Journal of Education and Literacy Studies

e-ISSN: 2811 – 4736
Volume 2 Number 1 February 2023, 41 ~ 55
DOI: https://doi.org/10.37698/jels.v2i1.194

Innovative ICT Education in Early Childhood: Building Young Talents for The Digital World

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ARTICLE INFO

Article history:

Received Jan 11, 2022
Revised Jan 31, 2023
Accepted Feb 1, 2023

Keywords:

Innovation,
Fourth Industrial Revolution,
Digital Education,
Coding,
Teacher Education,
Future Skills

Conflict of Interest:

None

Funding:

None

ABSTRACT

In the fourth industrial revolution, growth and value creation are thought to happen through innovation, adaptation to change and flexibility. Human capital is a critical factor that drives innovation ecosystem formation. To be part of this future, children must learn early to actively engage in innovative ideas through critical thinking, problem-solving and systems analysis, all of which are in high demand in the labour market in coming years. Online digital education that includes coding can help facilitate experiences for children that allow them to contextualise learning within an innovative environment.

Even though Finland is a leading country in the world regarding digital performance and competitiveness, Finnish experts stress the growing need for future skills for working life: knowledge of sustainable development, digitalisation, and continuous learning. Experts stress that digital education starts at a young age. Finland's child-centred early childhood education system is one of the most impactful benefits for society. Playful methods for developing mathematical thinking, verbal and social skills embedded in multidisciplinary creative activities and creating equal preconditions for every child's holistic growth are at the centre of the national curriculum.

Removing different physical or psychological barriers to learning leads to better utilising the potential lying in society. Kodarit-method concentrates on the premium educational segment, which includes high-quality teaching skills for teachers, a carefully planned curriculum, and a motivational pedagogical approach. This enables professional growth and provides skills for students, who are the centre of the pedagogical model. All the top organisations, including Kodarit Coding School in Finland, cooperate in developing these areas efficiently by sharing knowledge and examples of best practices and building a tech sector, society, and world where no one is left behind.

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1. Introduction

1.1 Fourth Industrial Revolution

In the fourth industrial revolution, growth and value creation are thought to happen through innovation, adaptation to change and flexibility. To obtain a competitive advantage in an economic context that is in a constant state of change, the ability to generate and adopt new ideas, concepts, processes and eventually products is essential, also at a country level (Schwab, 2018). Human capital is a critical factor that drives innovation ecosystems' formation (Jackson, 2011; Suseno et al., 2020). To enable the creation of future human capital and productively contribute to a future economy, children must develop the skills necessary to generate new ideas and turn those concepts into viable and adoptable solutions, products, and systems.

1.2 Future Skills

To promote the creation of innovation, specific skills, and traits, such as curiosity, creativity, critical thinking, problem-solving and system-level analysis, should be cherished, encouraged, and trained (OECD, 2011). These skills are also predicted to be in high demand in the labour market shortly (World Economic Forum, 2020). Part of improving and acquiring these skills is the adaptation of the learning styles towards more active techniques instead of passive ones. This includes active engagement with learning materials and critical analysis of the current situation. Furthermore, these skills can be improved early through playful learning, including structured and unstructured play activities that encourage curiosity, accessible exploration of solution space and learning through trial and error (Zosh et al., 2017). The adoption and application of playful learning can happen through formal and informal education. For example, in Finland and Estonia, it has been widely incorporated into early childhood education and essentially forms its basis (Dickinson, 2019).

1.3 Coding Education

Online tools, coding games and education incorporating them can allow children to channel their creativity in novel ways and provide them with experiences related to learning that are part of their worlds. This creativity can be combined even with design and engineering fields by bringing in suitable software tools (Dassault Systèmes, 2019). As these approaches differ significantly from the traditional top-down approach to teaching but are, on the other hand, required to foster innovation and promote creativity, a shift in instructors' and teachers' attitudes and skills is also required. The teachers need to take roles that resemble the role of a coach, mentor, or facilitator to enable this change. The Kodarit Finland Education Model is an excellent example of an innovative pedagogy approach for impactful learning.

