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# Implementation of Digital Portfolios in Early Childhood Education

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**Abstract:** Curricula, influenced by the digitalization, set requirements for early childhood education (ECE) settings to implement digital practices. However, ECE teachers are struggling to integrate information and communication technology (ICT) and child-centered pedagogy, such as digital portfolios, successfully into practice. Previous research efforts have focused on analyzing the barriers of digital technology implementation. This study, in turn, takes a broader view and addresses the complex task of implementing digital practices into education by analyzing the factors that foster and challenge the implementation process. The results show that human related factors are considered the most fostering, and resources the most challenging factors in the implementation process of the digital portfolio practice. Challenges with resources may negatively affect teachers' attitudes towards the new digital practice and technology in general. Results of this study have both practical and theoretical implications to how implementation process of digital practices can be supported and researched.

## Introduction

Digitalization has challenged early childhood education (ECE) settings to integrate information and communication technology (ICT) into everyday practices. It has been noticed that digitalization not only challenges but creates also opportunities for educational change, especially regarding pedagogical approaches and practices. Educational challenges, such as personalizing learning and students as co-designers of learning, have been highlighted in NMC Horizon reports for K-12 education (e.g. Freeman, Adams Becker, Cummins, Davis & Hall Giesinger, 2017). In addition, contemporary visions of ECE highlight pedagogies, which support learning of 21st century skills and child-centered approaches (Scott, 2015; Finnish National Board of Education, 2016). At best, developments in technology and diverse educational challenges are examined together with trends accelerating technology adoption.

Discussions and actions around digitalization in ECE have focused on provision of access and examination of the role of ICT. Many countries have attempted to increase the access to ICT (e.g. Blackwell, Wartella, Lauricella & Robb, 2015). Yet, teachers are reporting inadequate access and lack of ICT equipment (e.g. Fenty & Anderson, 2014; Liu & Pange, 2015). It seems that the level of digitalization in ECE varies widely worldwide. In recent years, the focus in research has shifted from considerations of whether or not ICT is good for children or enhances young children's learning, to pedagogical considerations on how to best integrate and diversify pedagogical ICT use in ECE settings (Lindhal & Folkesson, 2012; Edwards & Bird, 2017). Some examples of successful combination of child-centered pedagogy and ICT are digital storytelling, digital play and digital portfolios (Kankaanranta, 2002; Meyer, Abrami, Wade & Scherzer, 2011; Wohlwend, 2015).

Despite the increased access to ICT, the opportunities ICT offers, and alignments that curricula make, the frequency of ICT use in education has not increased (Blackwell et al., 2015) nor is ICT and child-centered pedagogy successfully integrated into ECE settings (Edwards & Bird, 2017). According to Preradović, Lešin and Boras (2017)

more insights are needed in how to assist ECE educators with knowledge, tools and strategies required to respond to rapid changes in digital environments. Instead of learning and taking individual digital technologies into use, there is a need for digital practices that firmly combine digital devices and pedagogy.

## Implementation of Digital Practices in Education

This paper addresses the implementation of digital practices by analyzing the implementation of digital portfolios in ECE. Implementing a new digital practice in education is a complex process influenced by diverse factors that either foster or challenge it (e.g. Blackwell, Lauricella & Wartella, 2014; Kale & Goh, 2014). Commonly research on the implementation of digital technology focuses on barriers (e.g. Hew & Brush, 2007; Makki, O'Neal, Cotten & Rikard, 2018). A widely utilized model in the research of educational technology implementation divides factors by their level to first- and second-order barriers, or external and internal barriers (Ertmer 1999; Tsai & Chai, 2012).

First-order barriers are regarded as crucial for the educational use of ICT. These factors relate to resources and institutions, for example access to appropriate ICT equipment and infrastructure, availability of resources and access to technical training and support (Ertmer, 1999; Makki et al., 2018). Having sufficient and proper technical infrastructure is essential for implementation of new digital practices (Kankaanranta, 2002; Meyer et al., 2011). According to Liu and Pange (2015) first-order barriers, such as lack of hardware, teaching material and pedagogical models, are considered the main barriers by ECE teachers in China. Inadequate access to ICT equipment in ECE is reported in various countries (e.g. Fenty & Anderson, 2014; Hujala et al., 2012).

