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Children's Peer Interaction While Playing the Digital Emotion Detectives Game

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ABSTRACT: Collaborative learning and collaborative use of digital technologies are essential skills in the twenty-first century. The aim of this study was to explore the features and types of interaction that can be identified during children's digital gameplay while playing in pairs. The following research questions were addressed: 1) What are the interactional play features that characterize the play sessions? 2) Which play types can be identified based on these interactional play features? 3) How do the interactional features and play types change during the eight-week play period? In this study, 16 children aged 5–6 years played the Emotion Detectives (ED) game in pairs at day care centres for 15–30 minutes per week. During the eight-week period, the children's gameplay was video-recorded, and three play sessions from each pair were explored using content analysis. The results of this study deepen our understanding of the features of children's playing in pairs and extend our knowledge of the suitability of the ED game for joint gameplay. On this basis, we make some recommendations for educational settings.

Keywords: collaborative learning, digital learning environment, playing in pairs

Introduction

Today, digital tools create a ubiquitous context and learning environment that can have a positive effect on children's social, emotional, cognitive and physical development (Blumberg & Fisch, 2013; Ito, 2009). Research indicates that children like to play digital games and that they are sociable and cooperative when playing these games with other children (Danby, Ewaldsson, Melander, & Aarsand, 2018). Compared to traditional ways of learning, digital games can make learning more pleasurable, motivating and effective (Breuer & Bente, 2010). Moreover, the interactive and multimodal features of digital games have been regarded as particularly useful (Arnseth, 2006) in helping children hone their social and emotional skills through reflection, feedback and collaboration (Stern, Harding, Holzer, & Elbertson, 2017).

In the communication-driven society of the twenty-first century, social-emotional and collaboration skills are important to be imparted during early childhood. Consequently, children should be provided with multimodal learning environments for practicing these skills. The Emotion Detectives (ED) game, a web-based freeware developed in Finland (Huttunen, Hyvärinen, Laakso, Parkas, & Waaramaa, 2015), aims to support the development of children's social-emotional skills. The ED game was originally designed for individuals to mainly play alone, with feedback and support given by a virtual assistant. However, as it is common that young children tend to interact with each other when playing digital games, we opined that playing the game with another child or with an adult would also have the potential to support the development of children's social-emotional skills. Thus, the focus of our interest turned to the quality and type of interactional features observed when children play together. This focus was also motivated from the research evidence on the benefits of collaborative learning and the usefulness of games in supporting such learning (Hummel et al., 2010; Whitton, 2010). In the ED game, social-emotional learning can actually be supported at three different levels: with the tasks of the game as such, in working with a pair and with support from an adult. In this study, we focus on exploring the interaction features in children's playing in pairs and whether these interaction processes change during the play period.

The objective of this study was to explore children's gameplay as a collaborative learning environment. Before presenting the children's interactional features when playing the web-based ED game, we briefly describe the prerequisites and features of collaborative learning using digital tools.

Collaborative learning

Collaborative learning is a process in which children participate in joint activities and strive towards a common goal through joint construction of knowledge, meaning and understanding. Thus, negotiations and sharing ideas and knowledge—that is, thinking together—is emphasized in interaction (Danby et al., 2018; Tomasello, 2016). An increasing number of studies have shown the effectiveness of collaboration to support learning (Cress, Stahl, Ludvigsen, & Law, 2015; Gómez et al., 2013; Miyake & Kirschner, 2014).

Collaboration deepens learning; moreover, it increases motivation and engagement, enhances critical thinking and shared understanding, promotes co-regulation and skills in the co-construction of knowledge and provides opportunities for developing social skills (Gómez et al., 2013; Järvelä, Volet, & Järvenoja, 2010; Tolmie et al., 2010; Tomasello, 2016). Therefore, it can be considered beneficial for social-emotional learning as well. However, it is not self-evident that social and collaborative aspects lead to successful interactions and learning (Oksanen, Lainema, & Hämäläinen, 2017). Conflicts are common during collaborative learning (Mercer & Littleton, 2007), but resolving conflicts can lead to the development of knowledge and skills by constructively working through problems (Lim, 2012; Wohlwend, 2010).

Collaborative learning and digital technologies

Previous studies have shown that children are eager to play digital games with peers (Danby et al., 2018; Lin, 2012; Maynard, 2010; Yelland, 2011). Therefore, one of the most important benefits of using technology in educational settings has been derived from the potential of digital games to encourage collaborative activity (Jeong & Hmelo-Silver, 2016; Ljung-Djärf, 2008), and a growing number of studies have highlighted the use of digital games to support collaborative learning (Hummel et al., 2011; Whitton, 2010). Studies on children's interaction while playing digital games with peers have shown that children engage in collaborative play by sharing ideas, negotiating for turns, solving problems and supporting each other (Flewitt et al., 2015; Kucirkova, Messer, Sheehy, & Fernández Panadero, 2014; Moore, 2014; Wohlwend, 2015). In addition, during joint play sessions, children's social behaviour can vary from collaborating with and helping each other and having fun to dealing with competitive tensions and disagreements (Falloon & Khoo, 2014; Lawrence, 2017). Typical tensions and disagreements stem from control of the device, demands for a turn, exclamations about unfairness and objections to partner's moves (Falloon & Khoo, 2014; Lawrence, 2017). Such tension over resource control is usual among preschool children during

traditional play as well (Vaughn & Santos, 2009). In addition, children's role can vary—for example, from leader to observer—during the play session (Ljung-Djärf, 2008; Arnott, 2016).

