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Peer Collaboration of Six-year olds when Undertaking a Design Task

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Abstract

The purpose of this study was to explore six-year-old Finnish preschoolers' collaboration during a designing session, where they received a task to collaboratively design and sketch forest animals' nests. Peer interaction is a natural part of craft, design and technology education because the learning situation itself provides various possibilities for collaboration. Craft making is traditionally seen as an individual execution, where makers are producing their own craft products instead of collaboration and shared outcomes. During this intervention, an experience of a shared designing and making situation was provided for children. The article focuses particularly on children's verbal and embodied interactions, as well as children's social roles in their groups, depending on their ability to use language during the designing process. Children's activities were examined within Vygotsky's sociocultural framework for learning and classified using a micro-level analysis methodology for tracking children's collaboration and meaning making in designing. The results showed that six-year-old pre-schoolers succeeded in working collaboratively and they managed to solve the designing task with their peers, but embodied expressions also played a notable role in designing. Four types of roles, which children had in their peer groups, were found.

Key words

preschool, peer collaboration, design and technology education, sociocultural learning, roles

Introduction

Interpersonal skills, including the tolerance to work together as well as the ability to listen and understand various opinions and different perspectives, are crucial skills in a culturally diverse world, in which young children are growing up (Finnish national board of education [FNBE], 2016; Sawyer, 2006b). These skills can be promoted through design education, which provides versatile opportunities for shared thinking and joint decision-making (Hennessy & Murphy, 1999). However, very little is known about young preschool-aged children's design and craft

processes and how they work collaboratively. This study aims to partially fill the gap by examining and analysing the nature of six-year-old preschoolers' social interactions during a collaborative designing session, where they sketched floor plans for forest animals' nests. The designed floor plans were later constructed. Children's design activities were approached from Vygotsky's (1978) sociocultural framework. Working together in a collaborative learning setting is a recent theme in educational research, in curriculums and in practical work with young children (Kangas, Seitamaa-Hakkarainen & Hakkarainen, 2013; Sullivan & Bers, 2016; Sundqvist & Nilsson, 2018; Turja, Endepohls-Ulpe & Chatoney, 2009).

Interaction, self-expression and the ability to understand others play major roles in an individual's functional capacity and well-being. The sociocultural perspective on learning emphasises the role and meaning of peer interaction (Vygotsky, 1978), and the cultural and collective bases are highlighted in sociocultural theories of child development (Kim, 2014; Rogoff, 2003). Children are considered to be active agents who learn through acting and using language and semiotics. Preschool-aged children are typically attracted by the other children, and they usually enjoy their peers' company. Children construct their identity and adopt peer culture and social skills through participation in communities, where collaborative learning supports a learner's mental, social and emotional development (Hennessy & Murphy, 1999; Lillemyr, Sobstad, Marder, & Flowerday, 2011). According to Vygotsky (1978), language is a dominant psychological tool for seeing, talking, acting and thinking. Language is used to accomplish ways of representing ideas, interpreting experiences and constructing explanations. The most favourable conditions for learning and interaction are situations where children define a problem, test different alternatives to solve it by themselves with peers, and finally find a solution through action (Hennessy & Murphy, 1999).

A number of studies have investigated primary-aged children's interactions whilst working in peer groups from the viewpoint of social and cognitive processes (e.g. Butler & Walton, 2013; Chen, 2016; Lim, 2012). While some studies rely on collaborative activities, other studies are focused on children's language skills during collaboration, since verbal interaction constructs a shared understanding between interactors (Edwards & Mercer, 2013). Sociolinguistic methods, which view classrooms as interactional settings, have provided useful concepts and tools to analyse classroom interaction from the sociocultural perspective (Kovalainen & Kumpulainen, 2009). Kumpulainen and her colleagues have implemented several studies on the social construction of teaching and learning in pre- and primary classroom communities, aiming towards dialogic meaning making and joint creation of knowledge. These studies are focused on the areas of mathematics, early years' science-learning and cultural content in creative museum engagement.

Children's roles in adult-set tasks have mostly been studied from the viewpoint of leadership styles (Lee, Recchia, & Shin, 2005). Such roles as leaders (primary leader and supporting leaders) and non-leaders (quiet members) were defined, when children's leadership was examined in discussion groups in classrooms (Li et al., 2007). Some research has focused on the

nature of relationships within children's spontaneous collaborative play. Mawson (2009) found two key roles, which he named dictators and directors, assumed within a group by individual children in situations where three-to-four-year-old children played without an adult's guidance. Ghafouri and Wien (2005) found four kinds of roles in four-to-five-year-old children's play. These were leading and following roles, supporting emotional well-being, collaborating by including others in play, and conflict resolution skills. Segal, Peck, Vega-Lahr and Field (1987) also considered those children who did not have a pivotal role in the group's dynamics, when they identified three social leader styles and two follower styles among preschoolers' group interactions during free play. Common among all of these studies is an observation of the importance of language in effective collaborative interactions (Fawcett & Garton, 2005).

All in all, previous studies have revealed the importance of peer interaction for children to learn collaborative skills, but also highlighted the difficulties related to verbal communication. The present study aims to describe young children's ability to work towards a shared goal in a designing task, where they had to solve the given task by discussing, drawing and cooperating. Craft making in an educational context is traditionally seen as an individual execution, where each of the children are producing their own craft products in a learning situation. During this intervention, we tried to avoid that kind of setting, and instead we provided an experience of a shared designing and making situation for children. Young, preschool children are just beginning to exercise collaborative skills, as well as many other skills for school and life. It cannot be expected that their collaboration is well-developed from the very beginning: at the very least, children need adults' scaffolding to achieve their common goals. Scaffolding (help, such as prompts and hints) from a more skilled person is a crucial part of the learning process (Ninio & Bruner, 1978). Thus, in the present study the nature of preschoolers' collaboration during the designing task will be investigated from the perspective of linguistic and embodied interaction. The specific research questions are as follows:

1. How does children's verbal and embodied collaboration occur in a collaborative designing session?
2. What kinds of roles did children have in their peer groups?