2. Literature Review

2.1 Finnish ICT Education Model

Finland's strong position as a leading country in the world regarding digital performance has been verified for several years by the European Commission's Digital Economy and Society Index (DESI) (Valtioneuvosto, 2022). In addition, Finland ranks very high in wireless and mobile connectivity, digital representation of companies (OECD, 2017), and support for digital enterprises (Bannerjee, 2016). Notably, the proportion of employed people working as ICT specialists is high, at 7.4%, as is the share of SMEs with at least a basic level of digital intensity (82%) and the percentage of companies utilising cloud solutions (66%) and integrating AI technology into their operations (16%) (European Commission, 2022). However, even though 80% of the population is equipped with at least basic digital skills, Finland still needs to increase the percentage of ICT specialists in employment and the share of ICT graduates. In Finland, a relatively small country, this translates to more than 130 000 experts in total, 13 000 a year to hold up the promise of the economic growth and well-being enabled by the digital-green industrial transformation (Technology Industries, 2021).

Finnish experts from the work, education, and training sectors highlight the changes in competencies needed in the long term and have identified digital, information evaluation and problem-solving skills together with knowledge of sustainable development as crucial development targets for future labour markets by 2035 (CEDEFOP, 2019). The students who manage these skills are predicted to be prospective change agents with a positive impact on their surroundings and the ability to influence the future through understanding others' intentions and actions (OECD, 2018). To be ready for the future, students will need both broad and specialised models, which can be seen as an analogy of the T-shaped skill set favoured in computing for several decades (Guest, 1991) and more recently highlighted as a success factor in a data science field (Fiore-Gartland & Tanweer, 2016).

The development of Finnish society, the Finnish model, has already shown that it is possible to advance from a relatively poor agricultural country to a high-tech country without abandoning the welfare state by applying similar skill sets (Himanen, 2014). Education can be a tool in this transformation and can be transformed as a part of the process, leading to change and sustainability (Wolff et al., 2022). To achieve this, the Finnish Ministry of Education has outlined that teachers' education should anticipate future needs, based on research, continuous and collaborative, promoting leadership competence (Ministry of Education and Culture, 2022).

Finland's education system is very successful in skill development, demonstrated by the top-level results of the Programme for International Student Assessment (PISA) since its start in 2000 (OECD, 2019). This translates to one of the highest levels of literacy and numeracy in the adult population within the OECD. This is also visible in the success of continuous education, i.e., many continue learning throughout their life, and two-thirds of the adult population participate in formal or non-formal learning activities every year (OECD, 2020). This capacity for continuous learning will be essential shortly as globalisation and technological change drive the change in the labour market, and people already in it are affected (OECD, 2020). Providing opportunities to obtain new and alternative skills will help to maintain the economy and well-being. However, when facing a larger shift in the operating environment, sufficient resources mean to produce competence and efficient steering mechanisms are needed to drive this systemic change (Sitra, 2022).

Even though Finland is well set up for these challenges, many countries and economies have different levels of quality education. Millions of children and youth need the necessary tools to realise their full potential (Zhongming et al., 2019) and, e.g., only half of all children in pre-primary-age around the world participate in Early Childhood Education and Care (ECEC), so teachers need more quality There is a worldwide shortage of ECEC teachers (UNICEF, 2019). This is particularly relevant with the emergence of Industry 4.0 and the requirements, i.e., understanding of automation, big data, and artificial intelligence; it imposes on the workforce. To address the twofold challenge of providing access to high-quality education and reforming education to allow people to thrive during this rapid change in the operating environment, continuous learning and mobilisation of global expertise and collaboration are needed (Zhongming et al., 2019).

2.2 Underlying Theories and Concepts of Learning

The theory of constructivism describes how learners construct knowledge from their experiences (Mascolo & Fischer, 2005) and have been the basis of many recent Finnish education practices (Kivelä & Siljander, 2013). In education, literature constructivism is also often associated with pedagogical approaches that promote active teaching (Behling & Hart, 2008) and active learning, or learning by doing (Hackathorna et al., 2011). Cognitive constructivism theory (GSI Teaching & Resource Center, n.d.; Piaget, 1964) suggests that learners actively construct knowledge based on their existing cognitive structures, which makes learning relative to the learner's stage of cognitive development (Barrouillet, 2015). The teaching methods connected to these theories suggest that teachers should help students assimilate new information to existing knowledge, allowing students to restructure their intellectual framework to proceed with the data (Baviskar, Hartle, & Whitney, 2009).

Recently more and more education specialists have been showing to expand their perspective from developmental constructivism to sociocultural theory, which has become an increasingly popular theoretical explanation for the development and learning in early childhood education (Edwards, 2007). One of the most popular learning theories in Finnish education is the socio-constructivist approach (Hämäläinen & Eriksson, 2016) which emphasises the importance of the learner being actively involved in the learning process (Palincsar, 1998; Fischer, 2005; Amineh & Asl, 2015).

