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Perspectives on the Finnish Early Years STEAM Education: Reflecting on the Avant-Garde

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Abstract

Skills needed to live in our current societies are rapidly changing. How will we provide children with the skills they will need in the future? While early years education has been traditionally strong in supporting 21st century skills like creativity, collaboration and problem-solving within play, new demands such as fostering digital skills and computational thinking challenge current practices and methods and call us as researchers and educators to urgently rethink and re-design how such skills could be advanced in early childhood education.

Over the recent years, the Finnish educational system has enjoyed intense national and international attention, and the Early Childhood Education and Care sector along with it. This has resulted in multiple descriptions and attempts to characterize its main differences from other national systems. The Finnish early years education has been heralded, for example, for its holistic orientation to children's care, and education as well as its focus on playful learning approaches and participatory culture. However, despite these positive characterizations and the arguably great potential of the Finnish pre-primary education for offering children with rich opportunities to engage in STEAM (Science, Technology, Engineering, Arts and Mathematics) learning, early childhood educators are still cautious to implement STEAM and phenomenon-based learning.

In this chapter, we will present three distinctive approaches to early STEAM education developed in Finland, namely 1) phenomenon-based learning, 2) children's maker-spaces and 3) children's projects. In addition, we will also discuss and draw out suggestions on how these approaches could potentially address the above concerns regarding Finnish early years STEAM education.

The Finnish early years education as a context for children's STEAM education and 21st century skills

Over the recent years, the Finnish educational system has enjoyed intense national and international attention, and the Early Childhood Education and Care (ECEC) sector along with it. This has resulted in multiple descriptions and attempts to characterize its main differences from other national systems (eg., Hujala, et al. 2009: Einarsdottir, et al. 2015). However, in her recent review Kumpulainen (2018) argues that the Finnish system does not have any one element that makes it unique. Rather, the merits of the Finnish ECEC lie in several intertwined values that permeate the different ECEC services and the educational system as a whole. According to Kumpulainen, these values are 1) the system's principled nature, i.e., the way in which education and care are embedded within the Nordic social welfare state model and its legislation, 2) mutual trust between families, the government, educators and children, 3) child-centered pedagogics and 4) the opportunity to personalize and build individualized support for children’s learning and development.

Although these values work in concert, we believe that the last two (child-centered pedagogics and opportunities for personalization) are most relevant from the perspective of STEAM education and fostering 21st century skills. Various definitions and frameworks for 21st-century skills (Trilling and Fadel 2010) have been used as a base for defining transversal competencies. In addition to these traditional 21st century skills frameworks, the new skills like computational thinking (Wing 2006; Denning & Tedre 2019) and computational creativity are needed to understand the role of digitalization and Artificial Intelligence (AI) in everyday life in our modern society. In order to understand and become an active member of the digital society utilizing widely AI, the holistic STEAM education in ECEC plays a crucial role.

We will elaborate this argument in the following paragraphs. In doing this we will approach STEAM education from a particular perspective that needs to be elaborated first. For us, STEAM education connotes a pedagogical approach that integrates content and skills specific to science, technology, engineering, arts and mathematics (Martín-Páez, Aguilera, Perales-Palacios & Vílchez-González, 2019). STEAM education connects science, technology, engineering, arts and mathematics into a meaningful combination of disciplines integrated into the one educational experience (Martín-Páez, et al., 2019). By merging science, technology, engineering, arts and mathematics into a seamless entity, teachers can provide children with possibilities to build their understanding of authentic scientific phenomena as they emerge in a child's life. STEAM offers a scene in which children can work with interdisciplinary problem-solving tasks and innovations from their own starting points. Hence, STEAM shouldn't be treated as a pedagogical approach that combines disciplines of science, technology, engineering, and mathematics, but STEAM should be treated as a meta-discipline created from science, technology, engineering, arts and mathematics (Kaufman, Moss, & Osborn, 2003). Consequently, STEAM becomes more than a sum of its factors. Meta-discipline thinking of STEAM opens up STEAM education to implement practices that develop children’s 21st century skills. Moreover, STEAM education adapts inquiry-based learning practices (Minner, Levy & Century, 2010) which require openness from the learning environments and tasks. We also think that STEAM education should be nested in authentic problems or tasks that arise from children’s everyday observations or wonderings. Importantly, in early childhood education settings, STEAM education doesn’t necessarily require integration of all disciplines. Rather, following Tippett and Milford (2017) we think that the integration of two disciplines can be counted as STEAM education in so far as the aspects of authenticity, children’s agency and inquiry-based practices are present.

