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RESEARCH

Children's Out-of-School Learning in Digital Gaming Communities

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The aim of this study is to investigate children's out-of-school learning in digital gaming communities. This was achieved by exploring girls' participation in Minecraft communities. Data were generated through interviews, video-recorded play sessions and video-stimulated recall. Multimodal interactional analysis was applied in order to analyze children's mediated actions. The components of Wenger's Social Theory of Learning were used as a basis when exploring learning in children's out-of-school digital gaming communities. Five significant themes of what characterizes learning in digital gaming communities were identified: learning through experiencing, learning through belonging, learning through performing, learning through struggling and learning through enacting participatory identities. The main findings are presented in a tentative conceptual framework that can support teachers, school leaders and policymakers who are interested in connecting children's out-of-school learning experiences with their learning in school.

Keywords: children; digital communities; learning; Minecraft; Wenger

Introduction

Understanding children's "out-of-school teaching and learning journeys" (Gee, 2018, p. xi), is of relevance to educational research as the conditions in which children shape their social relationships and learn are changing (Ito et al., 2019; Stephen & Edwards, 2018). Unlike the traditional learning that many children still experience in school, digital communities offer self-selected and intentional learning that is tied to contributions to social communities and recognition in such communities. The aim of this study is to investigate children's out-of-school learning in digital gaming communities. Through participation in such communities, children acquire new or modify existing skills, attitudes and knowledge by performing certain actions that represent the self and gradually develop contextual knowledge (Dezuanni & O'Mara, 2017; Wernholm, 2018). It has been shown that what children learn from digital gaming is linked to what the gaming context offers (Beavis, 2017), in line with Wenger's notion of situated learning (1998/2008).

We know from previous research that children participate in a variety of Minecraft worlds that offer very different kinds of gameplay (Mavoa, Carter, & Gibbs, 2017), including Minecraft for educational purposes, MinecraftEdu (Beavis, Deuzanni, & O'Mara, 2017). How these experiences make a difference in school is tied to curricula and teacher's attitudes. Research reveals a disconnect between teachers' understanding of game world mechanisms, uses and benefits and how to apply them to the curriculum (Lewis Ellison, Evans, & Pike, 2016; Overby & Jones, 2015). Studies indicate that when teachers recognise and acknowledge children's gaming knowledge and expertise, this insight can be used as inspiration and as a resource for connecting and enhancing learning (Beavis et al., 2017; Callaghan, 2016). Teachers tend to choose digital games that are aligned with their own beliefs and approach to teaching, just as with any other pedagogical tool (Prestridge, 2017). When there is a discrepancy between the chosen digital game and children's gaming experiences this becomes problematic (cf. Dunn, Gray, Moffett, & Mitchell, 2016). Out-of-school learning as a field of current research also requires the addition of underrepresented groups, for example, younger girls' digital gaming experiences (cf. Ito et al., 2019). Mavoa et al. (2017) reveal no significant gender differences present in children's (9–12 years of age) overall Minecraft play and therefore out-of-school learning in digital gaming communities could be addressed by investigating girls' gameplay. Thus, learning will be explored by studying girls' situated learning in Minecraft. Minecraft was chosen mainly for its complexity insofar as it offers children the opportunity to compete, play and/or design new worlds and thereby answer the call for a shift away from 'what works' to more complex studies (Halverson, 2012).

This study advances new knowledge by contributing with a tentative conceptual framework for visualizing the characteristics of children's out-of-school learning. As such, the framework can assist both stakeholders interested in connecting children's out-of-school learning experiences with learning in school, as well as policymakers as

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it reflects what education might look like when the focus is shifted from 'what works' to 'what's happening' and 'what's possible'(Halverson, 2012, p. 5).

Previous Research

Here relevant research based on a systematic review conducted using both thesaurus terms and free-text terms in four databases[1], has been organised into two themes.