Social constructivists consider learning as a social process (Hickey, 1997). It has been inspected from various angles in Finnish education literature (ETW, n.d), for example, in interaction and children's thinking and actions in problem-solving (Järvinen & Twyford, 2000), teaching and programming (Hiltunen, 2016) and in phenomenal learning (Symeonidis & Schwarz, 2016; Lonka, 2018). As Finnish education professionals in general, Hilppö, Vartiainen and Silander (2022) believe that the Finnish child-centred pedagogics and opportunities for personalisation in education are most relevant from the perspective of STEAM education and fostering 21st-century skills. Personal learning skills and techniques are strongly connected with the outcomes, but these skills must be adequately measured to have the correct information (Hoskins & Fredriksson, 2008). The students are then individually supported to strengthen these skills, which leads us to another central Finnish education concept, inclusion, which means offering similar opportunities for all learners, despite their need for additional support (Kivirauma, Klemelä, & Rinne, 2006; Jahnukainen, 2015; Sundqvist & Hannås, 2021).

The Finnish pedagogical approach has developed over decades and involves several concepts that strengthen the quality of education (Kortekangas, Paksuniemi, & Ervast, 2019). For example, ' learning to learn (Hoskins & Fredriksson, 2008) and 'cross-curricular knowledge, skills, and attitudes are understood as primary cognitive and affective elements when individuals apply their existing skills to novel tasks and new learning (Hautamäki & Kupiainen, 2014). The Finnish Learning to Learn Framework (Hautamäki et al., 2002; Hautamäki & Kupiainen, 2014) was conceptualised by the Finnish National Board of Education and the City of Helsinki Education Department and further developed at the University of Helsinki.

Also, motivation has been shown to affect performance (Brackney & Karabenick, 1995) and to have a strong connection in promoting and sustaining self-regulated learning, which can be achieved by adopting mastery and relative ability goals. Similarly, positive self-efficacy and task value beliefs can promote self-regulated behaviour (Pintrich, 1999), affecting learning results. Playful methods and play-based learning are popular to awaken motivation and interest, especially in early childhood education (Ferreira, 2021). Recent studies show

how play has remarkable benefits for early learners and should be considered an essential classroom activity (Moore et al., 2014; Kangas et al., 2019; Ferreira, 2021). The concept of play covers different meanings: child-centred free play, collaboratively designed play, and teacher-directed play that happens with games and playful learning situations (Marston, 2021). At the same time, gamified solutions are becoming more common in teaching older students and are used widely in any school subjects (Shernoff, Hamari, & Rowe, 2014; Majuri, Koivisto, & Hamari, 2018; Felszeghy, 2019). One central concept to strengthen motivation and sustainable learning is positive pedagogy. Positive pedagogy aims for well-being and learning-based activities based on positive interaction and participation. Avola and Pentikäinen (2019) report results in well-being, rewarding social relationships, successful self-management, and positive learning outcomes (Ranta & Hyvärinen, 2022). Well-being in this context is a dynamic process including control of one's life, covering feelings, needs, goals, psychological capital, and a meaningful social environment (Ranta & Hyvärinen, 2022).

2.3 Early ICT Education for Children

2.3.1 Digital skills

STEAM education is a discipline that involves multiple elements of the concept of learning to learn, especially of the mastery of thinking. Traditionally STEAM brings together content, knowledge and hands-on skills from science, technology, engineering, arts, and mathematics (Martín-Páez, Aguilera, Perales-Palacios & Vílchez-González, 2019). Computer programming integrates the elements of STEAM and makes it an urgently needed school subject around the world (Tuomi et al., 2018). Learning the skills related to coding is essential, but what is even more important is what students will learn to do after they understand how to code (Tuomi et al., 2018)-being able to think like a programmer offers skills that help children to work with interdisciplinary problems, solving various types of tasks and innovate new solutions based on the available information (Scherer, Siddiq, & Sánchez-Scherer, 2021). Furthermore, STEAM education's inquiry-based nature requires environments that allow open and creative task completion (Minner, Levy & Century, 2010).

