

Situated collaboration and problem solving in young children's digital gameplay

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Abstract

Collaboration is an important aspect of social activity associated with young children's digital gameplay. Children organise their participation as they communicate with and support one another, through sharing knowledge and problem-solving strategies, displaying their expertise, encouraging others and creatively exploring possibilities for collaborative game moves. Drawing on a social interactional perspective, we explore the situated and embodied practices of the young players aged 3–8 years. We present three video ethnographic case studies of young children's everyday peer interactions from three different settings and age groups: Australia (home), Norway (pre-school) and Sweden (afterschool). Across these settings, the findings identify how children collaborate with one another to progress the game by using multiple strategies, including instructing each other, monitoring each other's actions and problem solving. In the process, collaborative peer culture was maintained and built as the players worked towards problem solutions that require taking each other's perspectives, and sharing digital devices and skills. This focus on children's situated language use and assemblage of multimodal resources shows their moment-by-moment collaborative action. These multimodal interactions create opportunities for peer and sibling learning without the presence of an adult. The collaborative activity was a strategic resource used by the children in their digital game playing. In capturing young children's own strategies, we highlight their agency in learning occurring through social interaction and gameplay.

Introduction

While traditionally the preserve of teenagers and adults, children are now engaging with digital technologies from very young ages. From babyhood, children participate in digital activities, although there is little evidence that they actively participate in digital gameplay until past infancy. Engaged with apps and digital devices from at least 6 months onwards, children's digital game playing emerges in their pre-school years, increasing rapidly throughout their schooling

Practitioner Notes

What is already known about this topic

- Very young children, from 6 months onwards, engage with apps and digital devices
- Digital play affords young children opportunities for language development and social learning
- Increasingly, young children play digital games.
- Children often use screen-based media and traditional toys interchangeably. For example, pretence is often used in both contexts and digital games become resources for playground games.

What this paper adds

- An ethnographic approach shows what children are doing through detailed descriptions of action and talk.
- Young children's interactions with digital games occur in social contexts where children interact with others to problem solve, share strategies and collaboratively participate.
- Gaming provides a context for peer learning, where children learn from each other through child-child collaboration and instruction.
- Young children's participation in gaming practices transforms their learning and play experiences and knowledge in peer/sibling group interactions.

Implications for practice and policy

- Recognise that children with digital tools, including digital games, are engaging from the earliest age onwards. This implication should be recognised in childhood curriculum and pedagogic practices.
- Recognise the value of young children's digital gameplay as a social context for practising social skills and collaboration.
- Digital gameplay produces social contexts for social development and learning, through children's collaboration and shared problem solving.
- Video observations of children's real-time interactions and digital resources are well designed to make visible how children use digital technologies during digital game playing.

(Marsh *et al.*, 2015; Paciga & Donohue, 2017; Rideout, 2017; Swedish Media Council, 2016). In this paper, we specifically focus on young children's gameplay across different settings and age groups, and show how young children instruct one another, monitor each other's activities, and problem-solve, in order to accomplish collaborative shared goals.

Young children's digital gaming is usually social. This social aspect is a driving force for children's participation (Ito *et al.*, 2010; MacKey, 2007; Marsh *et al.*, 2015; Plowman, Stephen, & McPake, 2010). Chaudron's (2015) study of young children's technology use in seven countries found that digital gaming was social, and shared many elements (eg, pretence, action) of traditional (ie, non-digital) games. Knowing how to play games in public places such as pre-schools involves social competences where children learn from each other how to organise games and evaluate each other's game moves, understand what is happening in the game, and know how to handle the technicalities (Björk-Willén & Aronsson, 2014).

The social relationships and activities between online and offline space is a reoccurring focus. Digital gaming is only one of many activities that children do, and include playing outdoors and

with non-digital toys (Chaudron, 2015). Children, unlike adults, tend to use screen-based media and traditional toys interchangeably, with both involving pretence and symbolic play (Arnott, 2016; Chaudron, 2015; Danby, Davidson, Theobald, Houen, & Thorpe, 2017). Similarly, children's screen playing of digital games are resources for games in the playground (Aarsand, 2010).