At their best, such collaborative activities can promote children's problem-solving abilities, critical thinking, social abilities, self-esteem and decision-making skills (Maynard, 2010; Stephen & Plowman, 2008; Wohlwend, 2010). Nevertheless, it is not self-evident that children cooperate (Ljung-Djärf, 2008), or collaborate when playing on a computer. Collaboration necessitates children's active participation and motivation towards achieving common goals through joint construction of knowledge and understanding (Jones & Isroff, 2005). Thus, negotiations and sharing ideas and knowledge—that is, thinking together—is emphasized in interaction (e.g. Arvaja, 2005). In this process, however, the social and affective factors are also crucial (see Jones & Isroff, 2005). In general, aspects such as age, temperamental characteristics and learned habits, relationship with playmates and the context of the gameplay have an effect on peer interactions (Howes, 2011). In particular, children's social competence is an important factor affecting interaction with peers; socially competent children succeed in playing with peers, are able to help their playmates, resolve conflicts and participate in reciprocal turn-taking (Howes, 2011; Rubin, Bukowski, & Parker, 2006). In addition, playmates who are friends collaborate and solve conflicts through negotiations more often than playmates who are not friends (Rubin et al., 2006).

Research questions

This article describes children's interactions while playing the ED game in pairs at day care centres located in two municipalities in Finland. The aim was to explore this digital game as a collaborative learning environment, particularly the interaction and game play features that emerged during children's play. Although the number of studies exploring children's interaction during gameplay has slowly increased in recent years, the knowledge on the interactions around digital games and the computer-supported collaborative learning process of young children remains limited. Moreover, there is scarce information on the changes that occur in children's interactions due to shared gameplay history. Accordingly, we set the following research questions for this study: 1) What are the interactional play features that characterize the play sessions? 2) Which play types can be identified based on these interactional play features? 3) How do the interactional features and play types change during the eight-week play period?

Method

The data comprised video-recordings of 16 typically developing children aged 5–6 years, who played the ED game in pairs at three day care centres. The data was part of a larger data set on the effectiveness of the ED game. Written informed consent for each child's participation was obtained from the children's custodians. The children provided their oral assent. In addition, the leaders of the day care centres and the teachers provided their informed consents.

There are many important ethical issues to consider when using young children in research, such as consent and informing the children about the specifics of the study and their rights (e.g. Flewitt, 2006; Morrow, 2008). The first author informed all the children's custodians and the teachers about the study and discussed playing the game as part of the study, and also told them about their right to withdraw from the study at any time and assured them that the children's and the day care centres anonymity would be maintained. Further, the first author asked the children for their permission to their gameplay sessions to be video-recorded. Because the researcher was not present when the sessions were video-recorded, the teachers, who recorded the gameplay session, were instructed to ask for the children's permission before each recording and ensure their voluntary participation. In addition, since children may not always understand their right to withdraw from participation, the researchers and teachers attempted to be sensitive to any reluctance to playing and respected the children's wishes.

Further, laptops and Wi-Fi devices to secure a fast and reliable Internet connection were loaned to each day care centre to enable children's gameplay. The children were asked to play the ED game with a peer for 15–30 minutes per week over a period of eight weeks at their day care centre by using a specific pair-account for log in. In two day care centres, children were allowed to decide their partner themselves, whereas in one day care centre the teachers decided the pairs. In addition, each child was also asked to play alone for 1–2 hours per week at the day care centre or home by using a specific single-player account. The duration of the play sessions was logged using a specially designed tracking system embedded in the research version of the ED game.

The main data comprises three play sessions from each pair that were video-recorded using GoPro cameras, which were placed on the edge of the table on which the laptop was placed. During the video-recording, children were initially interested in the camera, particularly during the first play session. However, most of the time children seemed to forget the camera's presence, although every now and then they looked at the

camera—smiling, blinking, making faces, or checking whether the camera was still recording. One play session was recorded in the first week, one in the middle of the eight-week-period and one in the last week of the play period. The purpose of this periodic data collection was to trace the possible changes taking place in the children's gameplay. The children played in pairs for six weeks on average at the day care centre (range 4–8 weeks), with the total play time per pair ranging from 91 minutes to 158 minutes. The mean total duration of the play sessions was 2 hours and 3 minutes (standard deviation (SD) 26 minutes). The total duration of the play sessions video-recorded for the analyses was 6 hours and 52 minutes, with a mean of 52 minutes (SD 10 minutes) per pair.

In the first phase of the analysis, all video-recorded play sessions were transcribed, and all identifying characteristics, such as the name and gender of the children, were changed to codes (e.g. C1, C2,...) to pseudoanonymize the data. Next, the data were studied repeatedly in order to identify interactional play features. Thereafter, the interactional play features were reviewed for accuracy and classified into thematic categories using content analysis (see e.g. Graneheim & Lundman, 2003; Schreier, 2014). Initially, nine different interaction features were identified in the playing in pair sessions: negotiations, cooperation, having fun, motivation to play, following the rules, helping and sharing ideas, conflicts and disagreements, competition over one's skills, and playing alone when joint play did not succeed. The identified features were based on the data but shared similarities with previous studies (Flewitt et al., 2015; Howes, 2011; Lawrence, 2017), and the names of the features were aligned with these studies. Furthermore, these features were arranged in a table that placed the child pairs to identify each feature in the play sessions of each pair.

After identifying the features, they were classified into three categories, each of which were labelled according to their contents. The features were categorised as skill- and interest-related, collaboration-related and atmosphere- and situation-related features. The categories were named with hypernyms that described different aspects of the play session. Then, each pair's play type was determined with the help of the interactional play features, by arranging the features and the pairs in a table. Finally, possible changes in play interaction during the play period were explored by tracking the changes in the play features of each child pair's three play sessions. The analyses were conducted independently by two researchers, and any discrepancies were resolved through discussions with each other and also discussed with the research group for better reliability.