Second-order barriers relate to teachers, their attitudes and beliefs. Teachers' active and positive outlook towards digital technologies, trust in their ICT-skills and courage to try new teaching methods support the use of digital tools in teaching (Blackwell et al., 2014; Kenttälä & Kankaanranta, 2017). Although ECE teachers generally share a positive view towards digitalization and utilizing new technologies, majority of teachers assess that their ICT-skills are low or mediocre or that they have only a limited amount of training in pedagogical use of ICT (Fenty & Anderson, 2014; Mertala, 2017). Furthermore, research suggests that ECE teachers are interested in receiving, but also in need of, more training in practical application of ICT (e.g. Fenty & Anderson, 2014; Ingleby, 2015). Successful implementation of regular and consistent use of ICT in teaching requires sufficient technical and pedagogical support for teachers (Blackwell et al., 2014) and also support from leadership and colleagues (Vermeulen et al., 2017).

Tsai and Chai (2012) propose the addition of a third category, third-order barriers, to the classification of barriers. Third-order barriers are related to teacher's design thinking when being confronted with the demands of learning environments and pedagogical affordances of the technology being implemented (Tsai & Chai, 2012; Makki et al., 2018). Tsai and Chai (2012) explain that due to the dynamic nature of students and classroom situations, teachers, while using ICT, are also expected to utilize their design thinking to create learning materials and activities and to adapt them to different learner groups and individual learner needs. Makki et al. (2018) suggest that focusing on developing teacher's ICT related design thinking skills, their level of comfort with ICT use may rise and they are more willing to overcome first- and second-order barriers.

This study explores the use of digital portfolios as a novel digital practice in ECE. The implementation of digital portfolios into ECE challenges teachers, as it may require amendments in both practical and pedagogical level (Chen & Cheng, 2011). Digital portfolios are defined as a children's own digital collection of documents of their learning, development and interests and, at best, the portfolio becomes an important part of child's learning identity (Jones, 2012). Portfolios are considered to have many benefits for children's learning, development and growth (Kankaanranta, 1998; Seitz & Bartholomew, 2008), and they can be used as a child-centered tool for pedagogical documentation, authentic assessment and children's self-assessment (Kankaanranta, 2002; Parnell & Bartlett, 2012). The use of digital portfolios and other digital practices in teaching can promote the utilization of more child-centered approaches (Meyer et al., 2011; Tondeur, van Braak, Ertmer & Ottenbreit-Leftwich, 2017).

Digital portfolios in Finnish ECE are based on traditional paper portfolios (Kankaanranta, 1998), which follow the basic principles of portfolio assessment: children collect, reflect and share documents of their own life and especially their learning (Seitz & Bartholomew, 2008). The use of portfolios quickly spread out in 1990s around Finland, but the basic principles of portfolio assessment were often narrowly followed. According to Knauf (2017) children's portfolios and the child-centered approach may easily turn into adult-centered compilation practice, where the portfolios showcase teachers' own pedagogical work. Furthermore, teachers' use of child-centered teaching methods may also be challenged by individual's inflexible role expectations and fear of losing authority and control (Routarinne, 2007; Kenttälä & Kankaanranta, 2017). This inflexibility may lead to teachers using a narrower variety of pedagogical practices to increase their control over students and also affect their attitudes towards using new technologies (Routarinne, 2007; Hsu, 2011).

## Research Design

This study aims to determine the factors fostering and challenging the implementation of digital portfolios in ECE. The study was conducted as a part of development project carried out during 2017 in 22 daycare centers in three Finnish municipalities. The development project proceeded through two interrelated phases, namely 1) co-design of pedagogical model for digital portfolio process and 2) implementation of this model in daycare centers (model in Finnish: Alanko, Kankaanranta, Smeds & Purola 2018). Both phases consisted of pedagogical training and coaching for teachers and leaders of daycare centers, a survey and five development tasks (three in phase 1, two in phase 2), which guided participants to reflect on their thinking and actions. The amount of support received during the project varied between municipalities and daycare centers, as each municipality hired a pedagogical ICT support person to support teachers locally, and some daycare centers and municipalities had also other technical support staff available.

## Data and Method

This study followed the principles of design research (e.g. Reeves, 2006) or design-based research (Anderson & Shattuck, 2012; Stemberger & Cencic, 2014) that has been widely used in the field of educational technology research, where research and design activities are often inseparable parts of improving current practices and refining design theories and principles (Oh & Reeves, 2010). This systematic methodology aims to improve educational practices through iterative analysis, design, development and implementation process between researchers and practitioners conducted in authentic environments (Wang & Hannafin, 2005).