In the following, we will first discuss the importance of peer interaction and collaboration in early childhood and the nature of young children's design and technology education, then we will present our research setting, method of data collection and data analysis. Results and descriptions of pre-schoolers' designing activities will be presented as a conclusion.

Peer interaction and collaboration in early childhood

Peer group work is an essential part of children's everyday life, social identity and the building of skills needed in the future. In peer groups children learn together, learn to make compromises, learn to create their own space, and learn empathy and assertiveness. Working in a peer group develops children's skills to meet criticism, for example, when peers express

their opinions. Peer groups also teach children to make social comparisons, which helps children to build self-perception (Marjanen, Ahonen, & Majoinen, 2013). Skills to negotiate, settle and solve disagreements are important developmental tasks, where children's skills will be refined and their abilities strengthened (Kronqvist, 2006). Peer group learning consists of shared goals, commitment, evaluation of actions and shared understanding.

Collaboration refers to a situation where students actively negotiate and work together to solve a problem or otherwise construct common knowledge for a shared goal (Hennessy & Murphy, 1999; Mercer & Littleton, 2007; Vygotsky, 1978) Successful collaborative working sessions with peers offer natural ways for scaffolding and supports deep understanding (Sawyer, 2006b). In kindergarten, collaborative action between children usually happens in informal situations, like play, frolic and games, where children must negotiate game rules. The peer groups may have a certain asymmetry (Verba, 1998), group members can express their feelings freely, challenge the peers' opinions and justify their points of view. Shared understanding is usually created through language, but communication might also be non-verbal. Since young children often lack words to express themselves verbally in social situations, they use non-verbal communication such as gestures and facial expressions (Verba, 1998). Embodied expressions are an essential part of young children's communication because they live, act and learn new things in a very holistic way. According to Capone and McGregor (2004), the development of gestures is closely related to the development of language skills and gestures enhance language development: gestures support spoken expression and help young children's concepts acquisition (Capone & McGregor, 2004). In this study, we defined a gesture as a visible bodily action that is used as a part of communication, such as pointing and depiction (Kendon, 2004; Kita, Alibali, & Chu, 2017). The distinct types of hand gestures are called representational gestures (Kita, Alibali, & Chu, 2017). In collaborative designing situations, hand gestures are considered to demonstrate children's thinking (Hall & Nemirovsky, 2012), like expressing ideas by pointing, nodding or shaking their head or making hand movements to express shapes.

Young children's craft, design and technology education

Craft has been a part of early childhood education since Fröbel's kindergarten ideology in 1800s (Kiviniemi & Vuorinen, 2010), but it's roles as a content of young children's education and kindergarten activities have varied a lot on decades. In Finland, craft tasks have been lately more like hobby crafts, or craft has been omitted and replaced with visual arts. Craft has, however, its own features, which cannot be replaced with similar kinds of activities. Craft education in early childhood education and preschool is a versatile combination of designing, inventing, experimenting and making, as well as science, technology and thinking skills (Finnish national agency for education [EDUFI], 2017; FNBE, 2016). Technology has quickly become a part of young children's lives, and because of this, educational purposes of technology have been emphasised in early childhood curricula in recent years (EDUFI, 2017; Sundqvist &

Nilsson, 2018; Turja et al., 2009). The purpose of technology education in preschool is to help children understand everyday technology and how it can be used to solve daily life problems (Sundqvist & Nilsson, 2018). Robotics and programming are educational tools for cognitive- and fine motor skills, as well as for peer interaction and collaboration (Sullivan & Bers, 2016). They present new ways to implement craft, design and technology education and they are tools for integration with STEM (science, technology, engineering, mathematics). These new contents do not exclude traditional materials and techniques away from craft, but they are an extra tool for playful and experimental activity with peers.

Peer interaction is a natural part of craft, design and technology education because the learning situation itself provides various possibilities for collaboration. Hennessy and Murphy (1999) have introduced a framework for optimal preconditions for collaboration in design and technology education. The strength of design and technology education is in its ability to combine procedural problem-solving activities to talk and provide feedback with peers and generate concrete results at the same time (Hennessy & Murphy, 1999). According to Mercer and Littleton (2007), task design and close relationships are necessary preconditions for a successful collaboration. Tasks should be open-ended, challenging enough, and allow students to work together (Mercer & Littleton, 2007). For example, elementary students (ten-to-twelve-years-old) managed to engage in and learn creative knowledge-creation by collaborative designing with appropriate support (Kangas et al., 2013). Rowell (2002) examined one pair of young students' interactions during a designing and making task, where the focus was on analysing the nature of participation through the words and actions between a student pair. Rowell found language skills to be crucial in collaborative problem solving. However, there is little research available on young children's collaboration in design learning concerning creative material activities (Vass & Littleton, 2009). Fredriksen (2011a; 2011b) investigated three-to-five-year-old children's interplay with three-dimensional materials (like clay) and the study focused on the interactions between the children and materials. Fredriksen identified four different processes, particularly the intersubjective process of expressing, sharing and negotiating meaning through social interactions. Yliverronen and Seitamaa-Hakkarainen (2016) observed that five-to-six-year-old pre-schoolers worked logically together in a situation where they decorated fabric bags, and the skill learning phases of perceiving, making and interpretation were revealed from their learning. Yalkin (2015) created a model for design education in kindergarten, which aimed to develop young children's thinking skills in a creative environment.