The relationship between young children's digital game playing and literacy practices shows that gaming is a rich resource for learning aspects of literacy. For example, children playing Club Penguin rely upon text and symbols (eg, arrows) to guide through the online world, and use avatars who "chat" and play (eg, penguins playing on icebergs) (Marsh, 2012). Digital game activity recognises the centrality of literacy, cultural practices, and the social orders of the virtual and networked worlds of children (Beavis, 2012; Davidson, 2009; Marsh, 2012).

Games allow for the production of narratives across physical and virtual locations, and across game playing in different media (Beavis, 2012; MacKey, 2007; Maine, 2017). Only a few studies have documented children's gaming practices in everyday peer/sibling group interactions in homes and schools (Davidson, 2010; MacKey, 2007; Marsh, 2011, 2012). These studies highlight children's agency in initiating and participating in these activities, similar to their agency in non-digital social and play experiences (Arnott, 2016). With little known, and the field rapidly expanding, more studies are needed to investigate the "interactions between players, games, and technology, and the active nature of play" (Beavis, 2012, p. 58) to highlight digital gaming as sites for role play, literacy learning, narrative construction and understanding and participating in cultural practices.

A social interactional approach to children's gaming

The social interactional approach is framed within ethnomethodological and conversation analytic understandings. This framework recognises that the activities of members of society are social and interactional, and that all interaction is socially structured (Francis & Hester, 2004). The focus on language-in-use explores how people use talk and action to accomplish their social activities and make sense of their everyday worlds.

A social interactional approach affords opportunities to investigate how children organise their participation in gaming practices as they communicate with, and support one another, through sharing knowledge and displaying their expertise. Goodwin and Goodwin's (2004) multimodal approach to participation is relevant for understanding how children collaboratively build and attend to each other's actions, and help construct relevant actions and contexts. In other words, children's digital gaming practices are "social and oriented to participation frameworks" (Björk-Willén & Aronsson, 2014, p. 320). When children support and instruct one another, they share their experiences and create alignments (or not) with one another (M. H. Goodwin, 1990; Maynard, 1986) as they position themselves in relation to each other and to their ongoing actions. Such positions are linked to social status and what counts as culturally valuable knowledge and friendship relationships among children in their local peer/sibling culture (M. H. Goodwin & Kyratzis, 2012). A multimodal focus alongside a social interactional perspective leads to detailed understandings grounded in observational data theorised as social practice, making visible the complex everyday practices (Flewitt, 2011). This theoretical perspective recognises children as competent interactants, displaying *insitu* competence and values children's participation and recognition of their agency in managing their everyday interactions (Danby, 2017b).

Ethnomethodology and conversation analysis have long taken an interest in children's game playing, but only recently in children's digital gaming activities. These studies highlight "the situated and shared negotiated accomplishment of the activity... [and the] players' orientation to rules and local practices" (Danby, 2017a, p. 35). Play as situated activity shifts focus from the function of children's play for individual development—the focus of developmentally oriented

studies of play—to how children collectively contribute to the organisation of play, generating different experiences through their everyday play participation (Evaldsson, 2009). These are shared orientations present whether players participate in digital or non-digital gameplay. In focusing on children's interactions and shared negotiations, analytic attention is given to the "resources and detailed practices through which activities are organised and made sense of" (Pirainen-Marsh & Tainio, 2009, p. 168).

Most investigations have explored adolescent gaming in informal contexts, with few studies focusing on understanding the young players' gaming experiences. Even very young children participate, though, in digital games; eg, 2 year olds playing a Wiggles game attended to the pre-determined game sequence while orienting to the father's mediation of game knowledge (Davidson, 2010). Family politics is another arena that explores how parents and children negotiate aspects of the game (Aarsand & Aronsson, 2009) or make social contracts with each other while playing the game (Tiilikainen & Arminen, 2017).