Data consists of 71 development task essays from 31 ECE teachers. This paper examines three of the five development tasks conducted during the development project, with a focus on implementation (Tab.1). The number of respondents in different tasks varied, and not all respondents had responded to all tasks.

Development task	Content of reflection	N
Task 3	First phase of the project, own learning, expectations and support	24
Task 4	Digital portfolios and their use in my child group, children's reflection	24
Task 5	Digital portfolios and their use in my child group and factors affecting it	23
Total		71

**Table 1:** Development tasks

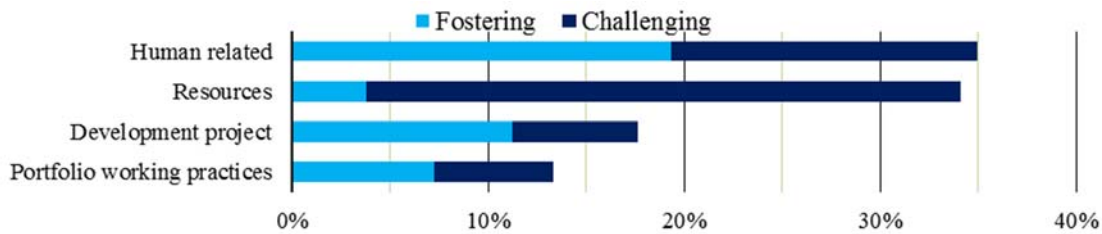
The essays were analyzed using content analysis techniques (Payne & Payne, 2004; Mathison, 2005). Teachers answered by either writing or recording their speech. Recordings were transcribed and data coded using the Atlas.ti qualitative data analyzing software. First, the essays were coded into simplified expressions and with codes *challenges* and *fostering factors*. Second, the simplified expressions were reviewed again and coded with subcodes. Finally, subcodes were grouped into main factors. The data were handled according to ethical principles ensuring anonymity of respondents, so that they are not trackable from the results of the study.

## Results: Factors Affecting Implementation of Digital Portfolios

For the examination and description of all the factors affecting the implementation of digital portfolios in ECE, the percentage of each factor and subfactor were calculated. The factors are described mainly qualitatively and the calculations are utilized as preliminary indicators in describing the relations between the factors for the further development of digital portfolio practices as well as presenting the prevailing situation in the daycare centers.

Teachers mentioned 346 times different issues affecting, either challenging (58%) or fostering (42%), the implementation of digital portfolios. The issues were grouped to twelve subcodes and further to four main factors:

human related (35%), resources (34%), development project (18%) and portfolio working practices (13%) (Fig. 1). Resources were mentioned mainly as a challenge, whereas topics related to development project were seen more as a fostering factor. Both human related topics and portfolio working practices were seen as almost equally fostering and challenging factors.



**Figure 1:** Factors influencing implementation (N=346)

In the following section, the main characteristics of each factor and its subfactors will be specified, and the contents of teachers' accounts of these topics in the development task essays will be qualitatively described.

### Human Related

*Human related* factors contain teachers', team members', children's and their parents' attitude (42%), involvement to digital portfolio practice (39%) and skills and knowledge (19%) (Tab. 2). Attitude and involvement were mentioned mainly as fostering the implementation process, whereas skills and knowledge were brought up as challenges.

Main factor	Subfactors	Fostering	Challenging	Total
Human related	Attitude	30%	12%	42%
	Involvement	23%	16%	39%
	Skills & knowledge	2%	17%	19%
Total		55%	45%	100% (n=121)

**Table 2:** Human related subfactors

*Attitude* consists of participants' positive or negative reactions towards either the development project or digital portfolio practices. Other topics related to attitude were level of courage and motivation to try and use new pedagogical methods or ICT. Attitude was more often seen as a fostering factor, as teachers described their or other participant's positive and enthusiastic reactions. However, some teachers mentioned negative and reserved attitudes as challenges. Attitude also seemed to be related to the level of involvement; when team members had positive attitude towards the implementation they wanted to be involved in the portfolio practice.

*Involvement* focuses on activity level of diverse parties. Teachers described children's active role in portfolio practices, team member's collaboration and participation but also parent's passive or low level of involvement. Especially children's and team member's active participation was seen fostering, whereas parents passive participation challenged the implementation.