Children's learning experiences through participating in digital gaming communities

Players gradually develop gaming literacy, previously defined as analysing, designing and playing digital games (Apperley & Beavis, 2013) but also designing them (Halverson, 2012). Consequently, gaming literacy is becoming more complex including both the 'textual' literacy of 'reading' (or playing) and 'writing' (or producing), being combined in multimodal forms (Apperley & Beavis, 2013). Findings show how digital gameplay-as-learning practices are supported by wider digital gaming cultures of gamers, taking on roles as 'advisers and language teachers' (Chik, 2014). Many children become involved in interest-driven learning and are motivated by a desire to participate in these cultures (Dezuanni & O'Mara, 2017; Schmidt, 2020). By engaging in new worlds that differ in norms of communication and stances on identity, children are shown to create spaces that are useful for reflecting on their practices in their real world (Halverson, 2012; Mertala & Meriläinen, 2019). Committing to challenging projects and honouring them, working strenuously on challenges as well as maintaining an effort and interest over time despite failure and adversity are associated with children's gaming and referred to as grit (Duckworth & Eskreis-Winkler, 2015; Duckworth, Peterson, Matthews, & Kelly, 2007). Grit is often regarded as an aspect of personality (Duckworth & Eskreis-Winkler, 2015; Duckworth et al., 2007; Klingberg, 2016). Here, grit is understood and used to explain the importance of situatedness on behaviour and conditions that encourage the expression of grit, as also suggested by researchers (Duckworth & Eskreis-Winkler, 2015).

Minecraft Worlds – Contexts for children's situated learning

Minecraft is an open game world that offers opportunities to explore and express curiosity (Garrelts, 2014a). Children's gameplay in Minecraft has evolved because of the huge number of online fan communities constantly producing tutorials and different types of video content (Garrelts, 2014b). YouTube has been shown to serve as a platform for spreading Minecraft productions and knowledge around the world (Schmidt, 2020). Consequently, children from different countries communicate, socialize and play together (Wernholm, 2018). Being good at a game can mean something completely different from the "mining and crafting" – still associated with the game (Dezuanni, 2018; Schneier & Taylor, 2018). Children distinguish between digital creation and play, in which 'playing' the game involves the challenges that come with the 'survival' mode (Dezuanni, 2018). Children are shown to position themselves by sharing stories about their gameplay and by designing, building and displaying their creations and digital productions. More experienced players can be defined by how they use spoken language and from their technical ability, knowledge, design and creation skills (Dezuanni, O'Mara, & Beavis, 2015). Multiplayer interaction is a collaborative process of digital creation in which no final 'text' is produced. Instead, the 'text' emerges as children keep negotiating and making decisions about what actions to take. Playing Minecraft requires collaboration, cooperation, respect for other's achievements and possessions and a willingness to learn from others, as well as system knowledge, gameplay skills and digital media literacy (Dezuanni, 2018).

Research exploring children's out-of-school learning in digital gaming communities appear to be scarce in Sweden. This study will explore what characterizes learning in girls' out-of-school Minecraft communities, as the group girls 9–13 are underrepresented in research (cf. Ito et al., 2019).

Theoretical Framing: Experience Learning in Practice

Wenger's social theory of learning was used as a basis for exploring children's out-of-school digital gaming communities. Wenger's conceptual framework of learning as situated and mediated provides an analytical tool with useful components for identifying, understanding and explaining children's experiences from learning in practice (Wenger, 1998/2008). The components (see **Figure 1**) *learning, meaning, community, practice* and *identity* characterize social participation as a process of learning and knowing.

Learning can be traced to a child's changing ability to engage in practice and to make use of available resources manifested through actions (Wenger, 1998/2008). Experience is gained by an activity being reflected upon evoking change (Dewey, 1916/2011). What a person has learnt in one situation becomes an instrument of understanding and dealing effectively with new situations that are encountered (Dewey, 1938/2015).