The Emotion Detectives game

The game design was not the focus of this study, but since children discuss the game content a lot and the qualities of the game partially determine children's interaction, it is worth introducing here. The ED game (Huttunen et al., 2015; see also Huttunen, Kosonen, Waaramaa, & Laakso, 2018) was designed to support the development of emotional knowledge skills of children aged from 5 to 12 years, as well as their prosocial behaviour and problem-solving abilities. The game's tasks concentrate on recognizing emotional expressions, labelling emotions and understanding the factors that evoke emotion (Koivula, Huttunen, Mustola, Lipponen, & Laakso, 2017). There are also tasks in which the player is required to practise his/her emotional regulation skills, for example, what kinds of thoughts or acts help to strengthen positive emotions and overcome negative emotions.

In the game, the player sets up an Emotion Detectives office (Figure 1) with a virtual character named Aksu (Figure 2). The Emotion Detectives collect fame points by solving problems in social situations and by practising their emotional skills in the context of various tasks to compete against similar enterprises in town. When the player has earned sufficient points, they obtain new tools (e.g. the Emotion Radar, Magnifying Glass and Emotion Glove) and these can be used to proceed to the next level in the game. The player collaborates with Aksu, who guides the child's thinking by asking questions, providing supportive feedback as well as encouraging, praising and demanding good prosocial skills—for example, being polite and saying thank you. The game finishes when the player earns a diploma that qualifies him/her as an Emotion Detective.

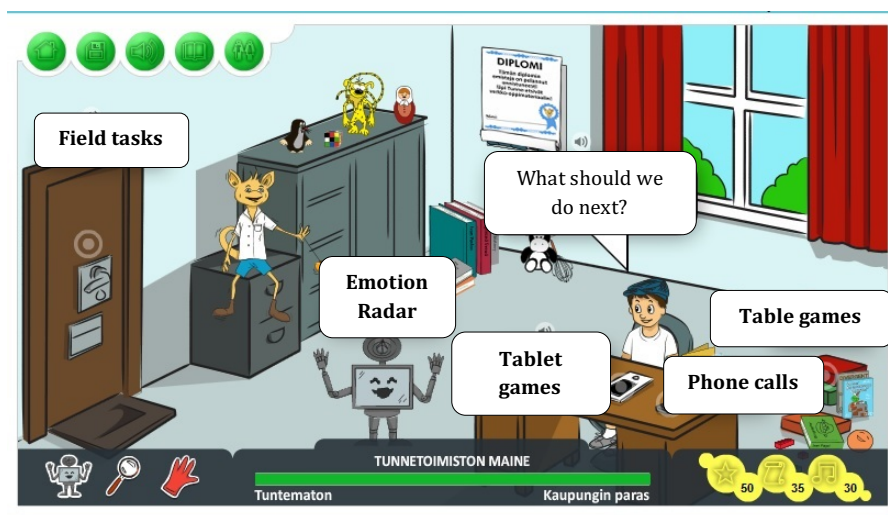


FIGURE 1 Office of the Emotion Detectives.

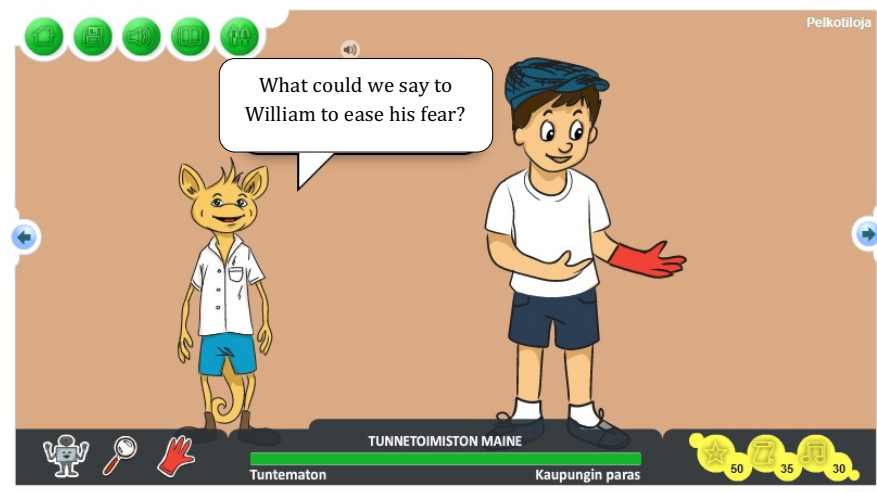


FIGURE 2 Virtual character Aksu helping the Emotion Detective with the use of the Emotion Glove.

In the present study, since the children were 5–6 years of age and not necessarily able to read, the game was coded into a version in which all the tasks that required reading skills were omitted. In the game, the players also have the option of listening to all the written texts by either having the listening mode on all the time or by clicking the loudspeaker icon beside each text box or speech bubble.

As a learning environment, the ED game design ensures that children have opportunities to repeat their favourite tasks and use their imagination, for example, dressing a character in the Mannequins of Mr Eagle Owl the Dressmaker task (Figure 3). Further, the ED game strengthens children's concentration by using humour and playfulness, with Aksu commenting on the player's actions using gestures and an encouraging tone of voice. For children prone to conflict in real-life situations and who often experience failure and negative feedback, such a learning environment provides them with opportunities to practise how they should behave in social situations in a safe and constructive manner.