*Skills and knowledge* contains teachers' and team members' ICT-skills and pedagogical thinking, children's insufficient linguistic skills and special needs. Low level of ICT-skills challenged the implementation. For example, some teachers and team members had never used tablet computers before and had difficulties to use the digital platform. From the perspective of pedagogical thinking, implementation process was fostered by teachers' and team members' earlier experience of portfolio work and their shared vision about children's potential and possibilities for growth and learning through active participation. In turn, adult-centered pedagogical approach and differences in the pedagogical views between educators challenged the implementation.

## Resources

*Resources* relates to ICT equipment (46%), time (27%), staff (16%) and various daycare center structures (11%) (Tab. 3). Out of all the subfactors, ICT equipment was mentioned most often. As seen in table 3, all of these subfactors, related to resources, were mentioned mainly as being challenging to the implementation.

Main factor	Subfactors	Fostering	Challenging	Total
Resources	ICT equipment	9%	36%	46%
	Time	-	27%	27%
	Staff	-	16%	16%
	Daycare center structures	2%	9%	11%
Total		11%	89%	100% (n=118)

**Table 3:** Subfactors related to resources

*ICT equipment* consists of access to ICT, the amount and quality of ICT equipment, digital platforms and internet connections. Teachers reported problems such as insufficient number, inadequacy and outdatedness of ICT equipment available for portfolio construction. Additionally, the lack of adequate internet connections challenged the portfolio practice, as documents could not be added to portfolios in a reasonable time. Long uploading times decreased children's interest in portfolios and teachers' positive attitude towards digitality. Teachers also faced problems with the digital platform, and expressed a concern that it did not enable children's involvement enough. However, some platform related problems were due to lack of proper training: the platform was new for the teachers and insufficient amount of time was used to learn its use before beginning the portfolio practice.

*Time* was mentioned mostly in the form of 'lack of time'. Teachers lack time to plan the portfolio practice and create portfolios with children. Combining new practices to existing ones was in some cases seen as a challenge, as additional time or resources were not provided for the teachers. Therefore, some teachers considered the digital portfolios as additional work. Time was often considered a mediating factor as it was described in relation to other factors such as skills, attitude, portfolio practices and daycare structures. Teacher's low level of ICT skills or portfolio knowledge increased the time needed for portfolio construction, and negative attitude towards portfolios increased the sense of it being more time-consuming. Teachers considered certain phases of the portfolio process to be more time-consuming than other phases, for example, choosing and uploading documents to portfolios (selection) and discussions together with children (reflection). Teachers also described how the hectic daily operation of daycare centers restricted the time available for portfolios.

*Staff* was mentioned solely through negative aspects, especially in regard to insufficient teacher-child ratio. Moreover, the absence of team members due to different reasons posed challenges to the implementation of the portfolio practice. Finally, the fourth subfactor, *daycare center structures*, consists of topics such as child group size, spaces and changes in the teams and child groups due to change of academic year.

## Development Project

*Development project* relates to training (61%) and support (39%) which were offered during the development project (Tab. 4). Both of these subfactors were mentioned more often fostering than challenging the portfolio implementation.

Main factor	Subfactors	Fostering	Challenging	Total
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Development project	Training	25%	36%	61%
	Support	39%	-	39%
Total		64%	36%	100% (n=61)

**Table 4:** Subfactors related to development project

Teachers valued *training* because of its content, instructors and the offered chance to discuss and debate with colleagues. Other teachers felt that they did not have enough time to be acquainted with training material available to them. Some teachers mentioned training as a challenging factor: training was offered only for teachers whose responsibility was to train their team members to the new practice. Some teachers found it challenging to share the new learned knowledge and skills with the team members.

*Support* includes collegial support and pedagogical ICT support. Teachers valued collegial support they received during project's training sessions. Additionally, having several teachers from the same daycare center participating in the project was seen as collegial support that fostered the implementation process. Teachers were also satisfied that local pedagogical ICT support person had helped them to overcome challenges with ICT equipment. Support factor was solely seen to foster the portfolio implementation.

### Portfolio Working Practices

*Portfolio working practices* contains matters related to practical arrangements (50%), portfolio process (37%) and planning (13%) (Tab. 5). Practical arrangements and planning were mentioned mainly as fostering, whereas portfolio process only as challenging. Of the four main factors, portfolio working practices was the least mentioned. Additionally, of all the subfactors, planning was mentioned the least.