Capturing engagement in social contexts means paying attention to the components that are involved in a dual process of *meaning* making, e.g. participation and reification as signs of learning (Wenger, 1998/2008). The concept of reification refers to the process by which we project our experiences onto the world by producing objects in which a certain understanding is given form (Wenger, 2010). Reifications emerge in children's words, concepts, methods and stories, reflecting their shared experiences. Meaningful learning in social contexts requires interplay between both participation and reification and that their interplay creates a social history of learning. This social history of learning constitutes a *community* which, over time, develops a shared repertoire (Wenger, 1998/2008). Repertoires include, for example, language, handling tools, ways of doing things and stories that become part of its practice which the children must understand in order to be able to engage productively with others and adopt this shared repertoire. Communities develop their *practice* over time through a variety of methods, including problem solving, requests for information, seeking

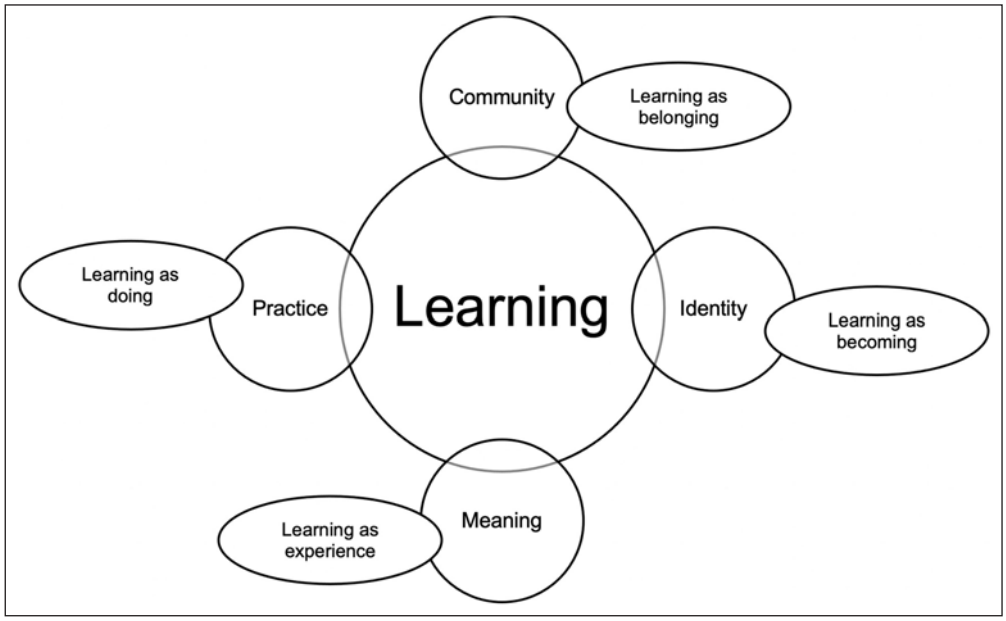

Figure 1: Components of Wenger's Social Theory of Learning, 1998/2008, p. 5.

Table 1: Overview of the participants and length of interviews.

Participants (age)		Interviews minutes	Recording
Anna (12)	Creator/Competitor	53	Audio recorded
Amelia (13)	Creator/Competitor		
Sabina (9)	Creator	55	Video recorded
Nellie (9)	Creator		
Stina (9)	Creator		
Total		108	

the experiences of others, etc (Wenger, 1998/2008). The concept of *identity* is a key element of the theory, as each member struggles to position themselves in the community: "The social world is a resource for constituting an identity" (Wenger, 2010, p. 2). Learning is not just about acquiring skills and information, it is about becoming a knower in context and knowing is negotiated in relation to the participant's ability to put the shared repertoire into play – situated learning (Lave & Wenger, 1991).

Method

A number of qualitative methods have been tried out and combined, all providing different insights contributing to a nuanced understanding of children's out-of-school learning in digital gaming communities. The methods capture both children's stories about their lived experiences, and their actions during play sessions. Thus, different sets of data have been compiled to capture characteristics of children's out-of-school learning in digital gaming communities.

Participants and ethical considerations

Children are shown to be mainly creating or competing when playing Minecraft and this is why both these activities needed to be included in the sample. When researching communities, snowball sampling is a useful method for sampling a population that relies on interpersonal relationships, known contacts and friends (Bryman, 2012). Here, access to one child player paved the way for access to other children and their playing network. Girls in one creative and one competitive community were selected and offered to choose settings for the interviews in order to feel as comfortable as possible. However, only two of the girls in the more competitive community choose to participate and therefore the total number of participants was 5 girls of 9–13 years old (see **Table 1**). All parents signed the informed consent form approved by the Research Ethical Committee (Dnr 2016/289-31). Consent has been collected both from the girls and their parents to show video clips in research presentations such as this article.