Method and data

The analyses build on data drawn from three video-ethnographic studies of young children's digital activities in peer/sibling groups from three different countries, settings and age groups: Australia (home: children aged 4–7 years), Norway (pre-school: children aged 4–5 years) and Sweden (after-school: children aged 8 years). Video recordings were the primary data sources in all three studies, building observations of situated activities as they ordinarily unfold in social settings.

The *home data* corpus from a 3-year Australian longitudinal study investigated digital technologies as part of the flow of everyday life across home and school settings (approximately 200 hours of video recordings). Six families participated over 3 years, involving 6 focus children and their siblings (aged from 1 to 11 years) and other family members (eg, parents, grandparents) in home contexts, and the focus children with their classroom peers for the first 3 years of formal schooling (approximately 300 children). Families were purposely selected in terms of urban and regional contexts, and range of family income and educational backgrounds. The home recordings were undertaken by family members (usually parents), in order to spontaneously capture family events.

The Norwegian *pre-school study* documented the use of digital technologies with the aim of exploring how these are integrated into children's everyday life in technology-dense pre-schools. The daily life during 1 week in three different pre-schools in a middleclass ethnically homogeneous urban area was video recorded with children aged 3–5 years old (approximately 70 hours of video recordings). Each day a different child was followed and video recorded by a researcher during the whole day, allowing the documentation of a broad range of digital activities and participant constellations.

The Swedish *after-school study* draws from a larger project focusing on children's (8-years old) multimodal engagements with digital technologies in peer group practices in afterschool, school and home contexts. The data cover educational settings where children's families have different income and educational backgrounds. The video-ethnographic data were collected by two researchers 2–3 days a week over 4 months in an afterschool program located in a low-income multiethnic suburban area (approximately 60 hours of video recordings). The focus was on children's communicative practices and multimodal engagements (including gaming, social networking, texting) in different peer group constellations.

The researchers' long-term participation in all three studies provided possibilities to access and document the children's everyday activities. They were particularly sensitive to possible resistance and avoidances from the children (Aarsand & Forsberg, 2010; Danby, 2017b), and adapted

their data collection practices accordingly, including stopping data collection when appropriate. As well, consent was obtained in an ongoing way every time the children were video-recorded.

We analysed data with detailed attention to the multimodal and sequential organisation of social actions afforded through repeated viewings of the video data, and selected transcripts (see appendix for transcript notation). Three methodological steps were undertaken (Francis & Hester, 2004, pp. 25–26): (1) we asked, what phenomenon is being made visible in this talk, activity or setting?; (2) on finding the phenomenon, children engaged in digital game playing, we asked, how is this observable feature produced?; and finally, (3) we described the methods used to produce and recognise children's collaborative, monitoring and instructional activities.

Within and across the different settings and age groups that our data represent, we identified three cases where children engaged in gaming activities with other children that are representative of each corpus in that they are mundane and recurrent activities, and where there are similarities in how children in different age groups and settings collaborate in organising their gaming activities. We have thus identified a recurrent phenomenon that concerns how children, as they engage in game playing activities in peer/sibling contexts, creatively collaborate using multiple strategies, including instructing each other, monitoring each other's actions and problem solving. Together, the children worked towards problem solutions that require communicative competencies for taking one another's perspectives, and making use of digital devices and skills for working out own agendas. There were many instances of collaboration as the children worked towards individual and, yet also, shared goals. Taken together, the studies present a broad ecology of peer/sibling learning practices and pedagogies around digital gaming and social interaction.

Results

Home: collaboration and instructional talk to accomplish shared activity

This data extract has two siblings, John (4 years) and Ella (7 years), playing Minecraft (<https://minecraft.net/en-us/>). In Minecraft, players construct different virtual terrains and buildings; use avatars to explore caves, mine for different ores such as gold, fight off monsters and zombies and defend themselves against attack. Players manipulate the virtual world, and the game can be played singly or, as in this case, with two or more players.

