/j.tate.2012.08.005>
- Kodinariya, T.M. & Makwana, Dr. P.R. (2013). Review on determining number of Cluster in K-Means Clustering. *International Journal of Advance Research in Computer Science and Management Studies*, 1(6), 90–95.
- Koskinen, K. (2017). *Finland. Country Report on ICT in Education*. European Schoolnet. Retrieved 30.1.2019 from: <http://www.eun.org/documents/411753/839549/Country+Report+Finland+2017.pdf/91b1a7a1-26dd-455c-8387-395073d43f97>
- Kumpulainen, T. (2014). *Opettajat Suomessa 2013. Koulutuksen seurantaraportit 2014*. [Teachers in Finland 2013. A follow up report for education]. Tampere: Finnish National Agency for Education.
- Lani, J. (2010). *Conduct and interpret a cluster analysis*. Statistics Solutions. Retrieved 16.09 from: <http://www.statisticssolutions.com/wp-content/uploads/kalins-pdf/singles/cluster-analysis-2.pdf>
- Ma, A. & Pendergast, D. (2010). Innovative Pedagogies for Family and Consumer Science/Home Economics Education-Utilizing Computer-Based Collaborative Learning to Foster Lifelong Learning Attributes. *Family & Consumer Sciences Research Journal*, 38(3), 273–288. <https://doi.org/10.1111/j.1552-3934.2009.00018.x>
- Mama, M. & Hennessy, S. (2013). Developing a typology of teacher beliefs and practices concerning classroom use of ICT. *Computers & Education*, 68(2013), 380–387. <http://dx.doi.org/10.1016/j.compedu.2013.05.022>
- Meneses, J., Fábregues, S., Rodríguez-Gómez, D. & Ion, G. (2012). Internet in teachers' professional practice outside the classroom: Examining supportive and management uses in primary and secondary schools. *Computers & Education*, 59(3), 915–924. <https://doi.org/10.1016/j.compedu.2012.04.011>
- Metsämuuronen, J. (2005). *Tutkimuksen tekemisen perusteet ihmistieteissä*. [The basics of research in human science]. Helsinki: International Methelp.
- Ministry of Transport and Communications. (2010). *National Plan for Educational Use of Information and Communications Technology*. Helsinki: Ministry of Transport and Communications. Retrieved 20.10.2018 from: http://www.edu.fi/download/135308_TVT_opetuskayton_suunnitelma_Eng.pdf
- Mominó, J.M. & Carrere, J. (2016). *A model for obtaining ICT indicators in education*. UNESCO Working Papers on Education Policy N°3. Paris: UNESCO.
- OECD. (2015). *Students, Computers and Learning: Making the Connection*, PISA. Paris: OECD Publishing. <https://doi.org/10.1787/9789264239555-en>