Data and data collection

The smaller community is valuable when the study includes tracing the manner in which the group's digital game play informs and relates to a wider social phenomenon, behaviour, its participants, their values or beliefs (Kozinets, 2010). Two focus-group interviews were conducted in which the girls shared their experience of the different practices of creating and competing (cf. Marková, Linell, Grossen, & Salazar Orvig, 2007). The competitors had experience of both practices and their interview was audio recorded as one of the girls did not want to be filmed. The interview was fully transcribed, enabling the

researcher to recall different situations by adding field notes. The video-recorded interview was also fully transcribed by the researcher and included additional information e.g. gestures, postures, interaction.

The digital play sessions were recorded, by the children, with GoPro cameras placed on their foreheads, capturing rich traces of their gameplay. The play-sessions were transcribed by the researcher and followed by individual video-stimulated recall, capturing children's intentions behind certain actions. Video-stimulated recall involves recording an activity and then replaying the recording to the participants so that they can comment on aspects of interest (Rowe, 2009). In this study, both the children and the researcher initiated comments. The video-stimulated recall gave agency to the children and allowed them to contribute to the account of themselves as game players. They also took initiatives to be in control: *if you rewind a little…a bit further back so that we enter…you can stop there.* **Table 2** gives an overview of the participants and generated data in the creating community.

Multimodal interactional analysis

Multimodal interactional analysis was chosen since it focuses on the actions taken by a social actor through mediational means, i.e. how a variety of modes are added and become constitutive of social interaction, identities and relations (Jewitt, 2011). Modes can never exist without social actors utilizing them in some way or other (Norris, 2011). Interactional analysis also put an emphasis on the notion of context and mediational means used for action which also interact in the situations studied (Jewitt, 2011). Here, the context is understood as being the Minecraft worlds, which offer a variety of modes in which situated social interaction can occur and characteristics of learning can emerge.

Data analysis

I constructed an analytical tool as an adaptation of Wenger's conceptual framework of learning (1998/2008), including the components *meaning*, *community*, *practice* and *identity*, adding Dewey's notion of *experience* (1916/2011). An extra column was added in order to gather the empirical data that could not be captured by Wenger or Dewey. The initial stage of analysis included the transcribed group interviews, to which exemplifying data were added. The next stage included the analysis of the children's actions in the recorded play sessions followed by an analysis of children's descriptions of their actions and intentions behind their actions from the video-stimulated recall. **Table 3** illustrates the analytical tool, to which exemplifying data has been added:

Table 2: Overview of the participants and generated data in the creating community.

Participants in a community (age)	Play session 1	Video-stimulated recall interview	Play Session 2 (+iPad)	Video-stimulated recall (+iPad)	Video-stimulated recall (+iPad)
Sabina (9)	X (GoPro)	X	X		
Stina (9)	X		X (GoPro)	X (GoPro)	
Nellie (9)			X (GoPro)		X (GoPro)
Researcher		X		X	X
Minutes	43	44	52*3 = 156	40	39

Table 3: An illustrative example of the analytical tool.

Extra column	**Practice – knowledge is located in the actions and the participants have their own experience of practice.**			
(see **Table. 4**)	***Participation:*** *can be traced to when they engage directly in activities and conversations*	***Reification:*** *can be traced to when they produce physical and conceptual artefacts – words, concepts, stories, tools, constructions and other forms of reification – reflecting their shared experience*	***Experience:*** *can be traced to when there is a reflected change in how they act*	***Competence:*** *can be traced in the ability to perform certain actions, in the expressions of certain pieces of information or in the mastery of certain skills*
	Sabina and Stina start to build their houses. A difference can be noted in how they construct the foundations of their houses. Sabina has constructed a foundation that looks like a platform. Stina just start to build the walls. Stina: *I'm a slow builder* Sabina: *Yes I've noticed that* (play-session)	Anna and Amelia use the abbreviation PVP when they describe what they usually do. When I ask what PVP stands for, they do not know. But they what it means – to fight.	Amelia explains: *If I do something that makes me lose a life, then I think about it next time. That I cannot act in the same way, instead I have to come up with another way of doing it.* (group interview)	Nellie explains that they are good at different things and that she is the best at constructing things with electricity. Meanwhile, Stina and Sabina are better at coming up with ideas. Nellie says: *They have NEVER started to build something using electricity, they just expect me to do it* (video-stimulated recall)

Table 4: Empirical data illustrating grit.