To conclude, young children must accomplish several cognitive skills for a successful collaboration. Firstly, they must be able to share and express their own ideas. Secondly, collaborative learning requires communication either verbally or non-verbally (gestures, facial expressions). Thirdly, planning their own activities during the collaborative situation is very demanding because they have limited experience in collaborative activities outside of free play. Essential is, that preschool education offers opportunities for children to exercise collaboration, listening to others and acquire knowledge in interaction with other children,

kindergarten staff and the immediate environment (FNBE, 2016, 18). From a perspective of design education, it is important to hear children's voice inside of the designing process and understand children's way to generate ideas further.

Data collection and methods of data analysis

The present case study took place in a public preschool situated in a small Finnish village. A total of 15 six-year-old pre-schoolers, seven girls and eight boys, took part in the craft project, which was implemented in the middle of the preschool year. Generally, the group worked with a kindergarten teacher and an assistant, but during the data collection, one of the authors and an external assistant were also guiding the craft activities. The preschool group was divided randomly into four groups of three or four children during the designing task. After a short motivation session that consisted of an animal fairy tale and a song, the teams were asked to decide which animals they would like to be. The team names Big Squirrels, Small Squirrels, Birds and Foxes were decided on together within the teams. All the groups built up their own places (shelters) using tables and blankets for the designing session. The first task was to discuss ideas related to the themes, such as how animals live in nature, and which items could make nests comfortable for them. As an outcome of these discussions, children were asked to design convenient homes for forest animals and simultaneously draw their thoughts on a sheet of paper from a bird's-eye view. The adult's role was mainly to scaffold the children's mutual work without giving ready answers and to take care of video recording. Children were encouraged to investigate and explore materials that were available for the designing task: textile materials, package materials and materials from the forest (such as sticks, pine cones, spruce branches).

The data collection consisted of five working sessions, about 1.5 hours at a time (see Table 1). In total, the data are comprised of video recordings from each group's designing and construction sessions (about 75 minutes per group per session), presentations of the ready-made nests (39 minutes), 127 digital photos of the ready-made products, and each group's sketched plans. Since the present study focuses on preschoolers' collaboration during a craft product designing, only the first session, which included all the designing activities (74 minutes of video data in total), has been analysed. All groups' designing activities started at the same time, but the intensity of how they concentrated on the task varied. The time groups used in the first session varied from 14 to 25 minutes. Table 1 shows all craft project sessions, the main content of the session and the time used in each session.

Table 1: Activities of the whole craft project and duration of video data.

Session	Content	Video data			
		Birds	Foxes	Big Squirrels	Small Squirrels
1st	motivation, brainstorming, **designing**	**20:00**	**15:00**	**14:00**	**25:00**
		Total 74:00 minutes designing			
2nd two days later	presenting ideas for each other, construction	2:00	4:00	7:00	6:00
		First total 19:00 minutes idea presentations, then total ca. 55 minutes construction from each group			
3rd five days later	construction	Total ca. 75 minutes from each group			
4th one week later	construction, modelling clay animals	Total ca. 75 minutes from each group			
5th after one week	finishing and presenting ready-made nests	10:00	8:00	9:00	12:00
		Total 39:00 minutes presentations			

The data analysis focuses on each group's video recorded designing session, which is the main data in this study. We adapted Ash's (2007) methodology of micro-level analysis for tracking children's collaboration and meaning making in designing. The video data were segmented and transcribed first (Derry et al., 2010). We transcribed only the actual collaborative designing from each session, not the activities before designing. Each group's transcribed data were written into a table format that consisted of two sectors: what was said and what was done (Sawyer, 2006b, p. 195). The units of analysis were a statement (meaning of the content) and related actions (see Table 2). Since young children often use a lot of embodied expressions to replace missing words (Yliverronen & Seitamaa-Hakkarainen, 2016), we also focused our observation on the gestures together with the children's talking. Thus, in the verbalised data we labelled the turn-taking, i.e., the speaker, and the actor (drawing, pointing). Table 2 presents an example of the organisation of the video data: the left side presents the children's

discussion (and turn-taking, when the speaker changes) and the right side describes what was happening (observation of gestures and actions).

Table 2: An example of transcription and observation from the group Big Squirrels.

Min	**What was said** **A=Ada, E=Emma, L=Luke, J=Jason**	**What was done**
2:00	12. A: Someone could make blankets there. 13. E: I'm gonna make blankets! Let me do it. 14. A: And then here. 15. E: Yeah, yeah. Jason, legs to the bed, so it stays up kinda like a chair. 16. L: Like this. 17. A: Kinda chair. 18. A: Like…have a look at this. 19. E: So… now you're making….	13. Draws 14. Points with a pen 15. Draws 16. Draws the shape of the legs in the air with his hands 17. Draws 18. Points at the table leg with her hand 19. Encourages Jason 20. Jason starts to draw
3:00	21. A: Everyone can make their own's here. 22. A: Emma can make it better. 23. E: I'm gonna make that a little bit longer. 24. A: Then a carpet. And a lamp! 25. E: Okay. Who starts? Me? Okay. 26. L: Okay. 27. A: Let Jason… 28. E: This is the leg of the lamp. Will you make this so, that the lamp gets a round form…? 29. A: I'm gonna do…Luke can do it. 30. A: Where do I put this?	21. Draws and shows with a pen. The others also draw simultaneously. 22. Looks at the plan 23. Draws 25. Asks with a look. Ada nods. Starts to draw. 28. Shows with her hand. Looks towards Luke. 30. Looks towards Emma