To productively contribute to the digital economy, children must learn at an early age to actively engage in innovative ideas through critical thinking, problem-solving and systems analysis, all of which are predicted to be essential in the labour market in future. Online digital education that includes coding can help provide children with learning experiences that allow them to associate and contextualise learning with an inspiring and innovative environment. Notably, even as coding can be studied as a problem-solving mechanism in any domain (Bers, 2019), computational thinking and coding are not just problem-solving process skills, but they also provide children capability to communicate their thoughts which supports their cognitive development, and social preparedness, emotional intelligence and affects positively into their language development (Sullivan & Umashi Bers, 2017; Strawhacker, Lee & Bers, 2018; Sheehan et al., 2019). However, it is worth noting that although the freely available coding apps have positively impacted children's computational thinking skills, they alone are insufficient to produce computational fluency (Papadakis, 2021).

Furthermore, even if children often seem to be more capable with technology than adults, guidance is needed to enable the use of technology responsibly and positively, in which schools can have an essential role by implementing safe and sustainable policies (Burns & Gottschalk, 2019; 2020). The major challenge lies in reducing negative uses of technology, digital devices, and the Internet while enabling their efficient use and contributions to teaching, learning and social connection. To allow this, children should also learn how to avoid and manage the related risks, supported by the schools and education system (Graafland, 2018). Higher levels of digital skills have been found to support that (Leslie et al., 2020). Furthermore, more excellent digital skills are linked to better learning outcomes. Parents also have an essential role in this framework as it has been found that their restrictive mediation is linked to children's lower digital skills, whereas enabling mediation and broader access to ICT links to better skills (Leslie et al., 2020). Further studies have shown a positive association between digital skills and identification and exploitation of online opportunities, benefits gained using and obtaining information, and positive orientation to technology in general (Livingstone et al., 2021). Particularly information skills were linked with positive outcomes for young people.

Following this, starting digital education at a young age is essential, as children use the technologies earlier. Countries worldwide have started introducing computing into their national curriculums and developing computational thinking skills in young children is attracting more attention (Strawhacker, Lee & Bers, 2018). However, even though digital skills may be considered the new literacy (Bers, 2019), they are generally perceived as something other than skills like literacy and numeracy. Access to technology or learning can be uneven and inequitable; digital skills are not often integrated into educational curricula, teachers need more training and support, and support for continuing education needs to be included (Donoso et al., 2020). The need for professional development of educators and lifelong learning in the workforce has also been identified in Europe (Braun et al., 2020).

2.3.2 Finnish early education model

The early childhood education (ECEC) system in Finland, which includes daycare offered to families and good quality and safe early childhood education, is a working example of a system where learning can be skill-oriented before primary education. In short, the Finnish ECEC prepares children for school. However, in addition to that, it provides them with the required future knowledge and skills such as self-efficacy, resilience, learning-to-learn skills, happiness, and holistic well-being (Kangas, Ojala & Venninen, 2015). It is also seen as a starting point of lifelong learning. It follows the so-called "Educare" principle, where the focus is simultaneously on education, teaching, and care as foundations for pedagogical activity. This pedagogical approach is rooted in learning and development as holistic experiences (Salminen, 2017).

The 21st-century skills are included in the Finnish ECEC, like higher levels of the national curriculum. As the role of multiliteracy and ICT competencies is increasing in children's life, practising ways to act in digital environments is included in the tasks of ECEC (Finnish National Agency for Education, 2022). Science, technology, engineering, arts, and mathematics (STEAM) and phenomenon-based learning advocated and implemented by the Finnish system hold a crucial role in achieving this (Hilppö, Vartiainen & Silander, 2022). These disciplines are introduced to the children through playful methods, and play-based learning and teaching provide motivational and practical learning opportunities (Kangas et al., 2019). Importantly, play-based, and gamified methods can also be successfully applied to learning ICT and computational thinking (Roscoe, Fearn & Posey, 2014; Kazimoglu, 2020). On the other hand, this sets high requirements for the up-to-date competencies of the teachers and educators, particularly as the play's meaning is understood poorly globally in teacher education (Ashari & Binti Hushairi, 2018).

The relationship between the child further emphasises this and the teacher affects the learning outcomes (Furrer & Skinner, 2003). The interaction between adults and children in the learning situation affects the development of a child's self-image as a learner (Ata, 2015). The teacher-and-parent relationship further shapes learning and development (Petrovic et al., 2019). To tackle these issues, positive pedagogy is central in the Finnish ECEC to build interpersonal trust and a safe learning environment. Good relationships and two-way communication between involved individuals form the basis for higher well-being and increased willingness to participate in activities for children, positively affecting their long-term development (Bethere, Pavitola, & Ulmane-Ozolina, 2014; Pietarinen, Soini, & Pyhältö, 2014).