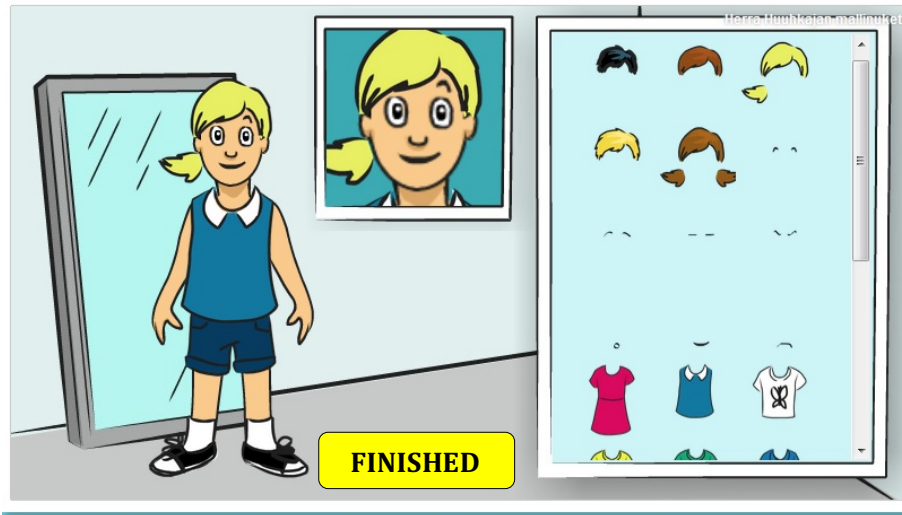


FIGURE 3 The Mannequins of Mr Eagle Owl the Dressmaker task.

The ED game is not specifically designed for playing in pairs, but it provides a collaborative learning environment, as the gameplay setup enables two or more children to play while seated side by side, sharing the screen and the touchpad. This permits the children to chat about their gameplay, negotiate on turn-taking and the game's tasks and discuss the social situations and emotions presented in the game. Hence, it is interesting to explore how the ED game works as a setting of playing in pairs, what actually happens during joint play sessions and whether the quality of interaction changes during the eight-week play period with the same partner.

Results

By focusing on peer interaction during digital gameplay, the study enables an exploration of what kind of collaborative learning environment the ED game provides for children. It is plausible that children's interaction during gameplay in pairs has unique characteristics, which stem from various factors (e.g. problem-solving skills, negotiations and peer support; for example, see Kurcikova et al., 2015) and which have an effect on their learning process. Therefore, it is important to add knowledge and understanding by exploring the similarities and differences in children's peer interaction and collaboration. First, we identified certain interactional key features characterizing the play sessions. Second, based on the variation found in the data, we recognized different play types. In addition, we explored the kinds of changes that took place during the gameplay across many weeks.

Interactional features of playing in pairs

We identified nine interactional features of playing in pairs (Table 1) and grouped them into three categories: 1) Skill- and interest-related, 2) collaboration-related, and 3) atmosphere- and situation-related features. *Skill- and interest-related features* comprised engagement and motivational play skills; *collaboration-related features* included peer relationships, collaboration, adoption of rules and negotiation; and *atmosphere- and situation-related features* were explored within the framework of other situational factors that emerged during the play sessions and included conflicts and disagreements, concentration and having fun.

TABLE 1. Identified interactional features and play types

	Interactional play features	Play type		
		'Conflict-prone play' (N = 2 pairs)	'Ambivalent play' (N = 3 pairs)	'Collaborative play' (N = 3 pairs)
Skill- and interest-related features	Engagement & motivation	Unwillingness to play together. No shared goal. Different motivations to play.	No explicit goal verbalized, but still motivated to play.	Explicit (verbally communicated) shared goal and good motivation to advance in the game.
	Play skills	One child had more experience in playing ED and was a more competent player.	Equal, but one child considered him/herself more competent than the other in playing the game.	Equal. One child was able to read at least a bit, which helped in advancing in the game.
Collaboration-related features	Peer relationship	Distant.	Unequal. One child dominated, but the children were friendly towards each other.	Partners behaved like friends.
	Collaboration	Only some collaboration when one child tutored the other.	Collaboration existed but was not equal: the other child dominated.	Fluent collaboration: turn-taking and negotiation.
	Rules	No shared rules.	Rules changed all the time or caused conflict.	Clear, shared rules were adopted.
	Negotiation	Negotiation on whether to stop or continue playing.	Negotiation on whether to choose the right or deliberately wrong answer, identify the correct answer, or about who knows the correct answer.	Occasional negotiation on turn-taking and the correct answers.
Atmosphere- and situation-related features	Conflicts & disagreements	Continuous conflicts with regard to turn-taking.	Frequent tension and disagreements regarding the rules and answers.	Seldom brief disagreements and tensions.
	Concentration	One child would often try to concentrate on the game, while the other attempted to draw their attention elsewhere.	Concentration was occasionally weak; both children were impulsive or distracted.	Concentration on playing was good.
	Having fun	Occasionally playing with the game's funny features or with other things like the video camera.	One partner liked to fool around more than the other. Occasionally playing around with the game's funny features or with other things like the video camera.	Frequently laughing at the game's funny features, playing around occasionally.

Skill- and interest-related features

Children's engagement and motivation were important factors in successful playing in pairs, which manifested as the desire to proceed with the game. Lack of engagement led to frequent conflicts. Furthermore, in certain child pairs, the partners had differing motivation levels. This was evident in situations in which one child wanted to concentrate on playing, while the other wanted to have fun, for example, by deliberately selecting incorrect answers. Some children also lacked motivation for joint gameplay because they had not selected their partner themselves. The following example illustrates this.

EXAMPLE 1 Lack of motivation to play with a partner allocated by an adult.

C1: *Here it is. I don't understand why I had to come and play with you. I don't want to play with you.*

C2: *With whom would you have liked to play?*

C1: *[Child's name]... S/he is probably playing with someone else.*

(Pair 037)

This example shows that one child's inability to choose their own partner decreased their motivation to play the game. In this example, the other child showed their dissatisfaction by sharing their opinion of their allocated partner. In contrast, the next example shows a shared motivation to play.