John and Ella sit side-by-side on the sofa, each with their own iPad. John and Ella look at their own screens, while monitoring the other's actions on their screen. Each has their own avatar. They call to each other as they manage the challenges and shared agendas of collecting treasure (eg, gold) and fighting zombies; in this, they shared a common goal. No parents were present, and nor were there calls for help to parents. The extract begins as they have to deal with invaders.

John and Ella defend themselves from the attackers by coordinating their actions. John has some unnamed invaders coming from the top down the screen. He gives an unsolicited directive to Ella (3). In a loud voice, he instructs her to "tap them," and he loudly repeats his instruction. This particular form of organising interaction displayed is that of instruction. An instruction leads to a type of understanding, involving a local knowledge source, accompanied by displays of knowledgeability (Koschmann, 2013); in this instance, John instructs Ella to "tap," a strategy that effectively stops the invaders on the screen. The loudness of his instruction suggests an urgency of action within the game. Timing is important in being able to tap the screen in order to destroy the invaders. John's instruction provides evidence of his knowledge of game strategies. In instructing Ella, both are collaboratively engaged in this shared agenda of destroying the invaders. John further instructs Ella to continue this action of tapping to put "more down" (5), leading to a coordination of both their actions.

Extract 1: Minecraft

Participants: John, Ella and Lana

- 1 Lana OH: ↑YE:↓AH:,!
- 2 (1.7)
- 3 John >NO ↑YOU ↓TAP THEM ↓EL↑LA,< (0.5) >↑TAP ↓THEM.<
- 4 (3.2)
- 5 Ella >Keep on putting more ↓down,<
- 6 (2.7)
- 7 John .hh Then ↑I: set the (tin teys) ↓dow:n: (0.4) >so we<
- 8 get the gold.
- 9 (4.7)
- 10 John .hh°k° >NOW ELLA (.) HEAD DOWN TOWARDS ME,<
- 11 (0.5)
- 12 Ella °M:kay°
- 13 (4.0)
- 14 John AW DAMN IT (0.6) it's them. (1.0) ↑HIT THEM:: ↓EL↑LA,
- 15 .hh Hit the:m:.
- 16 (1.5)
- 17 Ella Hm↑:?? (0.3) WITH WHA:↓:T,!
- 18 (2.0)
- 19 Ella With ↑this stuff, (0.2) ↓Like ↑thi↓:s?=
 20 John =No:w: (0.2) they're in the mid↓dle.
- 21 (1.7)
- 22 John BOOM ↓boom ↓boom. (0.3) S:EE?
- 23 (1.1)
- 24 John .HHH.- WE GOT THE GOLD A:↓ND THE PO↑TA↓TO ↑Y:UM! .HHH- (0.2)
- 25 °#Y:e:s:.#°

With no discussion of future game plans until now, John introduces a plan (7) that involves shared strategies. John suggests that he will set down the tin keys and that this will lead to him and Ella getting the gold. With great urgency, John signals some problem (14) with displayed high emotion, and curses (DAMN IT). He again takes the lead by directing Ella to “hit them” (3 times). His use of the indexical pronoun “them” suggests that both he and Ella know what “them” refers to. In enacting his plan, he first addresses Ella by name to alert her and urgently get her attention, uses a loud voice, and directs her to “head down towards me” (10). Ella, with equal urgency, seeks confirmation that her action on the screen is what John is seeking. John does not directly respond, but his directive “now” (20), and an explanation of where these things are, implies both urgency of action and support of Ella’s gaming move. The final turns of talk

show John formulating the success of their collaborative gaming as they claimed the resources of gold and potatoes, a formulation with which Ella agrees.