The child-centered nature of Finnish ECEC makes it poised to support this type of STEAM education. In the opening statements of the current National Core Curriculum one of the main goals of ECEC is outlines as “to promote children's holistic growth, development and learning in collaboration with their guardians” and that “Knowledge and skills acquired in early childhood education and care strengthen children's participation and active agency in the society” (Finnish National Agency for Education, 2016, p. 12). Later, when discussing learning in ECEC settings more specifically, the curriculum states that “In early childhood education and care, the previous experiences of children, their interests, and their competences are the starting point for learning.” and that the curriculums’ “conception of learning is also based on a view of the child's active agency.” (Finnish National Agency for Education, 2016, p. 18). In practice, this emphasis has meant that children are invited to participate in creating and assessing activities with the early childhood educators and that their interests and lifeworlds are taken as a starting point for the activities (e.g., Alasuutari, Karila, Alila, & Eskelinen, 2014; Kangas, 2016). While these educational policies and guidelines have not always translated into professional practices as such (Kangas & Lastikka, 2019; also Paananen, 2017), the child-centered nature of the Finnish ECEC means that children have both the opportunity and the support they might need for both STEM learning and developing their STEAM interests.

This opportunity and support is further accentuated by the number of structural elements aimed at securing individualized care and support for learning and development. In addition to families having the several options to choose between the type of care best for their child, Kumpulainen (2018) highlights the individualized education plan (IEP) negotiated between the parents, the child and the early childhood educators as an important tool in this regard. The IEP's goal is to act as a formative bridge between the child's current interests, their possible developmental needs and the ECEC curriculum and help tailor the pedagogical practices for each child (Finnish National Agency for Education, 2016). Again, while the IEP's are not always taken into account in everyday practice and can become stagnant documents (Paananen & Lipponen, 2018; Heiskanen, 2019), they do offer a substantial opportunity to bridge children's lifeworlds and deepen the connections between home and pre-primary education. In relation to STEAM education, this means that children's interests in STEAM phenomena can more easily travel between kindergarten and their home.

In addition to these two central values there are also other contributing aspects that make Finnish pre-primary education a formative setting for STEAM education. The Finnish pre-primary education, like in other countries, is situated between early education and care services and elementary education, as such a transitional institution itself, and arguably a mix between the care and play oriented kindergarten groups for 0 – 5-year-olds and primary education with its emphasis on formal instruction. For example, approximately 700 hours per year are used for different pre-primary activities, which breaks down to four hours per day (Kumpulainen, 2018). Although only this part of the day is mandatory for all 6-year-olds, most of them attend for the full day. In addition, in most cases pre-primary education groups are situated in the kindergarten's facilities (Kumpulainen, 2018). This means that the schedule and daily rhythm has room for guided STEAM exploration as well as self-generated activities around STEAM.

Novel Finnish approaches to early STEM education

We will next present three distinctive approaches to early STEAM education developed in Finland, namely 1) phenomenon-based learning, 2) children's maker-spaces and 3) children's projects. In addition to showcasing new ways to engage in STEM education, these approaches importantly also show the way in which the two core values of the Finnish early education and care system we discussed above make possible the development and implementation of multiple mutually supportive pedagogical designs aimed at supporting STEAM interests and learning.

Phenomenon Based Learning as a holistic approach to STEAM

Phenomenon based teaching and learning uses the natural curiosity of children to learn in a holistic and authentic context. It is important for learning 21st century skills like critical thinking, creativity, communication as well as computational thinking. Phenomenon-based learning can be described as multidisciplinary inquiry learning where teaching and learning are based on holistic and authentic topics — not on traditional decontextualized exercises. The key dimensions of phenomenon-based learning are:

- Holisticity: The topics and concepts to be learned are chosen for their relevance in the real world, and a 360° perspective is offered through the integration of traditional school subjects.
- Authenticity: The methods, tools, materials, and cognitive practices used in learning situations should correspond to ones in the real world: for example, in professional life.
- Contextuality: Learners learn new things in their natural context and learn to move fluidly between contextualization and abstraction.
- Problem-based inquiry learning: Learning and collaborative knowledge building are based on the questions and problems posed by learners, and solutions are created by them as well, allowing them to take an active role in designing the curriculum.
- Learning as a nonlinear process: Learning is seen as a nonlinear process, which is activated, guided, and facilitated by open learning challenges and supporting structures.