Showing interest	Training	Having goals	Failing	Being persistent
Anna motivates why they did not give up, although they kept losing their games: *It was still fun!* Stina says: *I love Minecraft! I play at least an hour every day!*	Sabina has trained a lot and finally learnt how to construct the kind of roofs that her older brother builds: *I don't want to have a flat roof, I want it to look as a real roof* (defining the goal). She describes in detail how she now builds roofs.	Anna and Amelia define their goal with playing as: "to be better at fighting". Sabina defines her goal: "I have always wanted a YouTube channel and record when I´m playing Sims and Minecraft. But I think you have to be 15".	Sabina built a house, without knowing that she was using dynamite: *The house somehow caught fire and then the whole house blew up! Now I don´t use dynamite when building houses.*	Amelia describes how happy she was after winning their first game: *We had been playing for about a month without winning. We didn´t give up!*

Data in the extra column appeared to resemble what in previous research has been referred to as grit (cf. Duckworth & Eskreis-Winkler, 2015; Duckworth et al., 2007; Klingberg, 2016). After identifying additional analytical concepts such as *showing interest, training, having goals, failing* and *being persistent*, it was necessary to return and scrutinize the data. **Table 4** illustrates how grit was exemplified in the data.

In the final step of the analysis, horizontal reading was applied in order to identify characteristics of learning in the components of meaning, community, practice, identity and the newly identified component – grit. The analysis generated five themes of what characterizes learning in digital gaming communities: learning through experiencing, learning through belonging, learning through performing, learning through struggling and learning through enacting participatory identities.

Reflections on the trustworthiness of the study

To increase the 'credibility' of the research in this study I used triangulation (audio-recorded group interview, video-recorded group interviews, video- recorded play-sessions and video stimulated recall) (cf. Lincoln & Guba, 1985). By comparing the different data sets with all of the data I could ensure consistency in that the findings described characteristics of children's out-of-school learning in Minecraft communities. It is important to provide clear, detailed and in-depth descriptions so others can decide the extent to which findings from one study are generalizable to another situation. Quotes are used to illustrate the empirical findings. Since the wider population easily can be found on for example YouTube, it is possible for anyone to compare and judge if conclusions are reasonable. The idea that I should have managed to sample exceptional children for my study is unlikely; thus, in my opinion, it is possible to transfer some of the findings to a wider population of children than just the participants. Finally, there is the issue of 'confirmability' (cf. Lincoln & Guba, 1985). I have regarded the girls' stories as valid and strived to uncover their lived experience and the meaning they give the data (cf. Cohen, Manion, & Morrison, 2011). I am well aware that I have the final say as a researcher, because I am the one who is responsible for the interpretations and the writing. In my opinion, girls' voices are added to the discussion regarding what characterizes children's out-of-school learning in digital gaming communities.

Results

The analysis finally generated five significant themes of what characterizes learning in digital gaming communities: learning through experiencing, learning through belonging, learning through performing, learning through struggling and learning through enacting participatory identities.