John's instructional work made visible how to destroy the onscreen intruders: (1) he first rejected Ella's actions ("No"), and instructed her to begin a new action of tapping the screen; (2) he instructed Ella by specifically directing her actions on the screen (eg, "head down towards me"); and (3) Ella monitored Jack's actions and reproduced them. Both players integrated their individual actions on their individual screens to tackle a shared problem that required monitoring each other's screens and actions. The two strategies used to organise the gaming activity were collaboration and instruction, with both players oriented to goal of destroying the intruders.

Pre-school: seeking and getting help

Children face different challenges when using digital technologies and how they solve these partly depends on the socio-material environment. Extract 2 shows four boys aged 4 years in a Norwegian pre-school where Jon has just opened on a tablet the Batman game, a teacher-provided app

Extract 2: Batman

Participants: Jon, Ben, Tom and Dan

- 1 Ben Tom skjøønne ittje (.) han [skjøønne ittje (.)
Tom does not understand (.) he does not understand (.)
- 2 Tom [Æ skjøønne det (.) Jon
I understand (.) Jon
- 3 skjøønne ittje æ skjøønne det ((Ben leaves))
does not understand I understand
- 4 () Tom kom!
Come Tom!
- 5 Dan Se det her da se på man styr bort med brettet
Look at this look one steers away with the tablet
- 6 (3.0)
- 7 Tom Ser du? du må styre med brettet du må=
You see? you have to steer with the tablet you have to==
- 8 Jon =Men kordan kjø:re dom fortar?
=But how do you dri:ve faster?
- 9 Tom Han bare (.) han bare (.) du- du må vent litt
He just (.) he just (.) you- you have to wait a bit
- 10 Dan Det e::r bare sånn fort man kjø_rre
This i::s just how fast one dr_vives
- 11 Tom JA ((nods))
YES

for older children. The peers deal with the fact that Jon does not know how to play the game. Just before the extract starts, Jon has loudly turned to the pre-school teacher help, who told Jon to seek assistance from his peers, demonstrating that gaming in the pre-school is a public and social peer activity.

A few turns after the teacher told Jon to seek help from his peers, Ben claims that Tom, the boy next to him, does not understand how the game works (1). The claim works to downgrade Tom's position as possible expert who can help Jon play the game. So far, Tom has not said anything and has not been addressed, but he responds to Ben's claims immediately by telling that he understands how to play the game and that Jon is the one who does not understand (2–3), thereby treating Ben's utterance as him being misinformed and taking a stance against the downgrading of his expert status. Both Ben and Tom are eager to display themselves as competent players, thereby they also become possible co-players or problem solvers. Dan draws attention to what happens on the screen, and tells that one manoeuvres the avatar by moving the tablet. Instead of claiming expert status, Dan responds to Ben's questioning of help and gives him directions concerning how to manoeuvre the avatar. After a three second pause, Tom aligns with the project on helping Jon to handle the game by asking Jon to confirm that he has understood Dan's commentary. Here, Tom positions himself as a knowledgeable player, and as instructor when he takes the responsibility to check if Jon has understood how to use the avatar. To notice, Jon does not once ask for help from his peers, rather this occurs after he has displayed his problem to the teacher and the peer-group.

Jon does not respond to Tom's question (7) but is already facing another challenging aspect of the game, namely how to make Batman drive faster. This time he asks his peers (8). Tom does not seem sure of how to increase the speed but indicates that this may be possible later in the game (9). Dan fills in and tells Jon that this is how fast it goes (10), and Tom agrees. Jon treats Dan and Tom's instructions as suggestions of how to solve particular problems (5–7, 9–11), not as something that he needs to confirm understanding (8). On one hand, we see how Dan and Tom orient to the on-going activity as an instructing or a teaching activity. Further on, Tom and Dan turn this into a joint project where they fill in on and support each other. On the other hand, we see how Jon treats their suggestions as a problem solving activity that helps him progress in the game.