The qualitative content analysis for data analysis was inspired by Määttä, Järvenoja and Järvelä's (2012) as well as Kumpulainen and Mutanen's (1999) studies, where both analysed students' interactions in collaborative learning. Määttä et al. (2012) conducted a micro-level analysis of the quality of interaction in a small group, particularly the quality during the on-task episodes. Kumpulainen and Mutanen (1999) provided useful content categories to analyse young students' verbal interactions where students negotiated and built their own understanding about the given task. Based on those categories, we adapted and developed our qualitative content analysis categories that capture the dimensions of peer verbal and embodied interaction (see Table 3, below). From the group's video recorded design sessions, we analysed each participant's spoken statements (*f*=357). After identifying *the speaker*, we classified *the main focus of discourse* (each statement/activity) in order to better understand the content and the proceeding of each group's collaboration. We identified whether the statement of the *verbal collaboration* represented 1) ideation (proposing a design idea such as shapes and materials), 2) developing (reacting to the presented idea or questioning the design), 3) agreement or disagreement (liking or disliking the presented idea), 4) questioning (presenting specified questions or ideas in a question form) and 5) organising process (asking someone to do something such as drawing or dividing turns). This data-driven classification corresponds to other studies of design such as Kangas et al. (2013), Lahti, Seitamaa-Hakkarainen, Kangas, Härkki and Hakkarainen (2016) and Welch, Barlex and Lim (2000). The *embodied collaboration* focused on 1) drawing, 2) working with materials (investigating and picking up materials to support designing), 3) non-verbal cooperation (supporting ideation with hand gestures, nodding or shaking head or active monitoring of the ongoing situation) and 4) playing and off-topic activities (singing a song that is related to the theme, taking on the role of an animal related to the presented story or off-topic activities, which were not related to the task).

Table 3: Classification schema.

Main categories	**Subcategories**	**Description**
Verbal collaboration	Ideation	Students generate ideas, beginning new designing cycles
	Developing	Developing the design idea further or commenting on or answering a presented question about designing
	Agreement/ Disagreement	Supporting one's design idea, or disagreeing
	Questioning	A question, which generates or defines designing
	Organising process	Talk that focuses on organising one's work, planning and division of work (whose turn it will be)
Embodied collaboration	Drawing	Drawing on the paper or picking up materials, touching the perceived object
	Working with materials	Investigating materials, picking up materials or tools for implementation
	Non-verbal attendance	Monitoring silently what others are doing, supporting verbal ideation with gestures
	Playing and off-task	Playing a role, which is evolving from the task's theme or activity, which is not related to the task

After visualisation of the groups' statements and embodied collaboration (Figures 2–5), we identified children's social roles in their peer groups. This classification was based on children's verbal activity and the content of their statements. Embodied collaboration, especially non-verbal attendance, also gave information about a child's role in the group and confirmed classification. We found four different kinds of social roles, which we named leaders, partners, followers and observers. These roles are described in the end of results chapter.

The reliability of the analysis was ensured by using a parallel coder. After the first independent coding round, an inter-coder agreement was 79.5%. Both coders realised that some extra categories were needed to be able to represent children's speech and designing activities with enough detail. Coders negotiated and constituted a joint understanding of the required classification, and after this phase coders individually coded the data again. After the second

coding round, the inter-coder agreement was 90.7%, which indicates significant reliability of the classification.

Results

Overview of groups' designing activities

The data were first classified on the children's verbal interaction and embodied design activities. The histogram below (Figure 1) presents verbal collaboration (light grey on the left, numbers 1–5) and non-verbal, embodied collaboration (dark grey on the right, numbers 6–10). It represents (from left to right) each preschool groups' interaction (Birds, Foxes, Big Squirrels and Small Squirrels) related to designing. Next, it presents embodied interaction in the same order. The children's verbal collaboration was clearly focused on designing, they proposed ideas, developed ideas further, they were agreeing and disagreeing with the proposed solutions and they were asking questions and organising their processes. The embodied interaction was focused on drawing, investigating materials, non-verbal participation like hand gestures, as well as playing around or other off-task activities. Generally, the children were mainly concentrated on their work, but naturally there were differences in their concentration.