EXAMPLE 2 Shared motivation to play.

C4: *Let's try to get that one [C4 points to the magnifying glass on the screen]—the Magnifying Glass. Let's try to get it.*

C3: *And the Emotion Glove! [speaking excitedly]—and finish this [game].*

C4: *Yeah, let's try to get the Magnifying Glass as well. [C4 points to the magnifying glass on the screen].*

(Pair 051)

This example shows that the game itself has motivating features, like the Magnifying Glass and the Emotion Glove, that encourage children to continue playing and collect more fame points to enable them to proceed. In the example, the partners use 'we-talk', which reflects collaborative play. This is a typical example of how the children reminded each other about the tools they were missing and about their shared goal to obtain new tools. The following example demonstrates increased motivation as the pair obtains a

new tool.

EXAMPLE 3 Engagement in play.

C4: *Let's hope that we get the Magnifying Glass this time. Look how close we are to the point where you get the Magnifying Glass!* [C4 points at the fame points on the screen.]

...

The voice of the Emotion Detective, generated by the ED game: *We have received a post from the Emotion Virtuoso Club.*

Both children are bouncing on their chairs and looking at each other with enthusiasm, shaking their hands above their heads.

C4: *Yeah, we got the Magnifying Glass! Yeah!* [C4 is moving around on the chair with enthusiasm.]

C3: *Yes! I think our fame points need to be right there so that we can get the Emotion Glove.* [C3 points at the screen.]

C4: *Let's play very well! Yes, we got the Magnifying Glass!*

C3: *Yeah!*

C4: *Yeah, yeah, yeah! Yeah, we got the Magnifying Glass!*

(Pair 051)

This example illustrates the children's joy on obtaining a new tool in the game. They were jubilant and praised themselves by clapping their hands, raising their hands above their heads and giving 'high fives' to each other. This joy lasted for the duration of the play session, and the pair remembered it afterwards. They also wanted to tell others about their new tool. This motivated them to continue to play to obtain the next tool.

Another important factor in the successful joint gameplay was the children's play skills. Some children had more experience and competence in playing the ED game than others, as the former played it alone at home, which appeared to lead to inequality and frustration during gameplay, as the other child was unfamiliar with the game. In addition, if one partner was able to read, then some parts of the game were easier for them and they could make the gameplay more fluent. This was despite the fact that all the texts and speech bubbles could also be listened to in the spoken version of the game. Further, since some children did not have any experience in using a laptop or touchpad, this led to peer tutoring at the beginning of the play period, as one partner advised the other while playing. This is evident from the following example:

EXAMPLE 4 Uneven play skills between the partners.

C2: *You are just not able to do that [laughing]. Just click on that, that, that, that, and that, will you? And that and that. And now you choose that.*

C1: *What am I doing...? Tell me what I should do. How can I get further from this point?*

C2: *I can help you. Let me help you. Look, I can do this!*

...

C2: *Oh, put it right there. [C2 points at the screen.]*

C1: *Okay, which one?*

C2: *This one here [points at the screen]. And now you put it on the sad one... This one you move to [points at the screen]. Are you able move it like this... and now put it there like that.*

C1: *Yes.*

(Pair 027)

This extract reflects the typical phenomenon of peer tutoring, which emerged when one partner did not know what to do in the game and possibly lacked the required technical skills. As the example shows, C2 became slightly frustrated because C1 could not use the touchpad correctly. However, this may have strengthened C2's self-management skills, as C2 had to regulate his/her own emotions while playing. Such a situation typically arose when playing ED for the first time. Subsequently, peer tutoring shifted to negotiation and arguments over who knew the correct answer and who had the right to select the answer.

Collaboration-related features

Another interactional feature characterizing the playing in pairs was the extent of collaboration, which included verbal negotiation and shared rules for the gameplay. In this play context, negotiation implied discussion about the tasks or answers to be selected or whose turn it is to play, whereas conflicts and disagreements referred to partners arguing and expressing their opinions, without listening to each other at all and not even attempting to compromise. Some pairs negotiated more on which answer to select, while others mainly negotiated for turn-taking. Further, some negotiations led to tensions and disagreements if, for example, one partner was unable to negotiate or had a strong opinion about the task. According to a typical rule in the children's gameplay, the partner whose turn it was to use the touchpad usually had the right to select the answer,

as illustrated in the following example.

EXAMPLE 5 Negotiation on turns and rules of play.

C3: *Let's take turns clicking, right?*

C4: *Yup.*

C3: *Now it's your turn. Now mine.* [Prevents C4's hands from moving towards the touchpad.] *Okay, you can have this task. I can read the alternatives.*

C4: *Okay.*

C3: *Click there* [advising on how to use the touchpad]. *Is it scared, happy, angry...* [simultaneously pointing at the words with a finger]? *One. Happy, sad, or...*

C4: *Angry, it's angry.*

C3: *You can have two [turns]* [shows using fingers] *and I'll have two.*

C4: *Okay.*

(Pair 051)

This example shows how the children created the rules for turn-taking within the first play session. The example also illustrates the flexibility of the rules, as C3 lets C4 do the task, appoints himself/herself as the reader and ultimately modifies the rules.

The results suggest that the pairs with shared rules for gameplay collaborated more than the others, concentrated better and negotiated more on the answers. On the other hand, pairs without shared rules negotiated on turn-taking in particular. Subsequently, when the pairs were familiar with the game and with the idea of playing together, the rules were followed less strictly. Once the pairs had played the game for a while, they began negotiating more for the answers, which is illustrated in the next example.

EXAMPLE 6 Negotiating for the answers.