The basis of phenomenon-based teaching and learning can be found in constructivism, which sees children as active builders and creators of artifacts. Knowledge is constructed as a result of problem-solving and creative production through the integration of little pieces into a comprehensive whole according to the situational needs and the information available at the time. When phenomenon-based learning occurs in a collaborative setting (when the children work together), it supports the socio-constructivist and socio-cultural learning theories (see e.g. Vygotsky 1978), in which knowledge is not just an internal element of an individual. Instead, knowledge is formed in a social context. Socio-cultural learning theories focus on cultural artifacts (e.g., systems of symbols, such as language, and different kinds of thinking tools). These artifacts are basic elements in computational thinking and need to understand digitalization and artificial intelligence (AI).

Phenomenon-based learning begins with the shared observation of holistic, genuine real-world phenomena in the learning community. The phenomena are studied as complete entities in their real context e.g. in the forms of plays, games or maker projects. In phenomenon-based teaching, understanding and studying the phenomenon starts by asking a question or posing a problem (e.g., why does a spider have eight legs?). At its best, phenomenon-based learning is cyclic inquiry learning, where children ask questions or wonder about a phenomenon that interests them and then discover answers and find solutions together. The problems and questions are posed by children together — they are things the children are genuinely curious. Children can create their own artifacts like drawings, stories or animations or construct Lego robots. Digital gaming, simulations and virtual worlds may also be used as a tool to build shared artifacts.

In the learning process, new knowledge and skills are applied to a phenomenon at hand, which means that new knowledge and skills have immediate utility values in the learning situation. This can be well implemented in STEAM projects involving design process, reflection and reasoning done by children. Even complex phenomena, like machine learning (ML) can be studied in ECEC e.g. by the activity where children are providing data sets and exploring ML by teaching computer to recognize emotions by showing facial expressions and gestures to a computer

(Vartiainen, Tedre, Valtonen 2020). The skills learned in the process were not only related to computational thinking but also to socio-emotional skills.

Overall, phenomenon-based learning is suited particularly well for fostering 21st century skills, knowledge creation and computational thinking. This is in part due to its epistemological differences in relation to more traditional instructional approaches. Table 1 below characterizes these differences and contrasts phenomenon-based learning to traditional surface learning and deep learning.

Table 1. The epistemic approach for learning the traditional and transversal skills (adopted Silander et al. 2020) in STEAM projects

	Surface learning	Deep learning	Phenomenon-based learning
Goal	Recalling facts	Understanding	Creating new solutions
Outcome	Capability to apply information only in a narrow context, if at all	Capability to apply knowledge in various situations	Capability to create new solutions for various new situations
Methods	Information acquisition	Collaborative knowledge building	Co-creation and co-innovation
Focus	Facts	Knowledge	Thinking skills and strategies as well as innovation practices

Makerspaces in early STEAM education: Melding STEAM into children's culture

In this section, we will present an approach to early STEAM education that nests STEAM practices into the context of makerspace in kindergarten (Vartiainen & Kumpulainen, 2019). Makerspace approach to STEAM education shares the holistic, cooperative, and authentic approach to STEAM as phenomenon-based learning described in the previous example. In addition it embraces creative, aesthetic and imagination-driven pedagogical principles. Makerspaces are introduced as environments that enable creative and collaborative problem-solving. Makerspaces have been studied as a venue for children to engage in authentic tasks that naturally invite children to solve problems that arise from their cultural spheres by applying STEM skills and knowledge (e.g. Kumpulainen, Kajamaa, & Rajala, 2019; Bevan et al. 2016). STEM education in makerspaces have been studied mostly among primary or secondary school children, while early childhood education has gained only a little attention although the learner-driven nature of makerspaces have a great potential to serve early STEAM education. Vartiainen & Kumpulainen (2019) implemented a Poetry Science project within early childhood education that combined STEAM education with maker activities. Their project underscored the approach to early STEAM that brings in contexts and cultural practices that are closely related to children's life worlds and culture. Mixing cultural practices of STEM into children's culture happens by penetrating the problem-solving process and making with imagination, play, stories and poems.

We will reflect on Vartiainen & Kumpulainen (2019) work and highlight the aspects of the project that aims to strengthen child-centeredness and personalization by looking at how children translate STEAM into their own cultural practices.