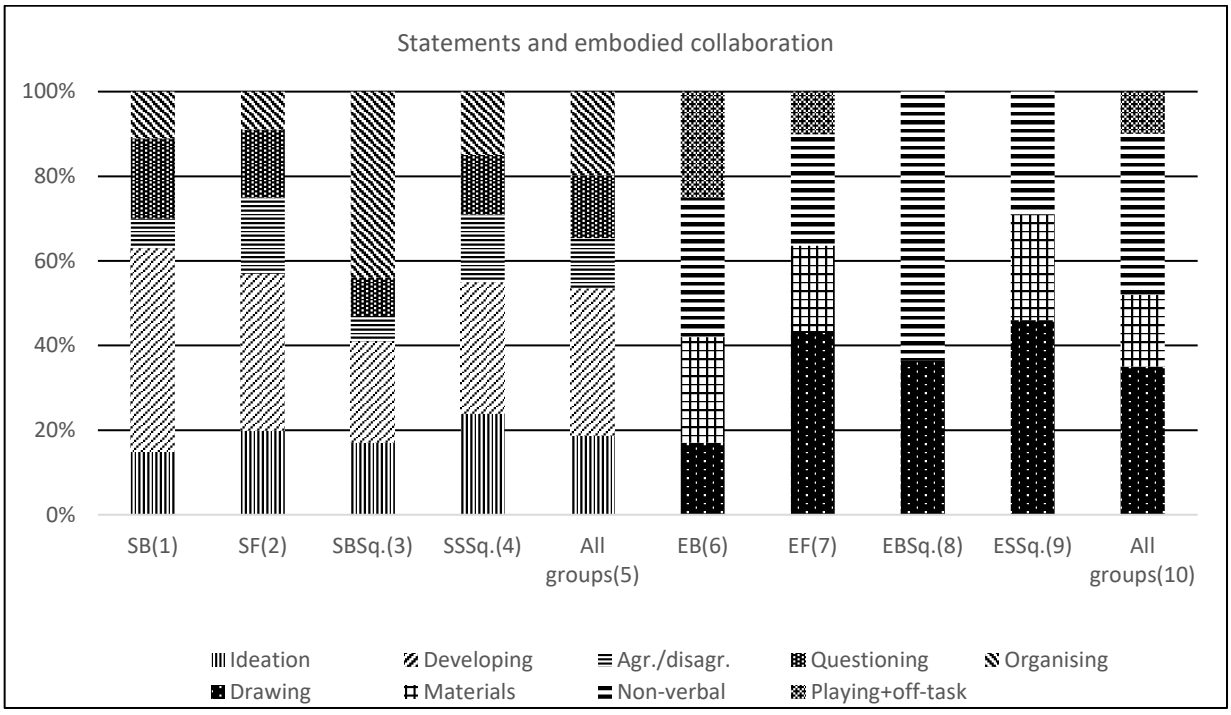

Figure 1. SB=Birds' statements, SF=Foxes' statements, SBSq=Big Squirrels' statements, SSSq=Small Squirrels' statements, EB=Birds' embodiment, EF=Foxes' embodiment, EBSq=Big Squirrels' embodiment, ESSq= Small Squirrels' embodiment.

The verbal interaction (columns 1–5) appeared to be quite similar in all teams. One third (1/3) of all groups' statements dealt with designing the idea further. On average, one fifth (1/5) of all

verbal statements offered ideas for the given task and began new designing cycles. Three groups of four had few statements that focused on organising one's work or whose turn it was. Only the group Big Squirrels had more organisation for taking turns with drawing or presenting ideas. The pre-schoolers had only a few expressions of straight agreement or disagreement (yes or no). They generally focused on the presented idea and continued their discussion from the basis of it.

However, when comparing groups' embodied collaboration and off-task activities (columns 6–10), there appears to be more variation between the groups. The Foxes concentrated on drawing, whereas the Birds had more off-task activities and non-verbal gesturing. This non-verbal gesturing was related to the designing, including silent monitoring of working (what the other group members were doing) or more versatile gesturing like pointing or proposing ideas with gestures to support their statements. The Big Squirrels' embodied collaboration consisted of drawing and non-verbal activities (such as using hands or head for gesturing and active, silent monitoring and attendance). The Small Squirrels' designing session consisted of drawing, material investigations and constant non-verbal attendance. Three groups of four investigated the materials, and only the Big Squirrels did not use that possibility. Playing, like taking on the role of a baby animal, and other off-topic-activities were present only in the Birds and Foxes groups, but did not occur at all in the Big Squirrels' or Small Squirrels' designing sessions.

In the following, we will describe each team's designing process on a more detailed level and introduce children's social roles, which were found in their peer collaboration.

Groups' peer collaboration on the task

Group Birds

Three children, one girl and two boys, belonged to the group Birds as seen in Figure 2. The division of the participation in relation to designing varied between children: Max was active in proposing ideas (ideation) whereas Mandy actively continued to develop ideas and elaborated on these ideas. However, most of the group's verbal statements were from Mandy, who presented about half of all the statements. It was typical for Mandy and Max to propose and develop the design ideas in a question form. Mandy also took on the role of organising their process. Elias was this group's silent observer. Although he did not participate actively in the verbal interaction or propose any questions to generate designing, he suggested some ideas and elaborated on them by using hand gestures. Example 1 represents his way of proposing suggestions.

Example 1

Max: Yeah. Let's make a pinecone storage.

Mandy: Yeah. Where do we make it?

Elias: [patting his hand above the drawing paper to show his suggestion for the place]

Mandy: Let's not make it next to these, cause then it's kinda stupid if the storage…

Elias: [patting another corner of the paper]

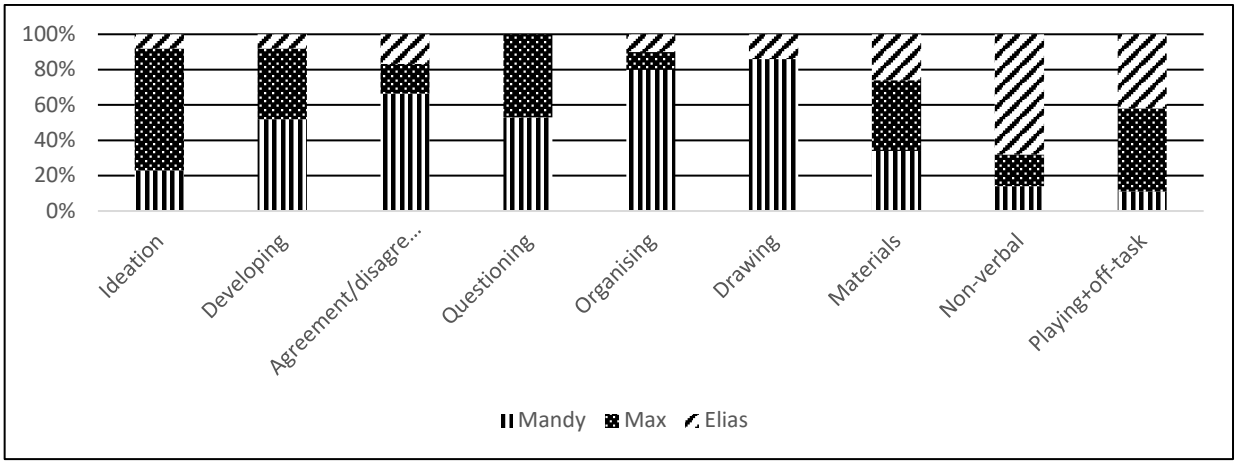

Figure 2. Group Birds' statements and embodied designing activities.