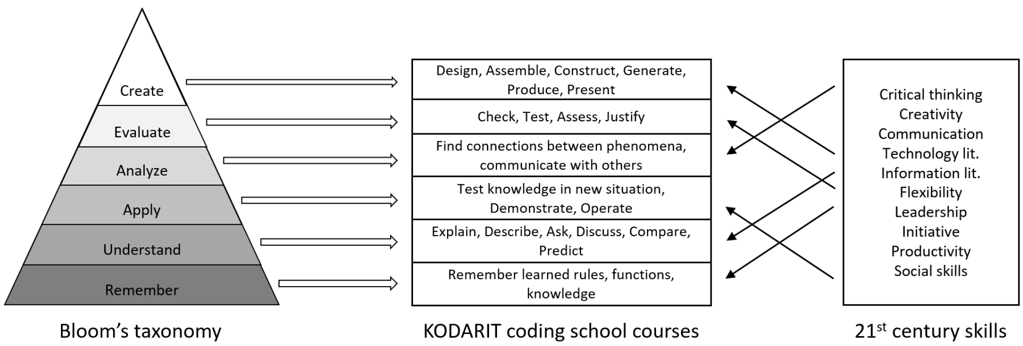
3. Method

3.1 Implementing Effective Method for Learning 21st-Century Skills

3.1.1 Kodarit pedagogy model

Figure 1 illustrates the Kodarit Pedagogy Model incorporating Bloom's Taxonomy and essential future skills of the 21st century. Bloom's Taxonomy is a framework for the different learning process outcomes and should be applied when creating course objectives (Krathwohl, 2002). The Kodarit course objectives are short descriptions of the learning results that we expect students to master after the course, and they are aligned with Bloom's taxonomy and 21st-century skills (González-Pérez, & Ramírez-Montoya, 2022). The idea of listing learning objectives is to conceptualise and make them transparent so they can be discussed, reflected on, evaluated, and processed further.

Figure 1. Kodarit Pedagogy Model

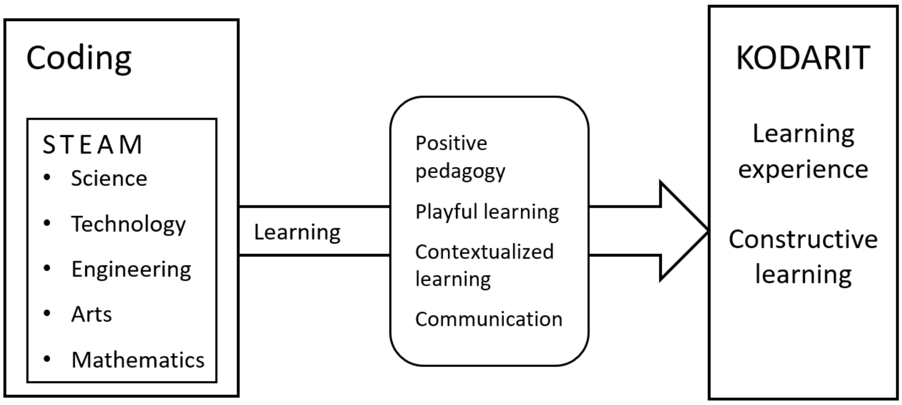


Description: Kodarit coding course objectives align with Bloom's taxonomy (Krathwohl, 2002) and 21st-century skills (González-Pérez, & Ramírez-Montoya, 2022). This ensures logical pedagogical progression that enables efficient, aligned, and constructive learning and a positive impact concerning the skill set required under the industry 4.0 paradigm.

3.1.2 Baby Kodarit education model

Figure 2 depicts the Baby Kodarit Education Model, built based on the need to learn STEAM skills incorporated into the coding teaching, and which utilises the pedagogical and scientific basis of the Finnish ECEC system.

Figure 2. Baby Kodarit Education Model



Description: Baby Kodarit Education Model embeds the teaching and learning of STEAM skills within coding lessons and education. This, together with carefully designed communication, enables learning STEAM skills before primary education through positive pedagogy, playful learning, and contextualisation adapted from Finnish ECEC, creating a constructive learning experience at Kodarit lessons.

3.2 Baby Kodarit Education Program

The current research describes how there are three different approaches to learning coding skills: 1) coding can be learned in formal settings such as schools and within their curriculum; 2) in non-formal settings, e.g., using online resources or in after-school clubs; and 3) by participating informal events such as hackathons and jams (Tuomi et al., 2018). Schools also often use the two latter options, i.e., they promote participation in coding events and use materials created by private companies, governmental actors, or other non-profit organisations—more than these materials are required for good quality coding education. The Baby Kodarit Program is an educational product designed to test how peer-reviewed, multidisciplinary knowledge and existing education materials could be utilised effectively in global ICT and coding teaching. The main goal was to create a program to help students develop skills to adapt, explore and apply information in an evolving and fast-paced environment, which is needed in the 21st century. Baby Kodarit was created in Finland by the most prominent local private coding school for children and young people, Koodikaverit Oy.

