Coding practices in early childhood classrooms: A phenomenological study with ECE teachers in Turkey

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The aim of the research is to understand in-service and pre-service preschool teachers' perceptions of coding after their lived experiences to develop suggestions regarding incorporating coding practices into early childhood education. The study employed a phenomenological design with a total of 28 pre-service and in-service preschool teachers (19 pre-service and 9 in-service teachers). Data were collected through interviews, focus group meeting, and artefact analysis. Six hours of trainings with in-service and pre-service teachers, both conducted separately by the researcher, introduced the participants to the concept of coding in early childhood and how to apply it to their own educational programs. The perspectives of participants were examined using a thematic approach based on the interviews, focus group meeting, and artefacts (coding activity plans) they generated. The findings can be used as a needs analysis in order to create a framework for coding in early childhood education and to customise activity plans for preschool children that fit the needs of early childhood educators in incorporating coding into their educational programs.

Introduction

Coding activities were integrated into early childhood education (ECE) shortly after they were introduced to primary education and above. Coding is considered a means for children to learn how to use technology successfully and efficiently. Studies on coding in the early childhood period have recently been regarded as a research topic, akin to technology integration (Arnott et al., 2018). Recent coding research has focused on the effects of coding on cognitive skills, such as problem solving (Barr & Stephenson, 2011; Siegle, 2017; Pollak & Ebner, 2019), reasoning (Strawhacker & Bers, 2019), sequencing (Kazakoff, et al., 2013), creativity and creative thinking (Fielding & Murcia, 2022; Murcia et al., 2020; Siegle, 2017), cognitive compiling (Marinus et al., 2018; Murcia et al., 2020; Siegle, 2017) or early mathematical skills (Vega et al., 2022). Although programming skills relate at first especially to cognitive skills, 'coding as playground' (Bers, 2018, p.2094) not only improves children's cognitive skills, but also promotes social connections, motor skills, emotional exploration, and making various personal and moral choices.

Many countries, including the United States, the United Kingdom, the Nordic countries, Australia, and the Far East were driven to propagate early coding skills due to the increased interest in teaching programming to children as young as three years old (Bers, 2021) and some of these countries have incorporated coding into their national K-12 curricula (Bers, 2021; Kazakoff & Bers 2013; Papadakis et al., 2016; Pollak & Ebner, 2019; Uzunboylu et al., 2017). In the meantime, numerous worldwide and local programming projects such as *Code.org* and *Code Club* have been launched (Bers, 2018; Marinus et al., 2018, Mason & Rich, 2019). Despite the recent policies of governments aiming at integrating coding into ECE and initiatives that present coding samples differentiated by

age levels, it is thought that a more specific framework is needed to guide teachers on how to apply coding in their classrooms. On designing the framework to be developed, it is important to understand how preschool teachers, as practitioners in the field, perceive the phenomenon and how they position themselves in the implementation process of coding at the preschool level.

Duties or responsibilities of early childhood educators include being a facilitator, a coach, or a model for children (Saracho,1990). However, preschool teachers often lack an appropriate educational background with coding experience to fulfil these responsibilities and also incorporate coding in their classroom practices. To accomplish this, teachers need training (Manches & Plowman, 2017; Mason & Rich, 2019). Mason and Rich (2019) also distinguished between pre-service and in-service teacher training. They have claimed pre-service teachers to be more competent in using technology for coding, whereas in-service teachers have more ingrained ideas and experience in applying pedagogical knowledge to teach a particular context. From this point of view, it is believed that studies to be carried out on coding at preschool level will benefit from hearing the perspectives of both pre-service and in-service preschool teachers.

The literature on coding in early years lacks teacher opinions after obtaining a self-lived experience of coding. My study intends to close this gap and contribute to a framework that will assist early childhood educators in incorporating relevant coding examples into their curriculum. With experience of the phenomenon itself, perceptions regarding that phenomenon will develop and become more mature (Yin, 2009). It is thought that the perspectives of preschool teachers after their coding experience will contribute to the framework to be created for coding practices in ECE. To achieve this goal, in-service and pre-service preschool teachers were asked what they thought about coding in early childhood and how they might incorporate it into their classrooms following the presentation of content that included an opportunity for practice in the subject.

Coding in early childhood education

'Coding', often known as 'computer programming', is described as providing computers with 'step by step' instructions on what they should perform (McLennan, 2017). Computer programming gained a presence in K-12 education decades after university-level computer science education (Barr & Stephenson, 2011), and it has only recently been associated with early childhood education (Bers et al., 2019; Bers, 2021; Lee, 2020; Marinus et al., 2018; Monteiro et al., 2021; Strawhacker & Bers, 2019). The studies involving coding activities with preschool children reveal that coding is highly associated with computational thinking. Papert coined the term "computational thinking" (Papert, 1980), and it is defined as "solving problems algorithmically and developing technological fluency" (Bers, 2021, p.59). Wing (2006) used the same term for thinking like a computer scientist. Wing (2006) stated that computational thinking overlaps with logical thinking and systems thinking, includes algorithmic thinking and parallel thinking, and engages thinking processes of compositional reasoning, pattern matching, procedural thinking, and recursive thinking. Barr, Harrison and Conery (2011) listed the components of computational thinking to be employed by educators as formulating problems to solve

them, organising and analysing data logically, representing data, identifying, analysing and implementing possible solutions, and transferring a problem-solving process to a wide variety of problems.