In this extract, we saw the social organisation of children's collaborative instructions. Jon sought assistance from the pre-school teacher, who redirected the request to the children gathered around him. Even though Jon did not ask his peers for help, they took up the role as instructors and started to instruct Jon on how to play the game.

Afterschool: collaborative problem solving

We now analyse how three boys (8 years old) at a Swedish afterschool centre collaborate to solve a common problem of how to get access to a popular network site for children called Momio. The network site was recurrently used by the children for playing games and establishing online social relations, communicating with children they already know from their local network. We examine how the boys, all are playing the same game on separate computers, collaboratively problem-solve by instructing, supporting and monitoring one another's actions.

Extract 3a begins as one boy, Hashim, who has unsuccessfully made several attempts to create an account, announces his problems. The login page requests both a user name and a password. Hashim highlights the problem by quoting the text on the screen: "write your password" (Figure 1).

Hashim pretends to write by rapidly pressing a number of random letters as he makes sounds "(d-d-d-)" and immediately comments on what he has done "like (.) I wrote" (2). He thereby treats the machine (ie, computer) as a social entity and an expert, and himself as a novice. At the

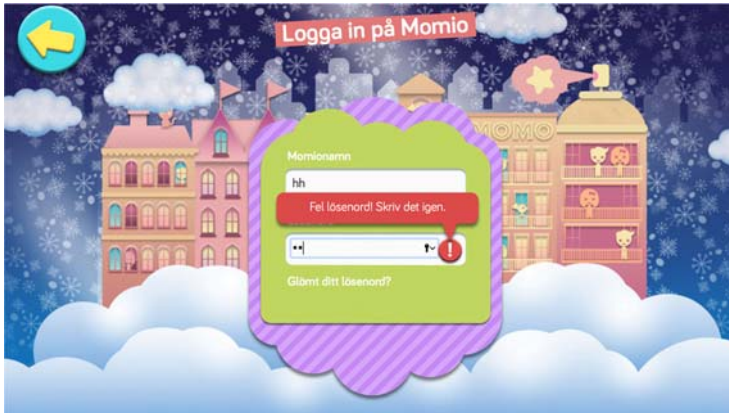


Figure 1: Login page of the Momio website with message about wrong password

same time, the online commentary adds a sense of Hashim as knowing what to do, claiming to have done what was required and complaining that the problem still remains. The pretend writing becomes part of an animated enactment and a performance, in which Hashim publicly stages his own problem for the other boys. The more detailed problem recapitulation is related to that the other two boys are also incorporated into the participation framework. Upon hearing that Hashim has a problem, Aziz immediately left his own laptop and is standing behind Hashim, monitoring his actions on the screen. Majid who is seated close to Hashim also leans in to look. By gazing at the computer screen and sharing the same visual field, the three boys create a shared focus of attention where they publicly and visually turn the problem of how to access the website into a joint concern for the peer group.

We continue by analysing the problem-formulation and instructional sequence that follows (extract 3b). Aziz is the only one who has access to an account and who consequently has the required cultural experience. As shown, knowledgeable instructions require access to the same visual field as the person requesting help, and also cultural experiences of what counts as appropriate knowledge.

The instruction sequence starts as Aziz moves closer to Hashim, shoving his hands away from the keyboard to control the computer. Rather than writing a password, he provides a verbal

Extract 3a: Momio

Participants: Hashim, Aziz, Majid

- 1 Hashim *Skriv in ditt lö:senord ja v- skrive- #kolla (d-d-d-)#*
Write your passwo:rd I v- writ- look (d-d-d-)
#writing#
- 2 typ (.) ja skre:v. (.) #logga in. (.) de gå:r inte:.
like (.) I wro:te. (.) log in. (.) it doe:sn't wo:rk.
#presses log in and a red sign
informing that log in has failed appears on the screen