Mandy and Max focused on drawing. While Mandy dominated the drawing activities, Max and Elias engaged in playing activities at the same time. Although Max engaged in quite a lot of playing activities during the designing session, he was also the most active member of the group when considering their generation of ideas. He seemed to play and have his playing role, but at the same time he monitored group members' conversation and participated in it actively. This is very typical for preschool-aged children: they can move smoothly between real-life roles and fantasy roles (see review e.g., as suggested by Vygotsky, (2004)). As noted earlier, Elias contributed a minimal number of statements, but he actively monitored other group members' actions and made non-verbal suggestions for the designing task by using gestures. In general, all the group members mostly investigated the materials together.

Group Foxes

Two girls and two boys formed the group Foxes as can be seen in Figure 3. Rose and Axel were more active verbally, but the two other children, Sandra and Hugo, also had their roles in the discussions. Axel was the most active in proposing ideas, but the other two children, Rose and Sandra, equally participated by building up on those ideas and developing them further. The Foxes chatted mostly between two children, but there was less discussion as a group.

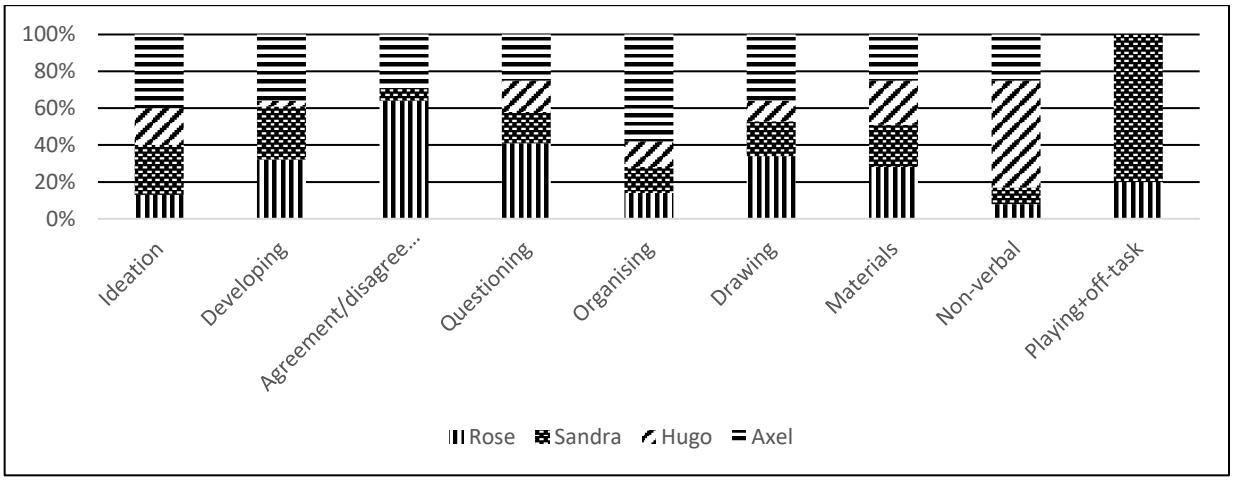

Figure 3. **Group Foxes' statements and designing activities.**

Rose showed good teamwork skills during the designing session. She, for example, gathered coloured pencils for the whole group and encouraged Sandra to continue with the designing task when she tried to end working. Rose also gave positive reactions for the other group members' suggestions and showed her agreement. It was typical for Rose to propose questions, but this is because of her tendency to present her ideas in question form rather than give straight suggestions. The Foxes only had a few statements for organising their work, and Axel presented most of these.

Figure 3 shows clearly each child's role in the embodied designing activities. Rose and Axel carried out most of the drawing activities, whereas Sandra managed to concentrate on the task only at the beginning of the designing session. She rather played most of the time under a table. Rose was mostly employed with the given task and chatted about their drawings with Hugo and Axel. These three children, (while Sandra was playing alone) explained their drawings at the same time when they were implementing them. Hugo took long pauses from drawing, but he used those moments for active, non-verbal investigating of other children's statements or drawings. The following example illustrates the Foxes' collaboration while they were drawing. Each of the group members seemed to work independently, but they actively monitored what the others were doing.

Example 2

Rose: Sandra, come here. There's colours here. Hey, where do we colour? [she has taken coloured pencils, chooses colours and begins colouring]

Hugo: Hey, I'm gonna put a steering wheel and wheels on my bed! [draws]

Axel: I'm gonna make…I don't know [continues drawing]

Hugo: I'm gonna make a wheel bed. Are you gonna make a putt-putt tractor? [continues drawing]

Axel: Heh, and then there's also that… [draws and chatters alone]

Hugo: Did you draw wrong? [asks Axel and draws]

Axel: Yeah [collects more coloured pencils]

Group Big Squirrels

Girls, Ada and Emma, and boys, Luke and Jason, were members of the Big Squirrels as seen in Figure 4. This group's verbal interaction was slightly different than the other groups' discourse. From Figure 4 (below), it can be seen that Jason did not participate in the verbal interaction during the designing session at all, and most of the discussion was between the girls.

