

DESIGNING WITH MULTIPLE TOOLS – SUPPORTING YOUNG CHILDREN AGENCY IN EARLY CHILDHOOD EDUCATION

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Abstract

Children's rights to participate designing their everyday activities and environments have been widely declared in international regulations. The practical implementation of these rights has also been advocated in educational research to support children's agency development. However, reported challenges such as young children's difficulties verbalising their thoughts, may discourage researchers to carry out investigations with children in early childhood education (ECE) environments. Tackling this issue, we present our exploratory work in Finland involving young children (9 girls, 5 boys, ages 4-6 years) designing a greenhouse space in their day-care using multiple tools. The design activity was carried out as part of the children's environmental education curriculum and was implemented through a participatory design (PD) framework to support and foster children's agency during the research. We gave the children low-tech tools (coloured pencils, paper) as well as with high-tech tools (drawing and augmented reality (AR) apps) to complete the design of their ideal greenhouse during four PD workshops: 2 workshops using an AR app, 1 workshop using a drawing app and 1 workshop using pencils and paper to draw. We explained the low-tech and high-tech tools to be used at the beginning of each workshop, allowing children to familiarise with them, if needed. Data were gathered through observations, videos, interviews and researchers' notes. Children had the freedom to spend as much time as they needed in the design activity and the ECE personnel accompanied two researchers with the children to provide familiarity and support. The workshops ended with a group interview where children were invited to describe their designs. Here we present how each tool type supported the children differently in their design activities by engaging and offering them suitable mechanisms to express their views and wishes, encouraging verbal expressions and interactions, and thus, fostering children's agency as well as assisting the researchers' work. Furthermore, the different affordances of the tools encouraged the production of diverse results through which children could record their "construction of meaning" during the design activities. Based on our experiences during this exploratory work, we advocate the use of multiple tools, particularly when carrying out participatory design activities with young children. Due to their different affordances, the provision of high- and low-tech tools for supporting young children's design can reflect better the children's individual skills, agency and interests and, therefore, offer researchers and designers a more efficient communication channel and a more holistic understanding of the design outcomes.

Keywords: *Participatory design, high-tech tools, low-tech tools, research in ECE environments.*

1. Introduction

The Convention on the Rights of the Child defines the child's right to be heard in things concerning themselves (United Nations, 1989). Children's opinions should not be only listened to but also considered in decision-making (United Nations, 1989; MacNaughton, Hughes & Smith, 2007). Therefore, giving all children the possibilities to share their opinions, views and dreams is crucial to support their skills and development from young age (Druin, 2002; Clasina Södergren & Suero Montero, 2022). It follows that in educational settings children benefit from participating in designing their everyday activities and the environments in which they act (see e.g., Dillon, Vesala & Suero Montero, 2015).

These views fall under the new sociology of childhood approach to research: children's agency is seen in their active involvement, participation, and social interactions (e.g., with teachers and peers) within their social environments and contexts (see for instance Bjerke, 2011; Katsiada et al., 2018). The new sociology of childhood (Oswell, 2013) proposes that children are active agents with the capacity to co-construct their "social realities" (Varpane, 2019). Within this framework, children's voices are heard through the implementation of participatory methods (Katsiada et al., 2018). In terms of the inclusive involvement of children in the design of technology and physical environments, a well-known practice is

the implementation of participatory design (PD) (Druin, 2002) also within educational research (Cumbo & Selwyn, 2022). However, challenges arise when involving young pre-school children in design activities, as they may not be able to verbalise their thoughts and ideas clearly, may have limited attention spans (Clasina Södergren & Suero Montero, 2022) or may not find the design activities fun or motivating (Schepers, Dreesen & Zaman, 2018). We pose that to face these challenges, one single tool for design in early childhood education (ECE) settings may not be enough to maximise the outcomes of the design activity. Furthermore, considering that young children need a variety of methods and tools to express and communicate their thoughts (see for instance Niemi & Ovaska, 2007; Papandreou, 2014), it is very important to understand the affordances that high- and low-tech tools might provide when involving young children in design activities within ECE environments. Hence, here we explore the use of multiple tools for engaging young children in the design of their physical ECE space in Finland, fostering their agency through supporting the expression of their thoughts and ideas. We expect our study to facilitate the understanding of young children's design ideas as well as their work with researchers and designers.

2. Background work

The concept of agency in early childhood is a contested one (Varpane, 2019). In our research, we take the new sociology of childhood perspective when doing research with children, that is, children have the capacity to influence the decisions taken regarding the development of their social context and environment. In Finland, this tenet is at the core of the ECE curriculum, where children are seen as active agents that must be allowed to “learn new skills and create meanings about themselves and the surrounding world” (Finnish National Agency for Education, 2022). Several participatory methodologies and frameworks have been developed for the purpose of involving children as active agents of research over the years. Through *cooperative inquiry*, for instance, intergenerational design teams work together applying a variety of techniques that facilitate the understanding of how children view, work, and develop technology (Druin, 2002). The *mosaic approach*, a framework for doing research with young children, capturing through observations and dialogues with care gives the different ways children have of communicating and allowing them to present their views of the environment through photos or drawings, has also been reported to support young children's expression and agency and to facilitate deeper insights from the collected multimodal data (Clark, 2001; Greenfield, 2011; Katsiada et al., 2018).