The project included a maker activity in which children were motivated by stories, poems and play to experiment properties of air resistance and to construct parachutes to help objects fall at a slower pace. The Poetry Science project was located in a Finnish ECE center and included 28 children aged 3–5 years old and their teachers. The problem-solving task was introduced to children by a puppet play and a related poem.

> *Teacher and the children sit on a floor. Teacher operates a dragon puppet called Hurricane. Hurricane tells children about a wacky incident she witnessed the other day. She has met two funny fishes that were planning to set their home into the tree. But the fishes had a serious problem: They can't fly so they are not able to get to the tree. Hurricane says she wrote a poem about the fishes and she reads it aloud to the children:*
>
> *There once were two little fish,*
> *who still had a lot to learn;*
> *they decided to fly to the moon and see,*
> *if they could build a nest in a giant tree.*
> *Time to go! They swam onto land*
> *and dug their launchpads in the sand.*
> *But – dear oh dear – they got nowhere near!*
> *And we all know why –*
> *fish can't fly.*
>
> *Children get excited and they suggest various ways the fishes could get to the tree: They need to borrow wings from a flying fish! They could use a rocket! I've been in an airplane, someone suddenly remembers. Teacher nudges children's thinking by asking what if fish could somehow get to the tree: How can they come down in a safe way? Children's ideas start bursting right away: They need a trampoline, they could use a slide, they could use a hot air balloon, they need a parachute! Children get excited about the idea of using parachutes and they start sharing their previous experiences about parachutes. Teacher grabs on the idea of parachutes and scaffolds children's thinking towards setting the aim for problem-solving. What do you say, should we build parachutes for the fishes? What properties should parachutes have to slow down the falling?*

In the example, the aim for problem-solving is generated from the shared playful moment. As in phenomenon-based learning, this approach follows inquiry-based strategies and setting the leading question or aim is important. Questions should be such that children find them meaningful and to support child-centeredness the questions should arise from children's suggestions. The makerspace activity is based on the pedagogical approach applied from guided inquiry meaning that some decisions in the inquiry process are defined by a teacher and some by children (Abrams, Southerland & Silva, 2007). The context of the story and poem steers the possible aims of a problem-solving so that the teacher can anticipate the spectrum of outcomes and hence control the complexity of inquiry. Still, the aim is generated by a child-centered basis. The example underscores that children's own ideas and interests can be summoned from playful situations by the teacher's responsive scaffolding. Children's life-worlds and previous experiences are connected to the STEM phenomena when children are allowed to reflect on puppet play by using their imagination and suggesting ideas. This creates a culturally meaningful space for children's joint meaning-making.

Next phase in the makerspace approach is to define how the question can be addressed.

> *Teacher has prepared materials children can use to experiment air resistance and what effect the surface area has on it. The teacher let children freely explore different sized and shaped recycled news paper pieces. Children start throwing pieces of news paper in the air. They laugh and enjoy watching newspapers falling down. As children make observations that some of the pieces come down later than others, the teacher starts wondering what kind of differences we can identify with quickly landing pieces and with slowly falling pieces. Teacher gives children room to experiment and play with pieces but she is constantly observing and listening to children's initiatives and ideas that could lead the inquiry process towards addressing the problem-solving question. When children compare different sized and shaped newspaper pieces the teacher scaffolds children's thinking by referring back to the story: Can we use that piece of information to help fishes? The working continues and the teacher subtly scaffolds children's process towards making parachutes. At first, children concentrate on making observations about the parachutes: they drop parachutes from different heights, they run, slide and rush with them and drop parachutes upside down. Little by little, more playful aspects emerge in children's meaning-making process and eventually it has taken the role of imagination-driven play with self-made parachutes.*

The inquiry strategy implemented here is open in the sense of methods and end result (Abrams, Southerland & Silva, 2007). The teacher has defined the materials but not limited them. If children want, they can bring in other materials from the environment as well. By referring back to the story, the teacher returns experimentation to children's culture. By doing that, children can express their observations and inferences through the familiar context with their own narrative ways. Eventually, children build their own parachutes. They tested and observed how parachutes acted under different manipulations. While experimenting with parachutes, children's engagement started sliding seamlessly towards playing with parachutes. In the example presented here, the play merged children's scientific observations, problem-solving, earlier experiences that the poem evoked and children's self-directed imagination-driven play. Although, the meaning-making took the form of a play, earlier observations had a remarkable role in defining how the play proceeded. Hence, children used results from their experimenting as the rules of the play (Vygotsky, 1967). This emerged unity is the sphere where children's STEAM practices become meaningful for children.