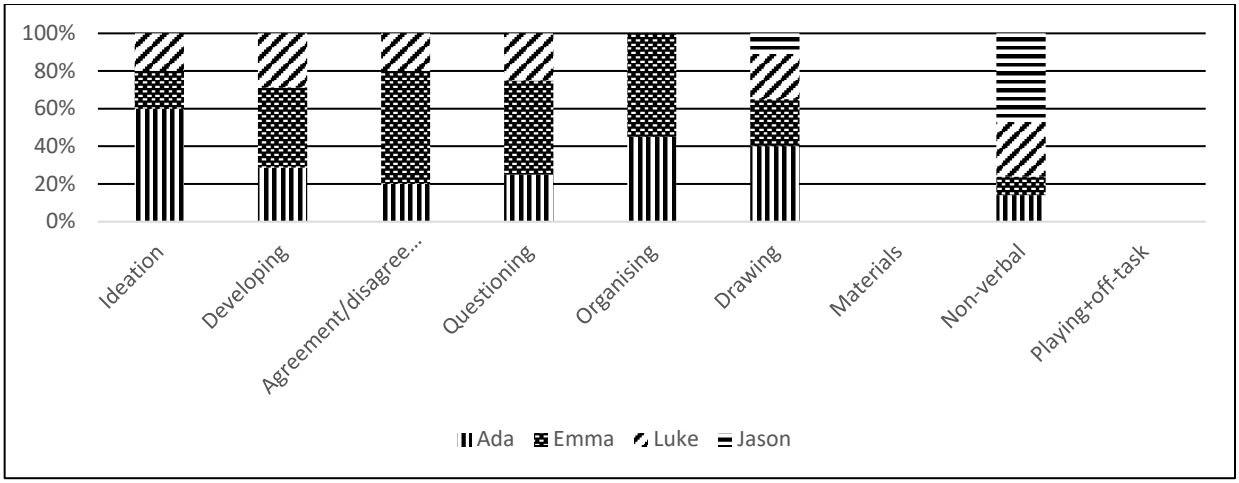

Figure 4. **Group Big Squirrels' statements and embodied collaboration.**

Most of the verbal statements focused on organising the group's work to give equal possibilities for each member to propose and draw their ideas for the design. For instance, Ada and Emma tried to engage Jason by giving him a pencil and advising how to draw the bed's leg (see Table 2: An example of transcription and observation from the group Big Squirrels). The group conversation mostly proceeded in this way, where Ada gave a suggestion, Emma replied, and Luke monitored the girls' discourse, and then he gave his input to the discussion. The group's cooperation started out well, but after an adult's verbal intervention they felt hurried, and the designing session became scattered.

Group Big Squirrels' embodied collaboration consisted mainly of drawing, and as stated before, they shared the turns for drawing and proposals. Ada drew a little bit more than the others, but Emma gave her drawing turns to Jason. The group's assistant (the kindergarten teacher) encouraged the children to investigate materials for the designing task, but they decided to continue drawing and discussing. This group's boys were deliberate, active observers: they

monitored the situation silently, while the girls used more gestures to specify their statements. Group Big Squirrels did not have any play or off-topic activities during the designing task.

Group Small Squirrels

Like the other groups, the Small Squirrels' group consisted of two girls and two boys as can be seen in Figure 5. Laura participated slightly more than the others. She was verbally active, and she initiated most of the ideas or developed them further. She also drew quite a lot, and the others let her keep that role, whereas Tim willingly examined the materials. Seeing and touching natural materials from a forest clearly helped him to generate ideas. Paul often used a question form in his speech. For instance, he wanted to ensure that he had understood things correctly, but he also gave some suggestions for the design and defined the idea in a question form. Melissa presented good teamwork skills: she carefully monitored what the others said, but she also gave many suggestions to generate the Small Squirrels' plan.

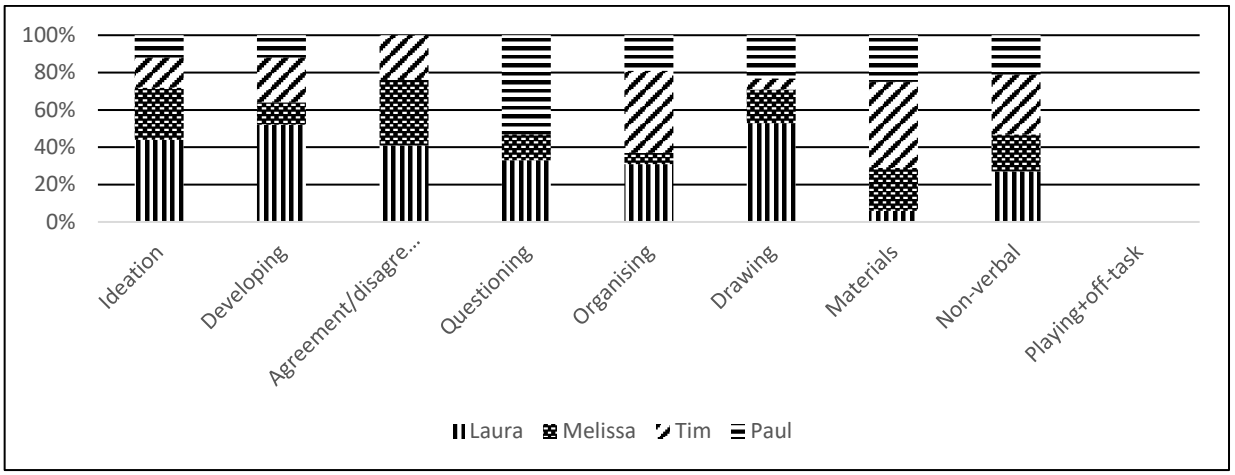

Figure 5. **Group Small Squirrels' statements and embodied collaboration.**

Tim played a notable role in encouraging the other group members to draw their ideas on the paper. This was because of an active organising of the group's cooperation. The Small Squirrels did not have any play or off-topic activities during the designing session. Example 3 illustrates the group's discourse, where all group members participated.