From an early childhood education perspective, these thought processes can be simplified under four categories, as pattern recognition, creating and using algorithms, decomposition, and understanding abstractions (Barr & Stephenson, 2011). Three of these categories correspond to the aims of preschool education that include enhancing pattern recognition, algorithmic thinking, and decomposition (Strawhacker & Bers, 2019). The cognitive development theory of Piaget suggests that children at preschool level are not ready to master abstraction yet. An increasing number of tools, apps and platforms help children embody coding with their block-based graphical interfaces, and enable them code either in an *unplugged* way without computers and screens such as KİBO, Cubetto, BeeBot or in a *plugged way* on screen such as ScratchJr, Tynker, code.org. (Caguana Anzoátegui et al., 2017; Elkin et al., 2016; Marinus et al., 2018; Papadakis et al., 2016). A very recent study by Yang and Bers (2023) which investigates gender difference in the use of ScratchJr revealed that both genders demonstrated substantial progress in programming. Their findings suggested that introducing computer and programming concepts during early childhood creates a favourable environment for both boys and girls to excel in traditionally male-dominated fields (Yang & Bers, 2023). The systematic literature review by Stamatios (2022) analyse 18 studies, concluding that despite not being a 'magic bullet', ScratchJr is a useful program that improves chldren's computational thinking and coding skills.

Coding Implementations in early childhood education

The literature about coding implementations in early childhood education unfolds its effect on children's cognitive skills such as computational thinking, algorithmic thinking, problem-solving or executive functions (Barr & Stephenson, 2011; Bers et al., 2014; Portelance et al., 2015; Strawhacker et al., 2018). Bers (2021) argued that coding is a new literacy for children that allows them to think and communicate in innovative ways apart from supporting cognitive skills development. Studies on early childhood coding activities, with an emphasis on language skills and visual memory (Clements, 1999), mathematical concepts including number, size, shape, representation, spatial concepts, and measurement (Highfield, 2000; Resnick et al., 1998), sequencing, modularity, and debugging (Lavigne et al., 2020), creativity (Fielding & Murcia, 2022; Murcia et al., 2020) and scientific research skills (Datteri et al., 2013) provide evidence for the contribution of coding activities to the development of children in addressed areas. A study by Critten et al. (2022) concluded that even 2-3 years old children could acquire communication, collaboration, planning, logical thinking, and problem-solving skills through coding activities. Although these studies report positive and promising results for educational potential of coding activities in early childhood, they do not provide an insight into how early childhood educators may incorporate coding activities into their classroom practices. Given that, in elaborating a guide for preschool teachers on how they can apply coding in their classrooms, it is crucial to get their opinions beforehand as they will be the practitioners in the field.

Role of preschool teachers to introduce coding to children

Studies on preschool education reveal the key role of teachers in children's learning and development during this period (Mertalla, 2019; Wang et al., 2021). Early childhood educators hold a critical responsibility in a child's life with different roles such as observer, communicator, facilitator, coach, or model (Saracho, 1990). In their study, Sheffield and colleagues (2018) asserted that teachers must have a high degree of digital competency in order to successfully scaffold and support students' acquisition of digital technology. Several studies argued that preschool teachers lack competence in integrating digital technologies into ECE (Brennan & Resnick, 2012; Strawhacker et al., 2018). According to Casey, Pennington and Mireles (2020), enhancing teachers' awareness of emerging technologies is the first step of a successful and effective classroom implementation. It is followed by recognizing the positive effects of technology on children and implementing it in their classrooms. Teachers can only adapt new technologies to their classrooms when they are confident in their knowledge of the subject; otherwise, they are adamant about not incorporating it into their classroom practices (Vidal-Hall et al., 2020). Therefore, it is anticipated that preschool teachers will demonstrate an inclination towards receiving education that clarifies the essentials of coding and how to apply it to ECE.

Knowing the teachers' perspectives on coding in early childhood will aid in developing recommendations for incorporating coding activities into early childhood curriculum, and will provide an advantage for teachers in transferring their knowledge into practice. However, it could be predicted that pre-service teachers who are prepared with ideas about educating young children with coding before entering the field, and in-service teachers who show interest in coding without this educational background, may have different opinions (Papadakis et al., 2021). It is thought that gathering pre-service and in-service preschool teachers' perceptions on coding practices in ECE will help shape the pedagogical framework to be created. The following research question was formulated as a result:

> What can we learn from in-service and pre-service preschool teachers' experiences with coding activities to make suggestions on incorporating coding in ECE?

Methods

Methodology and the context of the research

This qualitative study employs a phenomenological design to elucidate the lived-experiences of pre-service and in-service preschool teachers on coding in early childhood. The phenomenological study design gives a meaning to an incident or subject involving subjective experiences of the participants (Patton, 2002). In my study, coding in early childhood is considered as the phenomenon. As preschool teachers are expected to incorporate coding into their classroom practices, it is important to understand how this phenomenon is perceived by preschool teachers. It is anticipated that direct experience would influence their perceptions (Yin, 2009). Pre-service teachers were introduced to

"coding in early childhood" through training integrated into their programs, and in-service teachers through an open workshop announced publicly. During their training, all participants were required to experience a coding process and develop a coding activity for preschool children. Later they were asked to reflect on their experiences to obtain their perceptions after their first coding experience. For a deeper understanding, a focus group meeting was held with four of the participants to discuss their identical, conflicting or complementing points of views. Transcripts of interviews, the focus group meeting, and their coding activity plans were obtained for analyses.

Participants

The participants comprised two separate groups as 'pre-service' and 'in-service' preschool teachers. Pre-service teachers were sophomore (second year) students of an ECE program at a university and in-service teachers were working at different schools with length of teaching experience ranging from 1 year to 19 years. Both groups participated in the study from Ankara, Turkey. The rationale for working with pre-service and in-service teachers is that different perspectives that allow for a deeper understanding of the phenomenon may be held by pre-service teachers, who are prepared to equip young children with coding during their education, and in-service teachers who lack this educational background, but exhibit interest in incorporating coding in their classroom. The diversity in the findings is believed to enrich the suggestions of the study. A total of 28 participants, all of whom were female, included 19 pre-service and 9 in-service teachers. The average age of pre-service teachers was 21.9 years, while in-service teachers was 32.2 years. The first group was trained for coding practices with young children as part of their curriculum in an ECE program (English is the medium of instruction), and the latter group voluntarily participated in the open workshop (offered in Turkish) announced publicly in Ankara, Turkey.