Childrens' projects: helping STEAM interests grow

Much like the two previously presented approaches, the idea of childrens' projects is aimed at cultivating children's interests and learning in STEAM. However, in contrast to them, the main pedagogical idea behind children's projects is to support and help the children to follow their emerging interests beyond the initial pedagogical designs or other sources that might have sparked their interests. This way the focus on childrens' project as a pedagogical approach is less on how STEAM interests can be introduced to children in early childhood education and more on how the development of already sparked interests can be accomodated and fostered.

Building on principles of agency-based pedagogy (Rajala, 2016) central features of this support include dialogical relationships between children and early childhood educators that are characterized by trust and the adults' continued interest in and appreciation of the childrens' learning process.

But what are these "children's projects"? Hilppö (2017) characterizes childrens' projects tentatively as child-initiated and child-lead activities that are centered around a particular theme or the production of an artifact. Such projects, like childrens' interest in STEM (Renninger, Nieswandt & Hidi, 2015), can be initially sparked by many different things or situations. For example, playing with water in puddles on the playground, visiting a dinosaur exhibition or doing a fun science experiment with the teacher can awaken children's interests and lead them to explore these interests more by themselves (Chesworth, 2019; Crowley et al., 2015; Anderhag et al., 2016). Similarly, such projects can emerge from sustained engagement with toys or technological devices during which their curiosity and a sense of agency, I want to know what's inside and I can open it, pushes the children into the opportunities they see as opening for them. These moments mark pivotal turning points in interest development as the children move beyond what has initially supported their interests and start creating new learning opportunities for themselves (Hidi & Renninger, 2006).

To be more concrete we will next provide a short narrative vignette of a childrens' project in a Finnish kindergarten that centered around bats. The observations on which the vignette is based on were collected by a pre-service teacher during a practicum period in a public, municipal kindergarten in the north of Finland. The narrative is told from the perspective of the observing pre-service teacher.

> *Most of the children in the kindergarten group I observed were very enthusiastic about bats. Bats were frequently part of their plays and the children had drawn a considerable number of pictures that displayed various kinds of bats, some coloring book pictures other drawn by the children themselves. They had even created a small performance about bats for the rest of the group. The whole thing had been started by a girl who had gotten excited about bats when seeing the movie Hotel Transylvania. According to her, the project was about exploring bats but also about exploring what she found scary about vampires. She told me that because of the project many of her friends come to her with questions about bats and that she likes this. The teacher of the kindergarten group saw The Bat project as educationally valuable. She told me that she and the children had read and learned a lot about bats, their habitats and their lifecycle. Although learning about bats was not part of the groups' official curriculum, the project had also offered the children a significant chance for self-directed learning. The opportunity to introduce a new activity as part of the kindergarten day as well as how they want to proceed with it and how to, for example, divide the work between themselves, were important learning moments for the children according to their teacher.*

What is particularly significant in the above example in relation to STEAM and STEAM learning, is the way in which the project functioned as a site for exploring bats and our current knowledge about them. While this was not the only aspect the children engaged with, it nonetheless suggests that when we support children in following their STEAM (or other!) interests, this can lead the children to substantial learning opportunities which they themselves also seem to recognize. From a deweyan perspective (Dewey, 1910; e.g., Miettinen, 2000), the Bat project could then be seen as a naturally emerging and collaborative inquiry process between the children and the teacher which entails encountering, engaging with and using disciplinary knowledge to advance, and as part of, the project (see also Hilppö, Suorsa & Rainio, in press; Hilppö & Stevens, in preparation). More importantly, the Bat project served also as a site for multidisciplinarity and integrated the arts as a meaningful way to further explore bats.

Discussion

Despite that conditions for engaging in STEM education in Finnish ECEC are in many ways arguably favourable, early childhood educators are still cautious to implement STEAM and inquiry-based practices with the kindergarten groups (Repo et al., 2019). Educators report that their own negative attitudes and low feelings of competence in the STEAM disciplines, unsuitable working environments, lack of equipment and materials as well as the heterogeneity of the children are significantly impeding them from engaging children more in STEAM education. Together and by themselves each of these reported problems are formidable obstacles that hinder advancing early years STEAM education Finland. In this section, we will shortly explore how the presented novel STEAM education approaches could address these obstacles.