The voice of the narrator in the ED game: *How do you think the boy is feeling right now? He is...*

C6: *What do you think?*

C5: *Astounded, let's choose 'astounded'. Here is happy, exhilarated, unsure, astounded, embarrassed, confused. Which one do you think it could be out of these?*

C6: *Could it be 'confused'?*

C5: *Let's choose 'confused'.*

The voice of the Emotion Radar in the ED game: *Buzz buzz. The emotion chosen seems to be incorrect.*

C5: *Wrong one. Let's pick 'embarrassed'?*

C6: *No. Could it be 'ashamed'?*

C5: *No. It must be 'astounded' because I have played this before and I think I chose it then.*

(Pair 055)

This conversation demonstrates how the children negotiated on which answer to select. C5 appeared to know the correct answer, but was attentive to or wanted to discuss the answer with C6. Even though C6's suggestion differed from C5's opinion, they decided to select C6's answer. Only once C6's answer was declared wrong, C5 selected the answer that they should have selected from the beginning. This example also illustrates how the children deepened their social awareness, as they learned to be more flexible and sensitive towards their partner's different perspectives.

Moreover, successful collaboration depended on the relationship between the partners and the children's social skills. All the children knew each other, but collaboration between friends appeared to work better than between acquaintances. The lack of collaboration may also have been the result of child's poor social skills, which was demonstrated in an inability to negotiate or take turns. However, collaboration was unsuccessful in certain pairs, even though one partner tried their best. In addition, our observations indicated that an adult's presence in the playroom appeared to increase collaboration and decrease conflicts, as the adult occasionally reminded the children to cooperate with each other.

Atmosphere- and situation-related features

In our categorization, atmosphere- and situation-related features included the number of disagreements and conflicts, concentration, and having fun during the play sessions. We included disagreements and conflicts in this category because of their continuance and significant influence on the atmosphere of the play session. Certain pairs, particularly those representing the conflict-prone and ambivalent groups, had more disagreements, tensions and conflicts than others. Most of the conflicts were related to turn-taking and who would decide which answer to select. Occasionally, the children argued over who was right. Some conflicts and disagreements stemmed from differences in the motivation to play and poor social skills and were evident, for example, in challenges in turn-taking and negotiating. The pairs were able to solve most of the conflicts independently, for example, by appealing to the rules and an equal right to play,

or by changing the task or topic of conversation in the game. The next example highlights a conflict over turn-taking.

EXAMPLE 7 Conflict over turn-taking.

C2: *Now it's my turn to do this.*

C1: *Now I am able to do it!* [C1 takes over the laptop.]

C2: *Wait! No, I can do it!* [C2 pulls the laptop back.]

C1: *This is a joint game!*

C2: *But you had more [time for playing] than I had!* [C2 takes over the laptop.]

C1: *Joint game!* [C1 tries to take over the laptop.]

C2: *Wait, you played longer than I did!*

C1: *This is a joint game!* [C1 tries to take over the laptop.]

C2: *But you had more so now it's my turn.* [C2 takes over the computer for him/herself.]

C1: *I'll tell the teacher.*

C2: *Listen, you have played more than I have.*

C1: *I'll tell [teacher's name] so that s/he comes and stops us from playing, okay?*

C2: *Look, I'll choose a tablet game, it is an easy one. I'll also let you play it because this is such a good game.*

C1: *I have already done this task. I want to play.* [C1 takes over the laptop.]

C2: *No don't!* [C2 turns their back to C1.]

(Pair 027)

This example is illustrative of a conflict the players cannot resolve alone. Usually, the conflicts and disagreements were brief and the children could easily resolve them, but longer conflicts disrupted the gameplay. In the example, it is evident that C2 attempted to take his/her turn by claiming that C1 had already played more, but C1 wanted to play and did not listen to C2, who appealed to the rules on turn-taking. They ended up pulling the computer back and forth to prevent the other from playing. Finally, C1 threatened to tell the teacher. As a counteroffer, C2 said C1 could do one of the tasks. This example shows that despite insisting that it was a 'joint game', C1 struggled with turn-taking and negotiating.

Further, the children's concentration on the game depended on their level of attraction to different parts of the game and on their attention span. For example, if one partner

was not motivated to play the game, this partner tried his/her best to distract the other partner. Obtaining a new tool in the game enabled children to advance in the game, improved their concentration and motivated them to continue playing. Further, as the children became more familiar with the game and had played the game through once, they proceeded through it relatively quickly. This occasionally led to mistakes, as they did not listen to the instructions and response alternatives as carefully as they had the first time. In addition, external environmental factors also distracted the children, such as movement outside the window or someone entering the room.

However, despite the conflicts, all the pairs also had fun while playing. They laughed at Aksu's funny comments, made funny characters in the Mannequins of Mr Eagle Owl the Dressmaker task, selected funny answers, played with the screen by changing the size of the game display or did some other humorous things that were not actually related to playing the game itself. When there was no adult present, all the pairs fooled around with the camera. The following example illustrates having fun with the game.

EXAMPLE 8 Having fun with the Mannequins of Mr Eagle Owl the Dressmaker task.

C1: Wait, can you put the hair on it? Choose one of the boy's hair.

C2: Why?

C1: This one or this one, and I'll choose the lighter one. Now it's good. Light hair. Happy. And a dress. [Laughing.] This is a boy. And another dress. And then trousers [tries different clothes on the torso and laughs], sneakers.

C2: And then click on "Save".

C1: Come and look at our old man [asking for the teacher to come]! A boy with a dress and ballet shoes!

(Pair 047)

This is a typical example of having fun with the game. The children enjoyed trying things that they could not try in real life, and the Mannequins of Mr Eagle Owl the Dressmaker's task offered a good opportunity for this. In this task, the children usually collaborated and negotiated on how to dress the character.