- OECD. (2016). *Innovating Education and Educating for innovation: The power of digital technologies and skills*. Paris: OECD Publishing. <https://doi.org/10.1787/9789264265097-en>
- Pajares, M.F. (1992). Teachers' Beliefs and Educational Research: Cleaning Up a Messy Construct. *Review of Educational Research*, 62(3), 307–332. <https://doi.org/10.3102/00346543062003307>
- Pandolfini, V. (2016). Exploring the Impact of ICTs in Education: Controversies and Challenges. *Italian Journal of Sociology of Education*, 8(2), 28–53. <https://doi.org/10.14658/pupj-ijse-2016-2-3>
- Pendergast, D. (2012). The intention of home economics education: A Powerful enabler for future-proofing the profession. In D. Pendergast, S.L.T. McGregor, & K. Turkki (Eds.), *Creating home economics futures. The next 100 years* (pp. 12–23). Bowen Hills: Australian Academic Press.
- Petko, D. (2012). Teachers' pedagogical belief and their use of digital media in classroom: Sharpening the focus of the 'will, skill, tool' model and integrating teachers' constructivist orientations. *Computers & Education*, 58(2012), 1351–1359. <https://doi.org/10.1016/j.compedu.2011.12.013>
- Piazza, T. (2010). Fundamentals of Applied Sampling. In P. Marsden, & J. Wright (Eds.), *Handbook of survey research*, (pp. 138–167). Bingley: Emerald Group Publishing Limited.
- Poirier, S., Remsen, M. & Sager, M. (2017). Teaching and learning in Family and Consumer Science education: Thriving in challenging times. *International Journal of Home Economics*, 10(2), 17–29.
- Prestridge, S. (2017). Examining the shaping of teachers' pedagogical orientation for the use of technology. *Technology, Pedagogy and Education*, 26(4), 367–381. <https://doi.org/10.1080/1475939X.2016.1258369>
- Richardson, V. (2003). Preservice teachers' beliefs. In F. Raths & A. McAninch (Eds.), *Teacher beliefs and Classroom Performance: The impact of Teacher Education* (1–22). Greenwich: Information Age Publishing.
- Sairanen, H., Vuorinen, M. & Viteli, J. (2014). *Opeka vuonna 2013. Trendejä opetusteknologiassa*. [Opeka year 2013: Trends in teaching technology].
- Scherer, R., Siddiq, F. & Teo, T. (2015). Becoming more specific. Measuring and modeling teachers' perceived usefulness of ICT in the context of teaching and learning. *Computers & Education*, 88, 202–214. <https://doi.org/10.1016/j.compedu.2015.05.005>
- Schulz, W. & Friedman, T. (2015). Scaling procedures for ICILS questionnaire items. In J. Fraillon, W. Schulz, T. Friedman, J. Ainley, & E. Gebhardt (Eds.), *ICILS 2013 Technical report. International Computer and Information Literacy Study* (pp. 177–219). Amsterdam: IEA. The International Association for the Evaluational Achievement. <https://doi.org/10.15478/uuid:b9cdd888-6665-4e9f-a21e-61569845ed5b>
- Sipilä, K. (2014). Educational use of information and communications technology: teachers' perspective. *Technology, Pedagogy and Education*, 23(2), 225–241. <https://doi.org/10.1080/1475939X.2013.813407>
- Sprinthall, R.C. (2014). *Basic Statistical Analysis*. Harlow: Pearson New International Edition.
- Statista. (2018). *Number of internet users worldwide from 2005 to 2017. (in millions)*. Retrieved 23.9.2018 from: <https://www.statista.com/topics/1145/internet-usage-worldwide/>
- Sue, V. & Ritter, L. (2012). *Conducting online surveys*. Los Angeles: Sage.
- Sundqvist, K. (2016). *IKT i huslig ekonomi: En kvantitativ enkätstudie om faktorer som inverkar på ämneslärares IKT-användning i huslig ekonomi* (Unpublished master's thesis). Åbo Akademi University.
- Sysiharju, A.-L. (1995). *Naisasian tytär-muuttuvien kotien tuki 1891–1990. Vuosisata kotitalousopettajien koulutusta Helsingissä*. [A daughter of the women's rights movement – Support for homes in constant change. A century of the education of Home Economics teachers in Helsinki]. Helsinki: University of Helsinki, The Department of Teacher Education.
- Tabachnick, B.G. & Fidell, L.S. (2007). *Using Multivariate Statistics*. Boston: Pearson International Edition.
- Tanhua-Piironen, E., Viteli, J., Syvänen, A., Vuori, J., Hintikka, K. & Sairanen, H. (2016). *Perusopetuksen oppimisympäristöjen digitalisaation nykytilanne ja opettajien valmiudet hyödyntää digitaalisia oppimisympäristöjä*. [The current state of digitalisation of learning environments in basic education and teachers' ability to take advantage of digital learning environments]. Publications of the Government's analysis, assessment and research activities 18/2016. Prime Minister's Office.
- Tavakol, M. & Dennick, R. (2011). Making sense of Cronbach's alpha. *International Journal of Medical Education*, 2011(2), 53–55. <https://doi.org/10.5116/ijme.4dfb.8dfd>

- Teo, T. (2009). Modelling Technology Acceptance in Education. A study of Pre-Service Teachers. *Computers & Education*, 52(2), 302–312. <https://doi.org/10.1016/j.compedu.2008.08.006>
- Tomes, N. (1997). Spreading the Germ Theory: Sanitary Science and Home Economics, 1880–1930. In S. Stage & V.B. Vincenti, (Eds.), *Rethinking Home Economics. Women and the history of a profession*, (34–54). Ithaca, London: Cornell University.
- Tondeur, J., van Braak, J., Ertmer, P. & Ottenbreit-Leftwich. (2016). Understanding the relationship between teachers' pedagogical beliefs and technology use in education: A systematic review of qualitative evidence. *Educational Technology Research and Development* 65(3), 555–575. <https://doi.org/10.1007/s11423-016-9481-2>
- Turkki, K. & Vincenti, V. (2008). Celebrating the past: A critical reflection on the history of IFHE and the Home Economics profession. *International Journal of Home Economics* 1(2), 75–97.
- van Braak, J., Tondeur, J. & Valcke, M. (2004). Explaining different types of computer use among primary school teachers. *European Journal of Psychology of Education*, 19(4), 407–422. <https://doi.org/10.1007/BF03173218>
- Veeber, E., Taar, J., Paas, K. & Lind, E. (2017). Handicraft and Home Economics Teachers' Understanding of the Possibilities of ICT Usage in Their Practice. In V. Dislere (Ed.), *Rural Environment Education Personality: report from the conference 12.5–13.5.2017* (pp. 400–407).
- Watson, J.C. (2017). Establishing evidence for internal structure using exploratory factor analysis. *Measurement and Evaluation in Counselling and Development*, 50(4), 232–238. <https://doi.org/10.1080/07481756.2017.1336931>

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	Communi- 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	Communi- 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, Terveystta 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			p
	Infrequent ICT users	Specific ICT users	Frequent ICT users	
	n = 60	n = 43	n = 58	
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)	