Teachers' low feelings of competence towards STEAM education could be tackled in at least two ways with the presented approaches. First, they offer teachers tools to reduce the complexity of the inquiry process and second they shift the role of the teacher from being a leader of the process to a co-explorer with the children. The makerspace approach demonstrated how play and stories can be used as a scaffold to reduce the complexity of inquiry-based STEAM activities. Such a reduction might mitigate teachers' possible insecurities about their STEAM skills and knowledge that stem from situations, imagine or experienced, where children ask or need assistance with something that is beyond their current knowledge and know-how. By using play and stories as naturally framed contexts for STEAM education, teachers can steer the question-generation phase and thus can also be more prepared to offer children with proper cognitive and procedural scaffold and materials. With the children's projects -approach the shift in the teachers role to a more co-explorer position is more extensive. While following the children's emerging interests and activities challenges the teachers STEAM substance knowledge, allowing the children to lead the project tasks the teachers more with helping out with the project, pointing to possible helpful resources and offering suggestions than knowing something about the content of the project.

According to Repo (2019), Finnish ECEC teachers also feel that the existing learning environments and materials are not sufficient to STEAM education. The approaches presented above address this concern with a change of perspective on what eventually constitutes early years STEAM education. Traditionally STEAM education is regarded from a procedural and discursive practices perspective that has been adapted from how science, technology, engineering and mathematics are conducted in the working life (Martín-Páez et al. 2019). Consequently, STEAM learning environments are seen as requiring materials, tools and discursive practices similar to, for example, science laboratory environments or discourses that build up from scientific concepts. The makerspace approach demonstrates how play and stories act as cultural bridges between children's life-worlds and the world of STEAM. In the approach problem-solving is looked at from the viewpoint of children's culture and hence the learning environments, materials and discourses are defined by children's cultural practices. Therefore, STEAM education can happen there where children naturally spend their time with equipment and tools that are familiar for them. Driving questions of inquiry emerge from children's observations and wonderings. Observations and results are discussed within the frame of children's culture and therefore the results become meaningful for children. In children's project approach, we demonstrated how children and a teacher through a collaborative inquiry process utilized disciplinary knowledge to advance their multidisciplinary project. While traditionally children's interests are harnessed to enhance learning of STEAM practices, with the children's projects -approach STEAM practices serve as tools to foster children's emerging interests. To sum up, early years STEM education does not necessarily always require lofty or expensive materials. Much can be done with "finding" STEAM in children's own cultural spheres and lifeworlds and cultivating these aspects with materials and practices available in each kindergarten. While we think that the teachers' concerns regarding how the kindergarten they work in are equipped for STEAM education should not be overlooked (rather the opposite!), we would also like to caution against seeing STEM education as being fundamentally made up by the tools scientists use. Tools are an important part of STEAM and STEAM education, but an overemphasis on them runs the risk of pushing children into the world of STEAM without generating a more authentic understanding of what they are needed for.

Lastly, the teachers in Repo et al.'s (2019) study highlighted that the heterogeneity of their kindergarteners in terms of existing skills and competencies is impeding the teachers from engaging in STEAM education with them. From our perspective, this heterogeneity is possibly less of an issue with both the makerspace and the children's projects -approach. With the makerspace approach, the joint stories, poems and plays offer various entry points into the inquiry process and also suggest different ways of exploring the underlying phenomena. Hence, with the makerspace approach there is no "one right way" to engage in the making process but rather possibility for variety and personalisation based on each child's own skills and interests. With more established and longer cultivation of makerspaces in kindergarten, one could easily imagine such opportunities being even further accentuated. As a mature and stable practice, makerspace can host multiple different maker activities simultaneously, much like in montessori kindergartens. In these kinds of learning environments, the pedagogical structure of the various maker activities gives teachers more time to focus on each child and their particular learning needs. In turn, with the children's projects -approach differences in terms of children's STEAM skills and knowledge is possibly even less central. With the projects building on each child's own interests and advancing much on their terms, the projects act as an arguable zone of proximal development (Vygotsky, 1978; or learning, see Chaiklin, 2003). As such, the projects call the children to both put to play what they know and can in the service of the project and also to learn and develop their skills further as part of it. In this way, their current skills, heterogenic between themselves or not, create the conditions for their own advancement in the context of the project.

Overall, while there are obstacles that significantly impede a more widespread adoption and implementation of STEAM education in the Finnish ECEC, the avant-garde approaches we have outlined in this chapter offer some interesting options and avenues for addressing them. Whether and in what possible ways these possibilities are realized in the various kindergartens across Finland is something we look forward to uncovering in future studies.

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