Instruments

The study utilised three instruments for data collection. The first is the standardised open-ended interview form, the second is the artefacts produced by the participants as coding activity plans addressing preschool children, and the last is the focus group meeting narratives.

Standardised open-ended interview form
It included two open-ended questions:

1. How do you describe the effects of coding practices in ECE?
2. How do you picture the future of coding practices in ECE?

Artefacts (coding activity plans)
These were used as the second instrument to collect data. After completing either the course or the workshop, the participants were asked to design a coding activity plan addressing early childhood. The activity plans of the pre-service teachers were in English since the medium of instruction is English in the ECE program. The workshop offered

for the in-service teachers was held in Turkish and their activity plans were consequently in Turkish. The aim of the coding activity plan and the method to apply coding in their activity was anticipated as indicators of participants' perceptions regarding coding and the role of teachers in incorporating coding in early childhood. The participants were provided flexibility about determining the aim of the activity (such as 'to introduce a concept'; 'to establish collaboration'; etc.) and the method to follow (such as unplugged, plugged or a combination of both). During the course and the workshop ScratchJr (a graphical programming language designed specifically for young children) was presented as a *plugged* way of incorporating coding into ECE, while programming without a tablet, like using BeeBot, Cubetto, or platform-games designed specifically to develop programming skills is presented as *unplugged* way of coding. An example of an artefact is presented below. Figure 1 shows a page from one of the pre-service teacher's coding activity plans which displays a screenshot from ScratchJr.

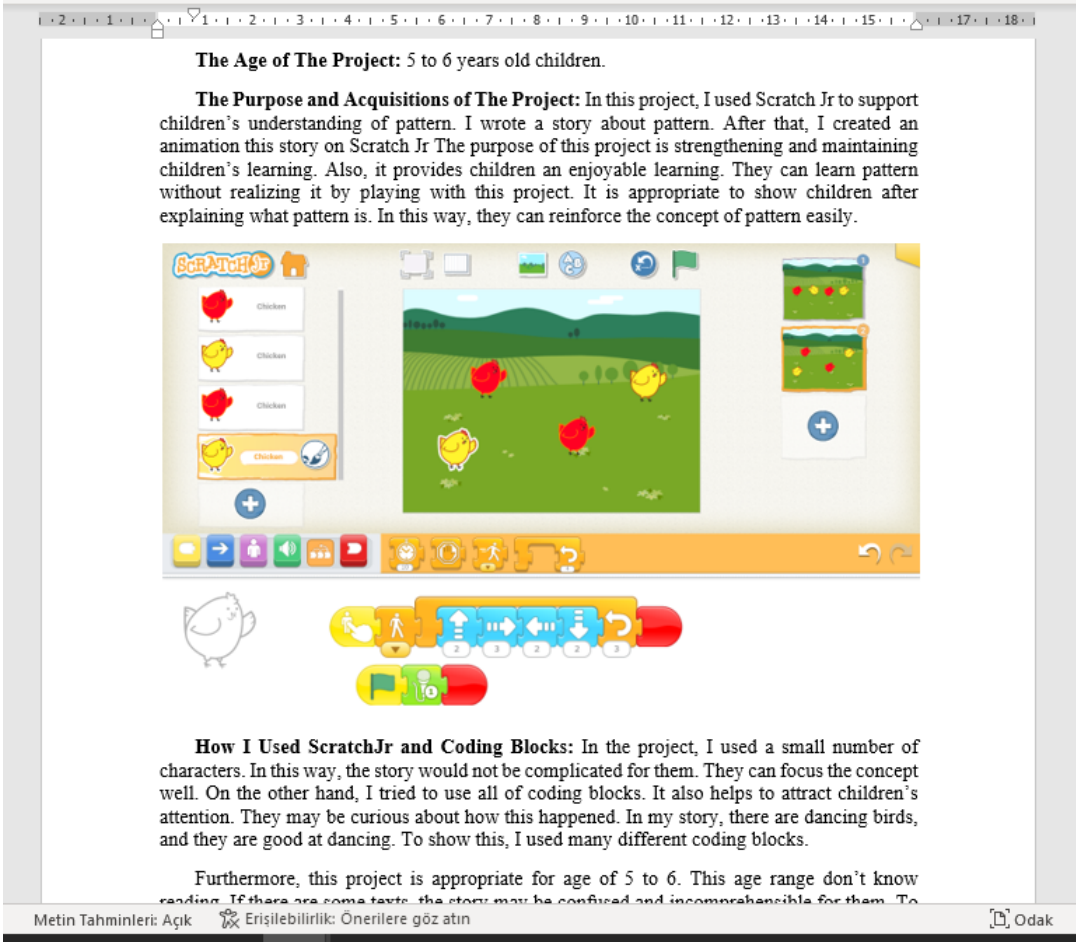

Figure 1: Artefact produced by one of the participants using ScratchJr program, addressing pattern concept.

In Figure 1's artefact sample, the aim of the coding activity is 'to support the understanding of a mathematical concept' and the method is 'plugged'. In another example, one in-service teacher designed a platform-game involving coding skills without utilising any device such as a tablet or computer. The aim of this activity plan was 'boosting social development' and the method was 'unplugged'.