Extract 3b: Momio

Participants: Hashim, Aziz, Majid

- 3 Aziz ((shoves Hashim's hands from the keyboard))
- 4 Aziz Vānta sk*ri:v din #efterna:mn.
Wait write your last name.
*retracts hands from keyboard and rises
- 5 Hashim #looks at Aziz
- 6 Hashim ↑Va? ((looks with consternation at Aziz and then turns to the screen))
↑What?
- 7 Aziz S-s-skriv din efterna:mn.
Wr-wr-write your last name.
- 8 Hashim °°Okej.°° a gå då.= ((writes his last name))
°°Okay.°° a go then.=
- 9 Majid =Okej. ja ska också skriva min efternamn. ((writes))
=Okay. I'll write my last name too.

instruction “wait write your last name” (4). At this point, Aziz retracts his hands from the keyboard and leaves room for Hashim to follow his instruction and to take control of the laptop. In response, Hashim makes a verbal and embodied display of surprise, “what?” which leads Aziz to repeat the instruction, “write your last name” (7). At this point, the instruction is treated as sufficient by Hashim who replies with a quiet “okay.” Turning towards his computer he starts typing, displaying his readiness to move on. Hashim closes the instructional sequence with an imperative “a go then,” directing Aziz to go away (8).

The instructional sequence establishes a participation framework for the third boy Majid, seated beside Hashim with his computer and who becomes a ratified participant. So far, Majid has remained a silent onlooker, but now he displays his orientation towards what Hashim and Aziz are doing. Majid strengthens his alignment with Hashim in a stepwise manner by first acknowledging the instruction with an “okay” and then repeating the instruction out loud (9), while typing his family name. Through the performed actions, Majid literally puts himself in a similar position as Hashim, which in turn creates possibilities for the two boys to collaboratively pursue their participation in the gaming activity. In so doing, he orients to the children's local peer culture where being more players make the game more fun to play.

In the after-school data, the boys drew on the social and the material environment to collaboratively solve the problem of how to get access to a website for communicating and gaming. In strategically monitoring and instructing one another through talk and embodied actions, the children positioned one another as more or less experienced and knowledgeable online users. By sharing their knowledge about how to utilise user names and passwords with one another, the children collaboratively develop competencies in their peer culture to enter a shared virtual world.

Discussion

Children engage with digital tools from earliest ages onwards, so understanding how they participate in digital activities with others to achieve goals, learn new practices and knowledge and engage with others, is important. Digital game playing is one aspect of young children's engagement with digital technologies.

Gaming is not a solitary activity. All three cases, across different settings and children's ages, identified the universal phenomenon of children engaged socially in gaming practices: Example 1 showed two siblings coordinating their efforts to destroy the screen intruders; Example 2 showed pre-school children supporting a novice player; and Example 3 showed children's collaborative efforts to gain password access to a game. Collaboration and social interactions were necessary to gain access, play and reach successful outcomes. Clearly shown was that gaming is not a solitary activity but rather a social enterprise. While this finding is not new (Björk-Willén & Aronsson, 2014; MacKey, 2007), shown here is how children use strategies within social interaction.

Competence in gaming is something that is socially built through children's experiences of helping each other out. The children's strategies of giving instructions and monitoring each other's activities led to shared problem solving, and also collaborative peer cultures that were oriented to sharing knowledge and goals. The players worked towards problem solutions that required taking each other's perspectives, and shared knowledge. Collaborative experiences such as these yield insights for how children learn how to handle problems within social spaces. Peer culture, then, involves sharing knowledge and how to learn how to problem solve and work towards shared goals.

The frequency of instructions suggested that children may be more expert or more novice. In each case, analysis showed the significant role others had in proffering and shaping that knowledge for others. Players were jointly directed by more experienced others, helping players make sense of the digital activity (Pirainen-Marsh & Tainio, 2009). A solitary player might have stopped playing (eg, accessing the password). Collaboratively the group was able to accomplish a goal that a solitary player may not have. This asymmetrical distribution of competence suggests that being a good or bad gamer is not age-relevant, but rather being a member of a knowledge-sharing culture.