Participatory research methods' application to education research have also been well-documented (see e.g., Cumbo & Selwyn, 2022), and while the opportunities for young children to be involved in designing their learning experiences have been explored (e.g., in Finland, Leinonen & Venninen, 2012), further research and practical applications in ECE settings are still needed. Nevertheless, we find some examples of research in ECE contexts for instance involving young children in designing a science curriculum (Goulart & Roth, 2010), in designing solutions for reducing water-waste in their local community (Clasina Södergren & Suero Montero, 2022) and in researching topics of their interest related to environmental education (Green, 2017). From several of reported methodologies and frameworks, we learn that designing technologies or physical environments with children involves both low-tech tools, such as paper and pencils, as well as high-tech tools, such as mobile devices and apps. However, more often than not one specific tool is paired with one methodology, an approach that has proven efficient when working with school-age children (Walsh et al., 2013). Therefore, we investigate the application of multiple tools towards facilitating young pre-school age children's expressions and agency during a design activity in their ECE context.

3. Research design and methods

Table 1. Design groups – participants per workshop.

Group	No. Girls (age)	No. Boys (age)
AR app	3 (5), 1 (4)	1 (5)
AR app	-	1 (5), 1 (4)
Drawing with app	1 (4), 1 (6)	1 (5)
Pen & paper drawing	3 (4)	1 (6)

Children's awareness of the ecology wellbeing is introduced in ECE curriculum in Finland through environmental education (Finnish National Agency for Education, 2022, p. 46). We see greenhouses as presenting a physical and natural context for providing this awareness. In our exploratory work, hence, fourteen 4–6-year-old-children in ECE contributed to the design of a greenhouse for their day-care. Four 35–45 minutes-long participatory design workshops (Table 1) were organised to gather young children's expressions of their ideal greenhouses, to be physically implemented at a later stage. The children worked on designing their greenhouses using high- and low-tech tools, randomly distributed. The

design workshops started with informal introductory discussions between children and researchers to get to know each other and the topic. Through this, children acquired a general understanding of what a greenhouse was – a place where trees and vegetables grow. The children were then given the task to imagine and design what a greenhouse space could include in their day-care setting. The children were encouraged to use artistic representations through drawing and modelling, as these activities are widely used in ECE practices (Green, 2017; Finnish National Agency for Education, 2022). All children had used tablets to draw, take photos and play in their ECE settings before the workshops, however, the AR app (3DBear, <https://3dbear.io/>) was new to them. Researchers demonstrated the apps to be used at the beginning of the workshops, allowing children to familiarise with them.

Data were gathered through observations, videos, interviews, and researchers' notes. Children could use as much time as needed in the design activity. One or two ECE personnel accompanied two researchers with the children to provide familiarity and support. The adults' role was to scaffold, i.e., encourage and provide appropriate means throughout the children's engagement in the participatory encounters (Green, 2017), as well as to provide technical support. The design sessions ended with a group interview where children were invited to describe their designs as to record the child's "journey of their constructions of meaning" (Einarsdottir, Dockett & Perry, 2009, p. 219). Group interviews also facilitated communicating private experiences and expectations to others as well as to further develop design ideas together (Brooks, 2005). All sessions were video-recorded and transcribed for analysis. Participants were recruited through an open call in one municipality in Eastern Finland. Approximately 200 invitations, alongside consent forms, were distributed to children and their families in three day-care centres. We received 14 positive answers. Ethical aspects, including children's right to participate voluntarily, to withdraw from participation at any time, and the right to stay quiet during interviews were guaranteed.

4. Results

Figure 1. Examples of children's greenhouse designs. Left) coloured pencils drawing design, (6-year-old). Centre) AR app design (5-year-old). Right) Drawing app design (4-year-old).



The video recordings were reviewed by the researchers and the transcriptions were analysed through content analysis. We observed that children could use all the provided tools to create their designs and they felt that the design activities were easy and pleasurable. The AR app allowed children to use a database of ready-made images including plants, rocks and playground equipment, which could be dragged and dropped into the design environment of the app - an empty room in the children's ECE environment (Figure 1, centre). Children chose not only plants and other common items found in greenhouses but also more surprising items, such as toilet seats, cars, or dinosaurs as well as playground equipment such as swings and slides. With a broad database of images, the app enabled the children to bring up diverse activities to be realised in a greenhouse, including sliding, swinging, and enjoying a merry-go-round. Many children also chose chairs or benches in order "to sit and watch the plants" or "eat berries" in the greenhouse. With the children that used a drawing app having their fingers as pencils, we observed that the app fostered the detailed drawing of single items in the greenhouse. For example, one four-year-old girl coloured the entire screen blue and called it a blueberry. Other drawings included a flowerpot with vegetables and berries (Figure 1, right). We observed that the children who made their designs in paper with coloured pencils mostly drew various fruits, berries, plants, and flowers, usually one of each. Some children also drew toys and other items such as a fridge "to store the edibles", a rocking chair, a light, a shelf, and a watering pot (Figure 1, left). Even though children were offered a big drawing paper for the group to share, each of them drew 'walls' to structure their own space for design.