Often much attention is focused on making the learning situation visually appealing for the children. Pugnali, Sullivan & Bers (2017) note that even though the type of user interface is essential to children's learning, it is still only one factor that positively affects their academic and socio-emotional experiences. The Finnish national curriculum for early childhood education describes how play, exploration, physical activity, and arts and skills promote children's creativity, participation, and learning (Finnish National Agency for Education, 2018, p. 58). While creating the Baby Kodarit programme, the primary principle was to offer practical, motivating and content-wise versatile information technology lessons for 5-8-year-old children globally and embed many good quality ECEC factors into the curriculum. Examining various learning standards for computer science, science, maths, technology, and language gave us a good understanding of the current demands pedagogically (Computer Science Teachers Association, 2017; Common Core State Standards Initiative, 2022a; 2022b; 2022c; ISTE, 2022; Next Generation Science Standards, 2022; SmarterBalanced, 2022). In addition, we researched the trends of working life. We discussed these topics with experts from the higher education and technology sector to gain a deeper understanding of the needs in society.

4. Results and Discussion

4.1 Baby Kodarit Programme

Utilising the previously presented theories and concepts, a course called Baby Kodarit was implemented with 60-minute weekly lessons for 15 weeks. The underlying values of this course are based on research on sustainable development, inclusion, and well-being (Gottschalk, 2019). Theoretically, it has been inspired by cognitive and social-constructivist teaching methods (Kalina & Powell, 2009) and a wide range of Finnish education literature. Awareness of the lack of teachers, teachers' education and knowledge about information technology was our first challenge (Derbel, 2016; Wu et al., 2020). Creating an effective learning platform would only be helpful if children had someone to teach them.

For this reason, we also created teacher training around the method. The second challenge we faced was reflecting on the rapidly changing needs and technology development in lessons. As a solution, we divided the lesson structure into five parts that are independently reviewed and renewed when necessary. The lesson structure follows this order:

1. Orientation
2. Basic computer usage skills
3. Information and knowledge
4. Coding exercises
5. Ending

4.1.1 Orientation

The orientation part includes active communication with children. Research shows that the participative orientation of children is strongly connected with creative thinking abilities, but it is rare in social situations concerning adults (Nikkola, Reunamo, & Ruokonen, 2022). Therefore, communication is given much attention in Kodarit teachers' education materials and workshops. For example, starting the lesson by asking about the students' positive impressions of previous sessions supports the classroom orientation stage. We realised that recalling what children have learned in previous lessons will help increase the excitement for the exercises and learnings you will introduce. In Baby Kodarit, we also successfully tested the effect of Class Dojo (https://www.classdojo.com/) to activate children at the beginning of the class and to increase communication. Good interaction skills promote the work of teachers in many fields. They improve the relationship between students and teachers and support teaching effectively and forward-looking. Communication is one of the most critical areas of expertise for coding teachers, so their practice and adoption in coding education cannot be underestimated. With his example, the teacher enables the examination and practice of communication, and the teacher's role model should be remembered in the students' eyes. Interaction skills, such as meeting a colleague or client in each practical internship, are also crucial in the university teaching curriculum. During teacher training, reflection notes or other reflection methods are used, based on which the student can review his or her learning and build new information based on previous knowledge. Based on the experiences reflected by the student, the training supervisor can engage in a dialogue with the student, thus developing learning and promoting the training by its goals. Interaction and reflection skills, such as problem-based learning and orientation exercises, are also practised in collaborative learning environments.