Focus group meeting

This served as the third data collection instrument. The agenda for the focus group meeting was determined after analysing the interview data and the artefacts of the participants. Four participants were selected purposively among 28 participants, due to the variety of findings from interview and artefact analyses. Two of the participants were pre-service teachers and two were in-service teachers. The purpose of bringing these four participants together was to have them share their perspectives and reflect on each other's views, which would help to extend and deepen the subject (Ward & Delamont, 2020). The researcher moderated the focus group meeting with an interview guided approach (Patton, 2002).

Data collection and analysis

The ethical approval for this study was obtained from the Human Research Ethical Committee of the institution employing the researcher. Participants were informed about the contribution of their unbiased views. The study was conducted by the ones who accepted to take part in the study voluntarily by signing a consent form regarding their permission to use anonymously the data collected. During the analysis, the participant teachers were given pseudonyms P1, P2, … to P28 for confidentiality of personal information.

The data was collected from two different groups. The first group included in-service preschool teachers who voluntarily registered to the workshop offered to preschool teachers publicly by the researcher in Ankara, Turkey. This workshop was offered in Turkish, in April 2019. The goal of the workshop was to introduce what coding is, what it refers to in ECE, and how to incorporate plugged/unplugged coding in ECE. The participants were presented a content including videos and samples that aligned with this goal (See Appendix1). The final hour of the workshop was set out for hands-on practice creating a ScratchJr project under the researcher's guidance. Six of the participants used Android tablets and three of them used iPads(iOS) for their ScratchJr project. Since ScratchJr is designed for young children who have not yet developed literacy skills, its interface was created using language-independent visuals. Despite receiving the introduction to the program's user interface in Turkish, in-service teachers had no problems using ScratchJr. After completing the workshop, in-service teachers created and submitted an activity plan to incorporate coding in their classrooms with an assumption that it would reflect their perceptions of coding in ECE. The interviews with this group, each of which was between 15-20 minutes, took place at the end of this workshop.

The second group included pre-service teachers. In the curriculum for the ECE Program, sophomore students are offered *Science Education in Early Childhood* and *Mathematics*

Education in Early Childhood courses. As the instructor for both courses, the researcher placed the same content of the workshop with in-service teachers into one week of the course program, for a total of six hours. The courses aimed at introducing the idea of using coding practices in ECE and presenting appropriate ways to implement them in a preschool classroom (Appendix1). At the end of the relevant courses in October 2019, the pre-service teachers were asked to design and submit an activity plan that incorporated coding in ECE. Thirteen of the students used *Android* tablets and six of them used *iPads* (iOS) for their project. The interviews with this group were conducted at this stage after the delivery of the coding activity plans. Each interview took between 20-25 minutes. Interviews with this group was planned at mutually convenient times during a four day period.

After completing the interviews and investigating the coding activity plans, finally the focus group interview with the four of the participants was held as the last phase of the data collection. As it was not possible to gather everyone in person, the focus group meeting was scheduled online in June 2020 using *Zoom*. All those present in the focus group gave their consent for the meeting to be recorded. The focus group meeting was transcribed into narratives for data processing. The transcripts and the artefacts were analysed with thematic coding in accordance with the six-phase framework by Braun & Clarke (2006). In thematic coding, the researcher first became familiar with the data and generated the initial codes. The themes that emerged as a result of coding were then revised and defined. Finally, the quotations that were thought to best convey each defined theme, beyond description, and open it up for discussion, were determined. The overall design of the data collection and analyses is presented in Figure 2.

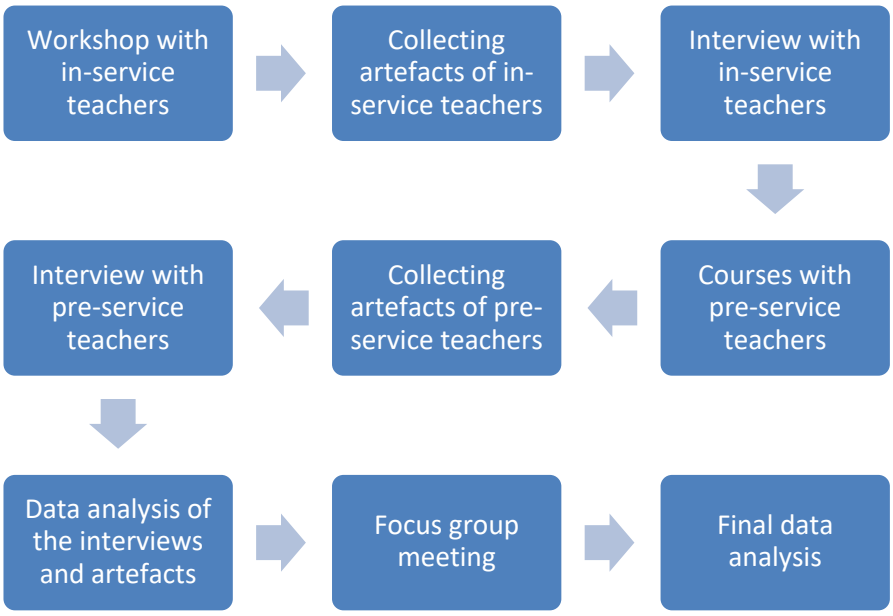

Figure 1: The overall design of the data collection and analysis

Validity and reliability of the study

For the validity of the data, the researcher collected the data from different groups (pre-service and in-service) related to the phenomenon at different times and stages (an interview and a focus group meeting). Artefacts that reflect the perceptions of teachers regarding the phenomenon were also used targeting the data triangulation (Ward & Delamont, 2020). For the reliability, the data was evaluated by a colleague and the inter-rater reliability was calculated as 91% for their consensus. In addition, to strengthen reliability, the results of the analysis were reported and shared with the participants for their approval (Yıldırım & Şimşek, 2016).