Main factor	Subfactors	Fostering	Challenging	Total
Portfolio working practices	Practical arrangements	41%	9%	50%
	Portfolio process	-	37%	37%
	Planning	13%	-	13%
Total		54%	46%	100% (n=46)

**Table 5:** Subfactors related to portfolio working practices

*Practical arrangements* describe how portfolio practices are integrated into daily practices. Some teachers had discovered best practices by trying various different solutions, while other teachers had not found any suitable practices. Good practices concerned group work and division of labour. While teacher works with one child on her portfolio, other team members guide the other children in diverse activities. Portfolio practice was supported with arranging quiet time and space for reflection as well as selection of materials and evaluation together with only a few children at a time.

*Portfolio process* presents teachers' views on the differences of portfolio process phases, on child's role in these and the guidance needed for children. Teachers felt some phases (reflection and selection of materials with children) of the portfolio process were more challenging than the others (documentation). Children could document their own work also independently, but the reflection and selection of material required more support and guidance. Reflection was related to practical arrangements, resources and children. Some teachers felt that there were not enough staff, spaces or time to work with individuals on their reflection. Furthermore, teachers evaluated the level of challenge of diverse portfolio process phases according to child's age, skills and amount of participation.

*Planning* emphasized the role of careful planning as a fostering factor. Portfolio work and the implementation process proceeded more efficiently when there was enough time for planning and when planning was done together

with team members. Collaborative planning was seen to enhance the involvement of team. Some teachers felt that a general portfolio plan created by the daycare center fostered portfolio work and acted as a base for planning the activities.

## Discussion

This study expands the current research approach on digitalization in ECE towards understanding adoption of digital practices, instead of simply implementing new technologies. The results indicate that there are four main factors teachers confront during the implementation process: human related, resources, development project and portfolio working practices. Although this research did not aim to model the relationships between the factors, the four main factors seemed to be closely connected to each other and having combined effect on the implementation process. According to earlier studies, the relationship between influential factors may be bi-directional (Tondeur et al., 2017), and the factors may have both direct and indirect effect on the use and implementation of ICT in ECE (Blackwell et al., 2014).

In this study, human related factors were most frequently mentioned, which may be partly due to the characteristics of the daycare centers (teamwork and educational partnership with parents) and digital portfolio practice (child-centered and interactive). Furthermore, the human related factors, more specifically attitudes and involvement, were considered most fostering factors for the implementation process. Resources, more specifically ICT-equipment and time, were the major challenges for implementation. Lack of ICT equipment, staff, suitable spaces and time affected the way teachers could integrate the portfolio into everyday practices and work individually with children. Training and support offered during the development project were mainly seen to foster the implementation process. However, access to training and the expectation of teachers to train their team members into the digital portfolio practice made some teachers question if they have enough resources (time) to actualize this. Thus, the sufficiency of the training received by the teachers to be able to train others in a practice they were themselves still in the process of learning, can be questioned. However, the situation differed between municipalities and teams, showing that peer training and sharing of pedagogical practices was already a common practice in some teams, while other teams were more oriented towards individual work. Portfolio working practices, in regards to planning and practical arrangements, were mentioned as fostering the implementation of portfolios. However, the actual phases of portfolio process (see Alanko et al. 2018), especially selection and reflection, were mentioned to be challenging, suggesting that additional support might be required to familiarize all educators with the digital portfolio process.

This study confirms the findings of earlier research that first-order barriers need to be overcome in order to successfully implement a new digital practice (Blackwell et al., 2014; Makki et al., 2018). However, this alone is not enough. This study also confirms that second- and even third order factors have an impact on the implementation experience for teachers (Tondeur et al., 2017; Makki et al., 2018). It seems that teachers who share a positive and active outlook on technology may be willing to subsist with limited resources. However, attitudes and beliefs may affect the teachers' view of sufficient resources (time, ICT equipment, spaces) needed for their work. The results of this study suggest that implementation of digital practices requires multifaceted support in both pedagogical and technical level. On the technical side, it is important to provide teachers with adequate and functional ICT-infrastructure. The results of this study can be used to improve the implementation processes of digital practices, but also to analyze the factors that support or hinder the implementation process.

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