4.1.2 Basic computer usage skills

The second part of the Baby Kodarit lesson, the 'Basic computer usage skills', includes a set of exercises and tasks that help children to become fluent users of computers, keyboards, mouse, and other relevant ICT tools. Two Baby Kodarit characters accompany children through the exercises. Playful and exciting tasks guide children to master the essential functions of computers and programs and create a solid base for their technological self-efficacy and correct vocabulary. Various ICT equipment is part of the children's study paths, and students can become familiar with digital devices and services in a safe environment. This part is based on an understanding of education through constructivism in computer science education (Ben-Ari, 2001), developmental psychology (UNICEF, 2014), and play and gamification theories (Bers, 2018; Kazimoglu, 2020). The exercises support children's independence, and when applicable, we let them explore the choices and content in activities, increasing their motivation and self-confidence (Kohn, 1993; Liquin & Gopnik, 2022). In Kodarit teacher education, teachers are encouraged to find a personal approach to teaching these classes using their strengths and sharing their experiences with their peers in a closed Discord chat channel or Moodle learning area. This will motivate teachers to increase their everyday communication and improve their teaching techniques and innovation-related actions based on growing knowledge of children's development, learning, agency, and well-being.

4.1.3 Coding teaching

The third part is an informational 15 minutes in which coding and computer-related terminology, concepts and functions are taught utilising storytelling methods and Kodarit characters. From research, several educational and didactic aspects were picked that characterise the good practices of digital storytelling in preschool age (Contini et al., 2018; Merjovaara et al., 2020; Rahiem, 2021). Critical Thinking is emphasised in this part to strengthen analytical skills, as strong critical thinking abilities have been shown to enable innovation and ideation leveraging logic and reasoning (Cambridge Assessment International Education, n.d.; Shively, Stith, & Rubenstein, 2018). Teachers are advised to try to resist the urge to fix the problems for children as it can take away children's sense that they are capable problem solvers but rather help them to find the solutions together with leading questions. During this session, teachers also discuss with the children the safety factors related to the internet, tools, and games, such as age limits and online codes of conduct using age-appropriate concepts and language. This part is called cybersecurity lessons which also includes a short physical exercise or stretching moment every time to increase the awareness of well-being and healthy desktop working style. For this part, the teacher education includes many materials to ensure the adults have broad background knowledge of the themes.

4.1.4 Coding learning

The fourth part, 'Coding exercises,' allows children to test coding and learn using visual methods. Children's interests were considered when choosing the combination of exercises that also reflect the current trends of technology and skills needed in study and working life in a child-appropriate way. In this part, we use play and experiences connected to media, games, and apps. The exercises allow the children to practice their problem-solving skills through interaction with teachers and other children. The sequence of different exercises is built to keep up with the typical attention span abilities of preschool-aged children (Mahone & Schneider, 2012; Nutbrown, 2018) by providing many challenging activities, such as maths games with more than one way to solve a problem. The selection of exercises was justified pedagogically and verified to be age and content appropriate. Creativity is one of the critical skills of today, and Baby Kodarit students are taught to use digital equipment to support creativity and as means of self-expression. The chance to experiment and produce content with other children promotes children's creative thinking, collaboration, and literacy skills. In lessons, children are encouraged to produce digital material by coding, innovating, or drawing. Digital methods are utilised in exercises, exploration and physical activity, artistic experience, and content production. Children's creations are studied together in the classroom and can be presented to others. Giving children positive feedback throughout the lesson is essential as praising the problem-solving process and encouraging them to keep trying.

4.1.5 Ending

The fifth part, 'Ending', summarises all the learnings of the lesson. Children are encouraged to reflect on the lesson with the teacher and their peers. The teacher assigns points for persistence, collaboration, and active participation. The class ends happily, and the teacher steers the children to their parents.

After the children have left, the teachers document their observations during the lesson. Pedagogical documentation is crucial for planning, implementing, evaluating, and developing child-centred ECEC (Helsingin Kaupunki, 2020). Based on their documentation, the Kodarit teachers discuss, evaluate, and reflect on the needs and challenges together to develop the lessons further. When applicable, the teacher may also involve the students in evaluation by interviewing them or providing a visual user experience survey.

Teachers of Baby Kodarit are offered an extensive amount of information, guidance, and support to run the lessons efficiently. In teachers' education, the teachers are taught that by appreciating a student's efforts, a student will learn that working hard and persisting are positive behaviours. Later in their lives, the students will have more complex problems ahead of them. They need to learn that it is okay to look for answers with others; it is part of the practical and successful learning process.

They are offered visual materials in digital form to guide the classes and given a detailed lesson description which helps them follow the lesson structure. Ideas for discussions and tips on how to activate children are included. Also, advice for challenging moments is included. As distance learning has become one of the options for classroom work, all the Baby Kodarit lessons are also instructed to be run in online and hybrid versions. This will increase the opportunities for education in various environments and situations.