Results

The study's findings will be presented beginning with the themes of the collected data. The themes were categorised under four titles as 'Purpose to employ coding'; 'Method used for coding'; 'Perceived role in incorporating coding'; and 'Satisfaction and concerns about coding'. A schema for the common themes is shown in Figure 3. The sub-themes derived from these four themes differed for the two groups. The categories resulting from each theme will be shown next, with separate titles for pre-service and in-service teachers' perceptions of coding.

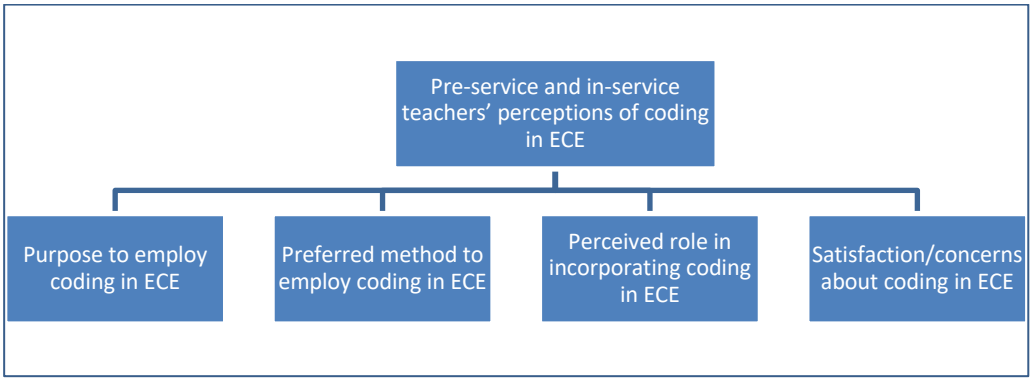

Figure 3: Themes obtained from the analysis of interviews, artefacts and focus group meeting regarding the teachers' perceptions of coding in ECE

Pre-service teachers' perceptions of coding in ECE

The findings of the analysis revealed that pre-service teachers' perceptions of coding regarding the four themes presented in Figure 3 differed to some extent from the perceptions of in-service teachers. The 'Purpose' theme from Figure 3 is expanded in Figure 4 into four sub-themes for pre-service teachers.

Purpose

Sub-themes formed for pre-service teachers' purpose to employ coding in their classroom practices are shown in Figure 4.

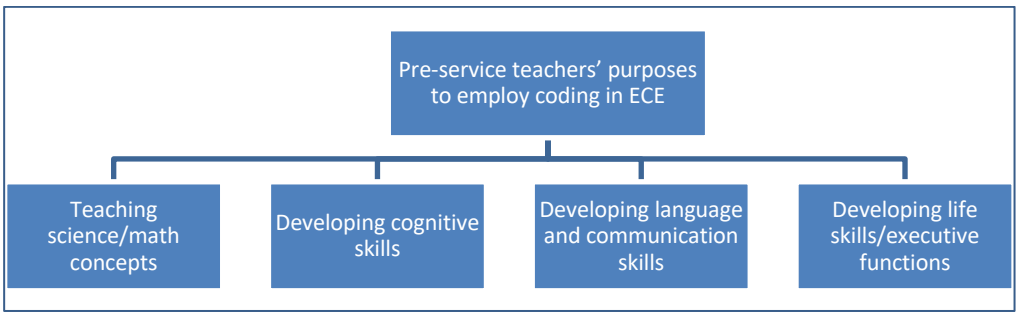

Figure 4: Sub-themes obtained from the pre-service teachers' purpose of incorporating coding in ECE

The results of the thematic analysis reveal that the pre-service teachers associate coding activities in early childhood with science and mathematics concept teaching, basic cognitive skills development such as problem solving and logical thinking, communication and language skills development, and life-skills and executive functions development. P4 from the pre-service teachers group shared in the interview session that she believed coding could be used in teaching science and mathematics concepts. However, in the focus group meeting where the potential of coding activities in early childhood was being discussed with in-service teachers, she declared that her opinions changed and shared her views as follows:

> I used to think that coding would be an activity that I could use in science-mathematics concept teaching. ... But I realised that coding is not limited to this. It can help the child in terms of basic cognitive and communicative skills development and collaborative learning.

Method

The second theme emerging from the analysis was the method that teachers preferred to employ while incorporating coding in their classroom practices. Figure 5 shows the categories for this theme derived from the artefact analysis in terms of pre-service teachers' coding experiences.

Artefact analysis revealed that pre-service teachers internalised early childhood coding practices by successfully combining unplugged and plugged activities. P7 explained the method she preferred as:

> Now that I know, the best approach to introduce coding to pre-schoolers is to begin with orientation games. I designed a platform game [unplugged coding] as a warm-up activity before the ScratchJr project [plugged coding] as the main activity (P7).

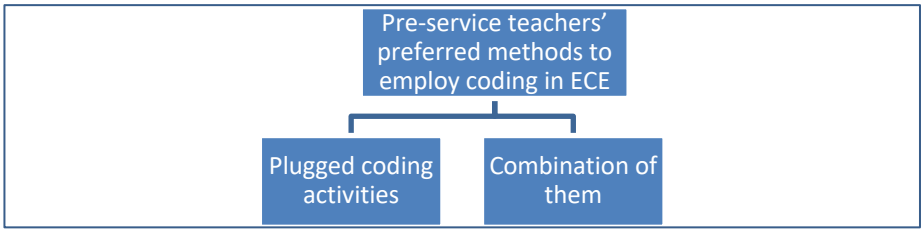

Figure 5: Sub-themes obtained from the pre-service teachers' preferred methods for their coding activities.

Perceived role

About the future of coding practices in ECE, pre-service teachers defined their roles in introducing preschool children to coding as presented in Figure 6.