Strongly linked was the relationship between shared goal accomplishment and the requisite strategies. Even when investigating the social aspects of situated collaboration and problem solving, it is possible to see gaming activities as contexts for literacy learning about text and symbols, and about literary devices such as narratives (Beavis, 2012; Davidson, 2009; MacKey, 2007; Maine, 2017). As Davidson (2009) points out, children's social interactions make recognisable how to mutually accomplish shared knowledge, how to produce different kinds of texts and digital practices, and how to produce and maintain locally recognisable peer culture.

The social interactional framing and use of video observations of the children's real-time interactions yielded new understandings of their interactions in and around digital gaming. This close analysis of how children participate in the social order of gaming contributes new understandings of their complex gaming practices. Detailed observation captured the situated social activity as it unfolded, showed the interactional sequences. This multimodal focus offered detailed understandings grounded in observational data theorised as social practice (Flewitt, 2011). Close analysis displayed the children's *insitu* competence as social, not residing in individual knowledge but within shared participant knowledge. This method provides a way of capturing the children's perspective as they engage in these activities. It shows both the challenges and successes of their collaboration, and recognises that this as an ongoing process of building peer social order.

Across all three cases, we observed children's actions made possible through specific interactional strategies, including collaboration, giving instructions, requesting and receiving help and formulating problems to be solved. These strategies are not specific to digital gameplay, but routinely occur in peer/sibling interactions involving multiple social contexts. Further, strategies such as instructing and formulating problems are often attributed as being used by adults but, as shown here, even young children draw on these strategies. While the children strategically designed and enacted these strategies within the digital contexts, and in real-time interactions of others, these multimodal interactions created opportunities for peer and sibling learning, often without an adult presence. In capturing young children's own pedagogic moves taking place, we highlighted their agency in learning occurring through social interaction and gameplay.

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Statements on open data, ethics and conflict of interest

The transcripts are detailed representations of videorecordings. The corpus of video data is not open access for privacy and ethical reasons, as per the consent agreement and institutional requirements. This paper will be available in author format through the university e-prints, an open data source.

All three studies sought and gained ethical approval from participants and university, educational and home settings. Children were involved as participants in the consent process. All participants were given pseudonyms.

There were no potential conflicts of interest.

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Appendix

Transcription conventions adapted from Jefferson (2004)

[]	Overlapping talk
=	Equal signs indicate no break or gap between the lines.
(0.8) (.)	Numbers in parentheses indicate silence. A dot in parentheses indicates a micropause less than 5/10 of a second.
. , ¿ ?	The punctuation marks indicate intonation. The period indicates falling intonation, the comma continuing intonation, the inverted question mark slightly rising intonation, the question mark indicates a rising intonation.
::	Colons are used to indicate prolongation or stretching of the immediately prior sound.
-	A hyphen after a word indicates a cut-off or self-interruption.
<u>word</u>	Underlining indicates some form of stress or emphasis. The more the underlining the greater the emphasis. Especially loud talk is indicated by upper case.
° °	The degree signs indicate that the talk between them was quieter than its surrounding talk.
↑ ↓	The up and down arrows mark a sharp rise/fall in pitch.
< >	Left/right carats indicate that the talk between them is slowed down.
> <	Right/left carats indicate that the talk between them is speeded up.
.h .hh	Hearable inbreaths are shown with a ".h" – the more h's the more inbreath.
wo(h)rd	Laughter particles
#word#	Smiley voice
(())	Double parentheses are used to mark transcriber's descriptions of events.
()	Empty parentheses indicate that something is being said but no hearing can be achieved.
* *	Gestures and actions descriptions are delimited between two identical symbols (one symbol per participant) and are synchronised with corresponding stretches of talk.
*->	Gesture or action described continues across subsequent lines
->*	until the same symbol is reached.