Play types

To answer our second research question, different play types were explored based on the interactional play features of each pair. Three play types were identified: 1) conflict-prone (two child pairs); 2) ambivalent (three child pairs); and 3) collaborative (three child pairs) (see Table 1).

In the *conflict-prone play type*, the partners' relationship was distant. The children did not want to play together, which decreased their collaboration during the play sessions. The main features characterizing these child pairs were the children's lack of motivation to play together and their poor ability to create shared rules for collaborative play. The two pairs that reflected this play type tended to get stuck on conflicts over turn-taking and often debated on whether to continue playing. When one partner wanted to concentrate on playing, the other one attempted to shift the attention elsewhere. Despite this, the partners achieved some collaboration, for example, in the form of advising the other child. They also had fun, for example, by playing around with the game's funny features or with other things like the video camera.

In the *ambivalent play type*, the partners could be friends but their relationship was unequal, as one partner dominated the gameplay. The dominating partner considered himself/herself to be a more competent player, which made their collaboration unequal and led to conflicts over turn-taking and selecting answers. In ambivalent play—unlike in conflict-prone play—the pairs were motivated to play and had shared rules, even though they had difficulties following them. The partners' motivations to play also differed, as one child wanted to fool around more than the other, for example, by deliberately selecting incorrect answers or fooling around with the video camera.

In the *collaborative play type*, the partners behaved like friends and had explicit shared goals and good motivation to proceed with the game. The child pairs negotiated fluently and collaborated effectively, with clear shared rules and equality, for example, in turn-taking. In this play type, the partners concentrated well on playing—they had brief disagreements but also had a lot of fun. The main differences between the ambivalent and collaborative play types were the partners' relationships, the clarity and the consistency of the rules applied and the ability of the partners to concentrate on playing.

Changes in interactional features of playing within the play types

For our third research question, changes in each pair's interactional features during the three selected play sessions were tracked feature-by-feature. Changes primarily occurred in engagement and motivation, conflicts and disagreements, and negotiation and collaboration. In contrast, few or no changes occurred in concentration, playing skills and having fun. None of the child pair's play type changed over the eight-week play period. Nevertheless, some changes took place within each play type, with the interactional features representing both positive and negative changes.

Over the eight weeks, changes were observed in the children's playing in pairs. In the last week, the pairs that were grouped into the *conflict-prone play type* were more

motivated to play than they previously were, had fewer conflicts over turn-taking and demonstrated at least some collaboration while playing. Despite this, they still did not have any shared rules for play. In contrast, the motivation of the pairs that were grouped into the *ambivalent play type* decreased due to differences in the partners' play styles, for example, one child played seriously and the other fooled around. However, collaboration increased and the relationships between the children equalized, as the pairs negotiated more during the last week of the play period as compared to in the beginning, when one partner had made most of the decisions.

In pairs that were grouped into the *collaborative play type*, the children's engagement and motivation increased even more as they proceeded in the game. These three pairs negotiated more on the answers, whereas in the beginning of the play period, the one who used the touchpad was the one who decided which answer to select. During the last play session of the play period, play became more casual and the pairs had even more fun than before. However, simultaneously, more conflicts also emerged because the children had relaxed with rules.

Discussion

The purpose of this study was to explore the collaborative learning environment created in gameplay by studying children's interaction as they played the ED game in pairs. We identified nine interactional features of play, three play types and clearer changes in six interactional features. Even though there were some variations in interactional features during the period of eight-weeks, there were no changes in the types of the playing in pairs. Further, we found that the ED game provided children with a versatile digital learning environment, with plenty of attractive features that gave them joy and supported their engagement, creativity, collaboration and learning.

The first research question concerned the interactional features of play that characterized the play sessions. We created three overarching categories based on the nine features identified. We could have categorized these interactional features differently, but the final categorization was judged to best describe the children's behaviour during the play session and was also in agreement with prior studies (e.g. Falloon & Khoo, 2014; Lawrence, 2017).

We observed numerous disagreements, tensions and conflicts during the play sessions, for which there are several possible explanations. First, conflicts in turn-taking can be related to excitement and eagerness to play a new game or to high motivation to play combined with mistrust of a partner's playing skills. As Newman (2004) explained, a

player experiences unfamiliarity and faces a challenge when first playing a game. These turn-taking conflicts may decrease if the children first familiarize themselves with the game so that they have enough patience to wait for their turn to play. Second, some children were not used to playing with or were even unwilling to play with their assigned partner. This reflects Lawrence's (2017) finding that not selecting their partners might influence children's ability to adjust to the demands of the play environment. In contrast, children who were allowed to select their partners had fewer conflicts and disagreements and concentrated better on playing, which supports Rubin, Bukowski and Parker's (2006) finding that friends who play together are more collaborative than non-friend peers.

Although socio-cognitive conflicts can promote peer learning (Mercer & Littleton, 2007), in our study, a few children's motivation to play decreased due to conflicts and disagreements, because the arguments over turn-taking distracted them from playing. Conflicts also consumed time and slowed down the gameplay. Lawrence (2017) also showed that tensions between peers, such as control over devices, decrease the joy of playing. Finally, the third explanation for frequent conflicts was that the two child pairs grouped into the *conflict-prone play type*, both from the same day care centre, did not have an adult present during the play sessions to reduce conflicts and help them concentrate on playing. As Stephen and Plowman (2008) stated, positive engagement with technology in the playroom depends on the sensitivity and responsiveness of the adult support provided.