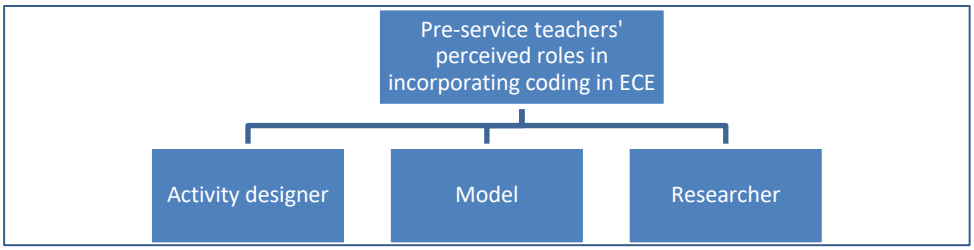

Figure 6: Sub-themes obtained from the pre-service teachers' perceived roles in incorporating coding in ECE

Apart from the researcher role, which is common to both groups, pre-service teachers underline the role of activity designer and model. They believed that they should be the ones who are capable of writing code for preschool level purposes, which was expressed by P7:

> Yes, preschool teachers should facilitate coding activities in their classrooms. To make it possible, first we ourselves need to learn it. The best way to strengthen a child's learning is to exemplify it in real life. If we manage to put into practice what we learned from coding by designing appropriate activities that we also engage in, we will become a good model so that the child will first imitate and then adapt what they learn to their knowledge (P7).

Satisfaction/concern

Pre-service teachers' main satisfactions along with reported concerns about incorporating coding in future preschool classrooms are presented in Figure 7.

Pre-service teachers were concerned that they may burn out after a while due to the ongoing effort to stay up to date with digital technologies for which they have no prior knowledge or experience. As P4 put it:

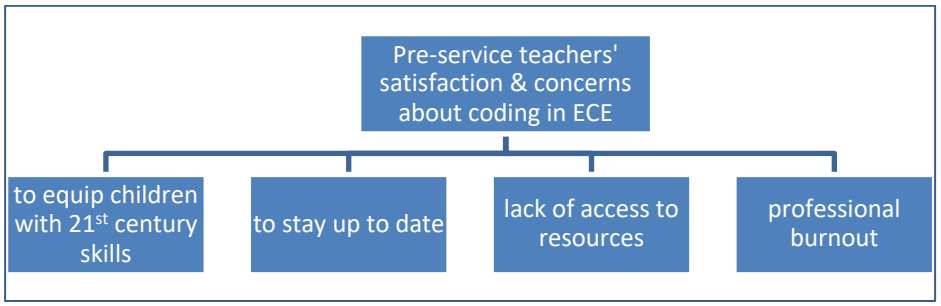

Figure 7: Sub-themes obtained from the pre-service teachers' satisfactions and concerns about coding practices in ECE

> I feel very satisfied to be capable of helping children to learn the language of 21st century. Today I know that the new language is coding and I learned about it as part of my undergraduate education. I will develop ideas to integrate it in my future plans. I feel up to date and I'm happy about this. But what about the next one? What comes next and how will I access the resources about the next innovation I need to learn? Will I keep my student role whole my life? I will be doing this job my entire life which means we can add more than 20 years from now on. And I know that this job requires a lot of energy. I sometimes get worried when I think about my future responsibilities, how will I survive? (P4).

In-service teachers' perceptions of coding in ECE

The following are the categories of in-service teachers' perceptions for the same four themes listed above in Figure 3.

Purpose

Categories formed for in-service teachers' purpose to incorporate coding in their classroom practices are shown in Figure 8.

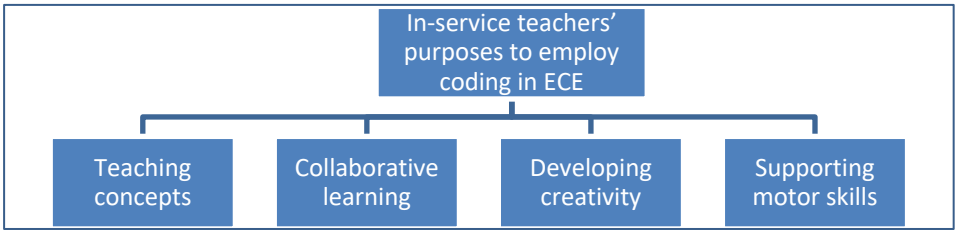

Figure 8: Sub-themes obtained from the in-service teachers' purpose of incorporating coding in ECE

Thematic analysis data revealed that in-service teachers associated early childhood coding activities with concept teaching, collaborative learning, creativity, and motor skills support. The focus group meeting elaborated on teachers' descriptions of coding activities in early

childhood. P23 from the in-service teacher group expressed the change in her view about coding activities as follows:

> Coding has become a term that I've heard a lot lately. I didn't know what it meant, but I guessed it was STEM-related, and I thought that the preschool period was too early for such activities. After learning what integrating coding activities into my class meant, I generated the idea that coding is about developing a mind-set for logical thinking and even the preschool children can write computer programs using blocks before they develop early literacy skills… For me this is just a beginning, now I became aware that there is more to learn about coding practices in early childhood classroom.

Method

Categories for this theme with respect to in-service teachers were presented in Figure 9.