4.2 Discussion

Today digital devices and programs are part of everyday life, even for children. Therefore, digital education should start at a young age. Several countries worldwide have already started introducing computing into their national curriculums and developing computational thinking skills in young children is attracting more attention. Digital skills may be considered the new literacy by many. However, they still need to be globally perceived as a right, compared to skills like literacy and numeracy. The teaching resources and methods are lacking as access to technology, or learning is often uneven and inequitable, digital skills need to be integrated into educational curricula and other school subjects, and teachers need more training and support. The support for continuing education needs to be included.

Finland's strong position as a leading country in the world in digital performance has been demonstrated during the last decades. However, nevertheless, the search is ongoing continuously for solutions on how to stay up to date with the rapid development and changes in the digital world. This requires multidisciplinary discussion and active communication between different stakeholders globally. One of the strengths behind Finland's success is education and the national desire for continuous learning. These proven success factors and extensive and verified pedagogical research base were used as a starting point for creating a new coding education programme, Baby Kodarit, for 5-8-year-old children. The pedagogical model's theoretical background, development, piloting, and the resulting program have been described above.

In the program, combining coding and STEAM education happened through exercises that were chosen to cover various basic computer usage skills and coding. Some concepts, such as binary numbers, were considered difficult to understand and, therefore, treated, e.g., as a playful "secret code". This was proven successful as it needed to be used only at the beginning of the class. Children began first by solving the secret code. Later, the students started to create secret codes using the same binary numbers, demonstrating the efficiency and applicability of playful learning. In addition, children were also offered more manageable art tasks that allowed them to have a creative break from the more intensive thinking, counting and problem-solving, which helped them to maintain their motivation throughout the lesson.

Children's academic competence and experience varied greatly as they were 5–8 years old during the pilot phase. Interestingly, it turned out that the younger children also enjoyed and could follow the curriculum if they were offered sufficient support and help. Open discussion with parents and children about their experiences allowed us to develop and realise the parts that needed extra attention, especially with the 5-year-old students. Based on these findings, the exercises were split into different skill categories. The fact that younger children often could not read or do sums had to be understood and considered by the teachers, who could then offer children teaching at a slower pace and choose the beginners' level exercises. In teacher education, we stress that motivation must be kept up, and all the children need to feel competent and experience success during the lessons.

Embedding an extensive amount of communication to the teaching turned out to be highly important for multiple reasons. First, the younger children express their ideas enthusiastically, which helps the teachers understand their learning stage, which further allows individualising the teaching. The teacher can repeat instructions and explanations further, correct some misunderstandings multiple times, if necessary, and take the learning to the next level if it turns out that the child can apply the knowledge smoothly. Second, discussing the topics with the teacher and other students created a great team spirit and supportive atmosphere. For example, as the two Kodarit characters were having challenges during the story-based parts of the lesson with the exercises or with their self-esteem, the children were eager to come up with solutions. This seemed to help the children accept the disappointment when they were struggling with the exercises and inspired looking for answers with various techniques such as analysing, testing, and exploring.

Playful methods, including stories, visual elements, and exciting and varying gamified elements throughout the lesson, helped the children to concentrate during the 60-minute lesson. Every lesson included a stretching break which allowed the little students to stand up and have some physical exercise that they found amusing and allowed them to show off their physical skills as well. Ideally, more physical activities could be added to the teaching in general. However, as this pilot was implemented in a hybrid mode, some development ideas were left for further testing with the entirely onsite class model.

The Baby Kodarit focuses on creating strong basic skills for young students and strengthening their multiliteracy preparedness. This also requires various skills from teachers: they must be competent in communication, coding, pedagogical approaches, and collaboration. Therefore, teacher education should always be included in the program before teachers try to teach such an extensive material set alone. Support from colleagues and sharing experiences allows continuous learning that leads to professional and mental growth and increases the feeling of belongingness, translating to a more straightforward implementation of positive pedagogy and playful learning, creating better learning experiences.

5. Conclusion

Initially, Baby Kodarit was a pilot to test if it is possible to create a practical coding school concept for 5–7-year-old children by using the theories and methods of contemporary early childhood education methods and combining this knowledge with STEAM education and the targets of 21st-century skills. From the process described in this work, we can conclude that the pilot of the Baby Kodarit was successful, and today the method can be applied globally. To implement this, we recommend translating the materials into the local language to support efficient and sustainable learning. Our next goal is to collect global user experience data from the Baby Kodarit method and develop it further to offer all learners a fun, motivating and efficient start for the 21st-century challenges. The Baby Kodarit method also includes teacher education, and the concept is suitable for use in school education, extracurricular activities and science learning classes offered by universities.

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