5. Discussion and conclusions

As per intuition, in our exploratory study the children's designs differed depending on the provided tool. This resonates with the ideas of DiSalvo and Roshan (2014) about medium probes, where

“the medium shapes the content that is expressed”. We could observe that design outcomes varied according to the affordances of the tool (medium) the young children used to produce their designs. Furthermore, different tools supported children to verbally express their thoughts and design ideas as well as agency, motivation and focus on the task in various ways, while producing rich data.

In terms of **affordances**, more fantastic spaces were designed using the *AR app* readily available database of images to drag/drop. This enabled children to build more playful designs and express their ideas faster. Comparatively, children’s designs with the drawing app or with pencils mostly reflected their previous experiences and socio-cultural contexts although with different abstraction levels. That is, because of the affordances that the *drawing app* provided and the children fine motor-skills development level, they sketched designs that were more abstract: a blue screen became a blueberry and one single flowerpot with roots and soil became an entire greenhouse. This also relates to the physical affordances of the tablet screen as its size could only offer limited space for the children’s designs. *Drawing with coloured pencils*, a tool that children were very familiar with, perhaps allowed them to create symbolic representations of their ideal greenhouses with ease, adding walls to frame their design spaces as a delimited room in the big drawing shared paper that was provided, adding new elements (e.g., a fridge, a shelf) to the greenhouse’s traditional functionalities (growing fruits and vegetables).

Regarding **agency**, we observed that children were eager to participate in the design tasks and were generally happy to express their views on their designs during the group discussions. We noted that the children were enthusiastic to explain their coloured pencils hand-made drawings and designs to the group at the end of the design activity, exercising their agency to voice their ideas during participation. However, they were a bit more hesitant to discuss their designs in other workshops, and many replied only yes/no to questions posed by researchers. This could be because the apps afforded more abstract representations of their ideas, which perhaps made it more difficult for the children to explain what their design was. We also noticed that children were **motivated** and **engaged** in the design activities as they were comfortable with, and interested in, the tools they were using. Also, children understood and anticipated the practical outcome that the design activity would bring to their everyday ECE environment – a new greenhouse would be built. We speculate that this further motivated them to engage and focus more closely on the task, since it had a concrete purpose, and it was meaningfully contextualised for them. For instance, we observed that even when children had difficulties using the AR app, they persisted until they succeeded, and reported that using the app “was easy and nice”. The AR app (high-tech) was new to the children and although it prompted the need for more scaffolding, its novelty also fostered interest and motivation. In addition, the tool also provided a wide variety of ready-made images that the children could explore and use to modify their physical environment and see it through a new lens. This playful affordance perhaps made the children overcome the difficulties using the app and the tablet without frustration (e.g., Couse & Chen, 2010). The children familiarity with the drawing app as well as pencil drawing (low-tech) made them comfortable to use these tools to express their ideas confidently.

In terms of **supporting children’s verbal expression** during the process of design and research, conversations and reflective interventions are important to scaffold and ground the means of meaning-making with young children, also supporting pedagogical strategies (Brooks, 2005; Green, 2017). That is, once the children concretise their designs through visual representations, they might be able to verbalise their thoughts and complex ideas easier as the process of drawing has been reported to promote higher mental functions and to facilitate communication and participation (Brooks, 2005). We noticed that particularly when drawing with pencils, children were very eager and inspired to describe their drawings and designs and share them with others. Therefore, although it is vital to maintain the delicate line between scaffolding and agency promotion throughout the design process (MacNaughton et al., 2007), conversations and reflective interventions are needed during and/or immediately after design sessions with young children, using their own designs as probes since these can be ambiguous and difficult to interpret otherwise. Moreover, the reflective interventions might reveal richer inputs and more complex insights from young children when their designs are produced using various tools that assist them in easily expressing their thoughts and ideas. We see these reflective interventions themselves also functioning as a *non-tech tool* that is very useful for supporting children’s verbal expression when coupled with children’s designs (probes).

Based on our experiences during this exploratory work, we advocate the use of multiple tools, particularly when designing with young preschool children. Due to their different affordances, the provision of various high-, low- and non-tech tools for supporting young children’s design process can reflect better the heterogeneity of children’s agency, skills and interests and, therefore, offer researchers and designers a more comprehensive view of the design outcome for different children and contexts. Although rarely described in the literature of designing with very young children, the use of multiple tools provides an exemplar way obtain rich data, when “we give them appropriate tools with which to express themselves” (Sanders, 2000).

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