Our second research question focused on the play types that were identified on the basis of the interactional features of play. These three play types resembled those found in Lawrence (2017), in which the peer interaction ranged from competitive to collaborative and somewhere in between. In our study, the three play types differed from each other in terms of engagement and motivation to play, manners of interaction, number of conflicts and disagreements and the level of collaboration. This confirms the findings of Howes (2011) that peer interactions are relational and depend on children's relationships and the play context. The pairs grouped into the *conflict-prone play type* had numerous conflicts and disagreements because of their lack of motivation to play together. On the other hand, certain children are socially dominant when playing with specific children (Humphries & McDonald, 2011; Vaughn & Santos, 2009), as seen in the *ambivalent play type*, in which one dominating partner made the collaboration unequal. According to Howes (2011), the criteria for successful peer play is that the peers have a desire to play together, which is similar to what we found in our *collaborative play type* in which the pairs collaborated during the play sessions.

In general, it appears that the ED game is suitable for children playing with a peer, if the partners have similar levels of engagement and motivation to play, are willing to play together and their relationship is equal or works well. Furthermore, according to Lawrence (2017) and Rubin et al. (2006), some children are more capable of sharing and engaging in collaborative play than others, depending on their varying degrees of social competence. In addition, the presence and support of a teacher also influenced children's play in the present study. Therefore, it is important that the learning environment should be peaceful, and educators be available to support, encourage and provide help if necessary.

The third research question was related to the possible changes in the interactional features of play and play types taking place over the eight-week play period. Despite the changes in interactional features within all play types, none of the pairs' types changed from one to another. Some changes in the child pairs' interaction were positive, and some were not. As children became more familiar with the game, there was a decrease in concentration, engagement and motivation to proceed with the game for some children. Newman (2004) also noted that as a player masters a game through repetition, playing becomes automated and feels like less fun. Surprisingly, the pairs in our *collaborative pair-play type* had more conflicts and disagreements over turn-taking at the end of the play period as compared to at the beginning. Further, contrary to our expectations, neither of the two child pairs representing the *conflict-prone play type* matured during the play period. Although these pairs had fewer conflicts at the end of the play period as compared to the beginning of the play period, they only collaborated in certain tasks. Therefore, some pairs may need more time to develop collaboration than others.

Taken together, it indeed seemed that the pairs' manner of playing together was relatively constant. Although during this eight-week period, collaboration did not dramatically change in any of the pairs, the joint gameplay setting provided opportunities to practice important collaboration skills. When considering the demands of the collaboration skills needed in today's society, it is important that opportunities are provided early on to practice collaborative working with unfamiliar peers or with whom interaction is not easy and comfortable. In such situations, the guidance and support of an adult is crucial.

According to previous studies (Humphries, 2016; Prot et al., 2012; Stephen & Plowman, 2014), the role of the game design is important in children's play and their motivation to play. In the present study, the ED game had the potential to provide the children with a joyful and motivating learning environment. Motivation plays a rather critical role in learning social and emotional skills (Humphries, 2016). Playing with another child

deepened the motivation and engagement of the children *in the collaborative play-type*, as they strived to attain a shared goal and strengthened their collaboration skills, such as negotiation and turn-taking.

However, social and collaborative aspects do not always lead to successful interactions and learning (Oksanen et al., 2017). According to Fischer, Kollar, Stegmann and Wecker (2013), learners with little experience of successfully collaborating may not have the spontaneous skills required to develop the participation roles necessary for productive collaborative learning. Even though collaboration was weak in certain pairs in our study, all the children had the opportunity to practise their problem-solving and collaboration skills with a peer.

Other studies have similar findings on collaborative learning (e.g. Danby et al., 2018; Gómez et al., 2013). Playing with a peer strengthens a child's problem-solving skills, as they have to responsibly resolve disagreements and overcome conflicts. When employing playing in pairs in educational settings, it is important to pay attention to the possibility of letting a child select their play partner or offer adult support and guidance in cases when cooperation does not seem easy after an adult has selected the partners. Overall, it is important to bear in mind the role of an adult in children's play and in ensuring that the time is appropriate for playing, without any distractions around.

Limitations of the study

With only 16 participants, the sample size in the present study was small but comparable to similar play studies (e.g. Humphries, 2016; Waern & Bohne, 2015). Although our results are not generalizable as such, it is plausible that similar interactional features can be observed in other educational contexts as well. Another shortcoming of our study was the relatively short play period; the children played the game in pairs for only 15–30 minutes per week for eight weeks, which was a short time to engage in playing and collaborative learning, and develop joint play routines. Some pairs did not even play the game every week due to illness or lack of motivation. The two child pairs representing the *conflict-prone play type* had less play time than the other pairs because of their lack of motivation to play; therefore, this pair had less time to develop their collaborative skills.

Although the children and their interactions during gameplay were the main focus in this data, it could be seen from the video-recordings that the presence of the teacher in the room had an effect on the play session. A limitation of the present study is that the effects of teachers' presence could not be eliminated totally from the results. However, this theme is important to explore more detail in the future through additional data.

Conclusions

Our data showed that with its funny, engaging and motivating factors, the ED game offers a versatile learning environment for children playing in pairs. The data demonstrated that by playing the ED game in pairs, children had the opportunity to learn and strengthen their collaboration skills, as they were required to negotiate their answers and turn-taking, make compromises in selecting tasks and answers and wait for their turn or take advice from another child with regard to using the touchpad. Playing with a peer also has the potential to strengthen children's problem-solving skills, because they must resolve disagreements and conflicts in a responsible manner while playing.

Since all the pairs had the opportunity to practice their problem-solving and collaboration skills in our study, further research is needed to explore the role of educators in play sessions in order to determine the extent to which children need adult guidance and support during gameplay and to determine the educator's optimal role in play. Although we did not directly include the role of the teacher in the research design, since our aim was to explore children's gameplay in pairs, our data suggests the significance of the teacher's role in supporting peer play. Further, investigating the impact of personality traits, such as temperament, on playing in pairs would also be helpful. Additional information on the features of an optimal game design that would support collaborative learning is also called for.

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