Example 3

Teacher: What else could be there?

Laura: Well, something soft, well…

Tim: Hey, cushions. Here and here [pointing with her finger]

Laura: I got it. Can there be spruce branches?

Teacher: Yes, spruce branches. Would they be like seats then?

Melissa: Or like as a carpet? Where should they be then? [pointing with her hand]

Tim: There [pointing with his hand]

Laura: No, here in the middle… [pointing to the designed door with her hand]

Paul: Could it be there too? [pointing with his hand]

Tim: Yeah, like a…

Laura: No, but there's an entrance

Melissa: There can be a lobby, where the squirrels can wipe their feet [pointing with her hand, drawing]

Laura: Okay. To the lobby, and here in the middle of the floor [pointing with her hand]

Tim: We're gonna make… so the carpet's there in the right spots

Children's roles in their peer groups

Four types of roles, both leader and follower roles, were found in children's peer collaboration. Each group had a *leader*, an active child who was active both in verbal and embodied collaboration. Leaders acted with *partners*, and these children generated most of the groups' discourse together. Partners had an active role too, but they preferred to answer the presented ideas by developing them or by presenting developmental questions. *Followers* were active actors, but they preferred to investigate the situation first and presented less statements as leaders and partners. *Observers* were the most silent children in their groups. Their role can be perceived from the subcategory of non-verbal embodied collaboration. Observers did not say anything or contributed a significantly lower amount of statements than the other group members during the designing session. They monitored the situation silently and gave some suggestions for the task using gestures.

Conclusion

The main objective of this study was to investigate the nature of preschool-aged children's collaboration during a designing task from the perspective of verbal and embodied interaction. This was analysed within the frame of sociocultural learning from children's discussions and embodied design activities with their peers in a situation where they received a task to design forest animals' nests. Speech, drawing and investigating materials, as well as silent monitoring and gestures, like hand movements or facial expressions and eye contact, were the basis for the children's communication and cooperation. The aim of the intervention in the kindergarten was to act in the most child-centred (Lerkkanen et al., 2016) way, where after a motivation session, the children received the task to solve and instructions to work in the groups with their

peers. Although the designing problem was not defined by the children, it was designed to align with their interests and be demanding enough for them. The children had to imagine the result of the task without making the final product at the same time (Hope, 2008), and they also had to verbalise their thoughts to the other group members, as well as find a way to work together as a team. The concept to work collaboratively, to solve the given task with peers and receive only minimal help from the adults, was new for these children. To support their activities, the children were given concrete materials to help their designing (Hope, 2008), and they were encouraged to investigate them. The possibility to investigate different kinds of constructing materials helped the children create more details for the plans, but there were, however, differences between the groups in how much their ideas arose from the materials or from discourse. Real materials from a forest and the texture of the materials, like softness, were important inspirational sources of ideation, which provided energy for the designing and pushed the processes ahead.

The results of the intervention showed that preschool-aged children succeeded in working collaboratively and finding ways to solve the designing task verbally with their peers. They had enough skills to express their thoughts, consider and listen to the other group members and find a way to collaborate as a group. Preschoolers' discussions followed a convenient designing session's structure, although their discourse consisted of shorter statements and less words than older children's or adults' conversations (Kangas et al., 2013; Lahti et al., 2016). Young children's verbal expression is often comprised of only a few words, and they usually don't generate proposed ideas by pondering various alternatives. Because of this, the designing cycles from an idea to another suggestion were quite short in the present data. Ideas were followed by some developmental statements or defining questions, and suggestions were easily accepted without disagreements. By using a lot of statements for organising their process, group members tried to give equal possibilities for all to express their ideas, like the Big Squirrels did. It was clearly seen that a child's ability to use language determined his or her role in the groups' collaboration (Fawcett & Garton, 2005). A shared understanding does not always need words, but communication can also be based on embodied thinking. There were differences between children in how much they used non-verbal expressions with gestures. For some children, versatile expression using both speech and gestures was natural, but other children were too shy to tell their thoughts aloud, although they made good suggestions for details using gestures. Typical non-verbal expressions were nodding or shaking the head, pointing or tapping the sketch with the hand or a pencil, or delineating the suggestion, such as when Emma clarified the form of a lamp with her hands. As is well known, play is an essential part of a pre-schooler's life, and therefore it is impossible to separate it from young children's collaborative activities. The young children clearly needed time to process the given task by doing something else for a while. In this case, some of the children lolled in their shelters under the tables, some other children played for a while, like Max and Sandra, but after a short break, they concentrated on the task again. Especially for Max, who took the role of baby bird, play seemed to be an expression of embodied thinking.

Design discourse has the unique potential to support shared thinking processes and gives a natural context in which to learn collaboration (Murphy & Hennessy, 2001). Opportunities for collaboration in crafts should begin at the preschool level, because craft activities provide a natural real-life situation to cooperate, negotiate and finally create a common product with peers. Thus, it is extremely important to trust in children's abilities to solve the given task in their own way without giving too much scaffolding (Sawyer, 2006a). An appropriate amount of scaffolding from a more skilled person assists children by passing on their skills, but children's own implementation of collaboration is the most valuable and instructive experience for them.

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