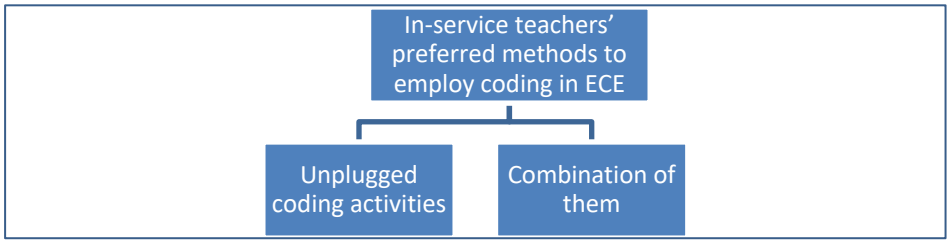

Figure 9: Sub-themes obtained from the in-service teachers' preferred methods for their coding activities

Although the combination of plugged and unplugged methods was common in both groups, the number of in-service teachers who preferred to use it differed from pre-service teachers. Only one of the in-service teachers included combination of unplugged and plugged coding in their activity plans. Other activity plans were limited to only unplugged coding activities. P23 clearly articulates why she prefers to incorporate only unplugged coding as:

> I see how coding can contribute to child's logical thinking so I'm eager to integrate it to my activity plans. And I'm happy that I can do it with simple in-class games like treasure hunt. I can distribute the roles: one of them can be the one to give the instructions, the other becomes the one to follow these instructions… This is how I can encourage children. But the other ways… apps and coding platforms? I'm not sure… For now, I don't have the courage to use them yet (P23).

Perceived role

About the future of coding practices in ECE, in-service teachers defined their role in introducing preschool children to coding, are presented in Figure 10.

In-service teachers agreed on the role of preschool teacher as a researcher with pre-service teachers. They did not address being a model, instead they defined their role as mediator to scaffold the children to be capable of writing codes. P25 put this as follows:

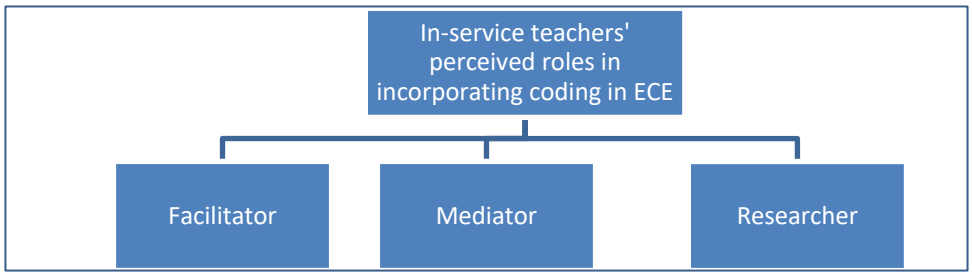

Figure 10: Sub-themes obtained from the in-service teachers' perceived roles in incorporating coding in ECE

> It is not easy for me to learn coding, what I can do will be to arouse curiosity and interest in coding, and to encourage children by presenting good examples. If I observe that some children have high interest and are eager to learn more than I can give, then for me the next step can be directing the child to extracurricular coding activities.

Satisfactions/concerns

In-service teachers' main satisfactions along with reported concerns about incorporating coding in future preschool classrooms are presented in Figure 11.

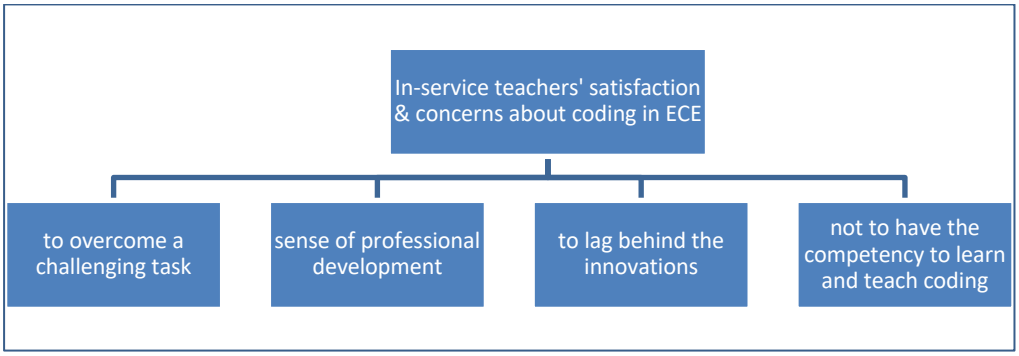

Figure 11: Sub-themes obtained from the in-service teachers' satisfactions and concerns about the future of coding practices in ECE

Coding seems to be perceived more challenging by in-service teachers. They highly value learning to code and consider being able to handle it as a satisfaction. For them, it is challenging to learn about new technologies with smart devices. When they find out that they can learn, it becomes a sense of fulfilment and competency as they name it professional development. On the other hand, they also reported some concerns about incorporating coding activities in their classroom practices. One of the in-service teachers (P25) simply expressed her concerns as:

> I learned a bit about what it means to code and what preschool children can do about it. But for me there is not such time left to keep up with this new language. I have already

> lagged behind the innovations, obviously. I don't feel competent enough either to learn or to teach coding (P25).

Discussion

Research on technology integration in ECE reveals that preschool teachers are generally positive about using digital devices in their classrooms, and seem enthusiastic about adapting innovative activities into their practices (Papadakis et al., 2021). Although studies have been conducted on coding with young children (Bers et al., 2014; Critten et al., 2022; Kazakoff et al., 2013; Monteiro et al., 2021, Metin, 2020; Papadakis et al., 2016; Strawhacker et al., 2018) there are not any studies investigating preschool teachers' perceptions on coding practices in ECE. In this study, preschool teachers' perceptions regarding coding practices in ECE were compiled to facilitate the incorporation of coding in their classrooms and achieve its contributions to young children's learning and development.

The results revealed that both teacher groups showed interest in the incorporation of coding in their classroom practice, as suggested by Papadakis and colleagues (2021). However some differences were found in the purpose and method to put it into practice. Considering the aim of their coding activities, it was seen that pre-service teachers set more concrete and focused goals for their plan. They were able to describe how they would benefit from coding in their classroom practices, making associations and giving tangible examples. In contrast, in-service teachers made general definitions such as 'introducing concepts' and 'creativity development'. This may indicate that in-service teachers require more assistance while pre-service teachers are more likely to use coding in their classes.

Another theme that emerged from the data was the method that participants preferred in incorporating coding activities in their practice. While most pre-service teachers were enthusiastic to employ plugged coding activities, in-service teachers preferred to use unplugged coding activities, as similarly stated in Mason and Rich's (2019) study. Given that research suggests young children benefit more from coding when they start with unplugged and kinaesthetic implementations and continue with block-based applications on screen, both groups can be encouraged to use a combination method to get the most out of their coding activities.

Teachers' depictions of the future of coding provided insight into their perceived roles. Both groups agreed on their role as a researcher, since none of the groups has previous knowledge or experience in coding (Manches & Plowman, 2017, Mason & Rich, 2019). Both groups indicated that coding is a new area to discover for them. Participants claimed that because many preschool teachers lacked personal experience with coding, they were forced to take on the role of researchers. The attributed roles, apart from the researcher role, indicated that pre-service teachers took proactive roles such as activity designer and model, while in-service teachers took on more passive roles such as mediator and facilitator. The literature suggests that bringing teacher awareness to a desired level will enable innovative approaches as embodied in Yuan and Patel's (2022) study with

preservice teachers, thereby opening the gate for meaningful implementations within the curriculum (Vidal-Hall et al., 2020). In this context, it is possible to interpret the opinions of the in-service teachers as a request for meeting the needs of teachers in terms of meaningful coding practices in ECE.

How teachers pictured the future of coding practices in ECE also revealed their satisfaction and concerns about incorporating it in their classrooms. Findings have indicated that pre-service teachers are confident enough to proceed with focused training that leads them to further classroom implementations, while in-service teachers need support regarding self-confidence and competency about the ways to incorporate coding in their classroom setting before they start hands-on practices which aligns with literature reviews (Casey et al., 2020; Papadakis et al., 2021; Somuncu & Aslan, 2018; Vidal-Hall et al., 2020; Wang et al., 2021).

After trainings through the workshop or course, pre-service and in-service teachers' opinions were reopened for discussion in the focus group meeting, and the changes in their views were evaluated. The focus group meeting determined that the views of both groups were enriched after the discussion of their responses. These discussions enabled teachers to develop an understanding on incorporation of coding in their educational program, rather than providing the technical knowledge on coding. Exchanging ideas prepared teachers to adapt coding to classroom practice in different ways and for different purposes, as Vidal-Hall, Flewitt and Wyse (2020) have suggested. This is found to be pleasing and promising for the implementations of coding practices in ECE. After studying with many colleagues and numerous published articles, Bers (2018, p.2094) suggested that coding should not be limited to being a tool that develops cognitive skills; instead it should be evaluated as 'playground'. In the focus group meeting, both groups of teachers had the opportunity to expand their views on how to include coding activities in classroom practices and they exchanged ideas on the notion of coding as 'playground'. The opinions of the teachers in both groups seem to be in line with this argument, as they included communication skills in the pre-service teacher group or collaboration in the in-service teacher group, apart from cognitive skills.

Limitations

This study has some limitations because of qualitative nature of the research design. The results from the two groups of teacher comparisons help to make conclusions that may fit only for this sample. The sample size is another limitation to making general statements, yet it helps to develop an understanding about the teachers' approach to coding incorporation in ECE from two different perspectives. It may be suggested to work with a larger number of in-service and pre-service teachers to get their opinions. The fact that the workshop participants of the study consisted of volunteers may create a biased result in the approach to coding activities. Therefore, another suggestion might be to conduct similar studies with other groups that resist coding practices in the preschool period. In this study some of the data was collected through the interviews and focus group meeting, based on the participants' declarations. It was assumed that the answers given to the

questions and the opinions shared in the focus group meeting were the sincere views of the participants and the evaluations were limited to that assumption.

Conclusion and recommendations

Early childhood is the period in which children have not yet developed abstract thinking skills. In this period, coding activities should be presented through appropriate methods, so that children can benefit from coding for their development. The findings of this study show that all participating teachers were willing to teach coding, while in-service teachers do not feel prepared to put the proper approaches into practice. The guidance that preschool teachers need to adapt coding activities to their classrooms with appropriate methods can be addressed by presenting a broad-based and comprehensive framework. For this, needs should be determined at a wider level by working with larger and more diverse samples. Interviews with teachers are believed to serve as a needs analysis and are important, so that the program, which will be prepared to effectively benefit from coding activities in ECE, meets the needs of teachers at different levels. Researchers can be recommended to organise training and workshops for preschool teachers at different levels, such as raising awareness about preschool coding activities, informing them about the achievements, creating opportunities for practice, and adapting them to their own practices. If researchers present developmentally appropriate examples of early childhood coding practices, preschool teachers will be able to implement and adapt these strategies to their own requirements. Along with a curriculum, based on a theoretical framework, teachers need appropriate activity plans covering all developmental domains including cognitive, language, social-emotional skills. Tangible samples of activity plans with coding activities that can be integrated in science and mathematics concepts, art activities, free play or structured play activities can be presented to preschool teachers to adapt in their classrooms.

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Appendix 1: Presentation flow of content for the workshop/course

1 hour – Algorithmic thinking and samples in ECE
1 hour – Unplugged coding and platform-game samples in ECE
1 hour – Unplugged coding and samples with Beebot and Cubetto
1 hour – Block based coding and introduction of ScratchJr user interface (project types and command blocks)
1-hour – Sample projects with ScratchJr (collage, story, and game)
1 hour – Interactive hands-on implementations of ScratchJr on tablets

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