Learning through experiencing

Significant for this theme is how the children integrate their experiences when seeking meaning. Children are positioned in two worlds simultaneously: the game world and the real world, and use experience of both in order to create meaning. According to data, all children participate in digital gaming communities using their know-how, tools and contextual information from both worlds, orienting in both action and identity. One example is the child who mediates her experience of signs in the real world:

> Nellie wants to type the term horse riding and starts typing horse on a sign, using the keyboard on the screen. She later explains her actions as: *I was writing a sign that said, 'horse riding' and Sabina will write a sign that says 'horse'.*

Nellie realizes the need to communicate with visitors and wants to make a sign that reflects her experience that there should be a sign saying horse riding. By engaging directly in an activity, her previous experience of signs is mediated through her actions. This example illustrates the opposite, how children integrate their experience of the game world into the real world:

> Sabina explains: *There are books on Minecraft in which you can write in, if you want to learn how to spell words. But you can cheat and just say them into a microphone, then you click on =. Me and my cousin have built a school in Minecraft.* Stina says: *Me too!* (and nods). Sabina goes on to explain how she does her homework in Minecraft, that it is more fun compared to just sitting alone and studying. Stina says: *You can do your homework in a game* (makes a supportive, sweeping gesture with her arm, as if presenting something new).

One of the children worked out how to use resources in the game world to suit her own purposes in another activ-

ity. When listening to others in the community, the children appear to create meaning by reflecting upon activities, as in this case, where Stina adds a new activity on how to use Minecraft.

The children are also shown to seek experiences for elaborated understanding, something which becomes possible in the process of integrating activities as experiences. Similarities between the Minecraft worlds and the real world make it possible for the children to use, try and challenge their previous experiences and put them into play in the respective worlds. In this example, Sabina reflects upon a learning experience that could be transferred between the worlds:

> Sabina recounts a story of what happened when she and Nellie were playing in survival mode: *Nellie told me that you need an oven in order to grill the chicken, otherwise you'd get sick when you ate it*

The children also explain how the Minecraft worlds offer new and unexpected experiences, as in this example:

> Stina takes action: *Now I'm going to dig a deep, deep hole* (she presses the screen and suddenly the screen turns blue) *Wow! What happened??* (sounds surprised)*...everything is blue* (she navigates on the screen and starts shouting and clapping her hands, showing the others her iPad) *Wow, look where I am!!!* (she continues to navigate on the screen) *I'm underground...*In the video-stimulated recall Stina takes control and gives instructions to the researcher: *This is going to be great fun now because I will fall into a hole! Watch now, this is a little creepy!* The researcher asks why it is creepy and Stina explains: *I fell into a hole and I couldn't get out. I knew what was going to happen, but it usually takes a long time. You need to destroy a lot of blocks. But not this time.*

Stina departs from her previous experiences of the game world, but here the game world offers something unexpected. It is apparently possible for the children to create new experiences for elaborated understanding when playing Minecraft.

Learning through belonging

Significant for this theme is that children are acknowledged by other community members by engaging in joint enterprises and developing a shared repertoire. This repertoire includes e.g. language, handling tools, ways of doing things, stories that become part of the community. In order to fully engage, the children need to understand the community's joint enterprise. Data reveals that engagement is the key to feeling a sense of belonging, and that community members do not appreciate when someone is not engaging in accordance with the negotiated joint enterprise in a creating community:

> **Nellie:** *Stina you have to start building* (they are supposed to build a fence together) *otherwise you won't get paid!* (sounds irritated)
>
> **Stina:** *Wow! I'm swimming with the dolphins* (laughs)
> **Nellie:** *You'll get fired if you continue!* (says this in an angry voice)

A member who does not act in accordance with the requirements of the community, appears to risk not being acknowledged by the other members. Another way of risking not being acknowledged is experiencing difficulties in adopting the shared repertoire. All of the children express that it is hard to learn how to make use of all the different resources in the game world.

The children align with a community in order to pursue joint enterprises. This appears to be a complex, ongoing process that allows children to learn how to negotiate, collaborate, resist and align with the collective. Children favour communities in which people support and help each other. It is of greater importance to the children to know how to give and receive help than to know everything by themselves, as illustrated here:

> The creators are building a zoo, which they have agreed upon. Stina feels unsure: *I don't understand how we should build the zoo. I don't think I'll be of much help.* She starts building a fence but is told by the others that she is building it in the wrong place. She is supposed to build it next to where Sabina is building a fence. Stina starts building a fence next to where Sabina has already started building a fence that is three blocks high. Sabina discovers that Stina's fence is not as high as it should be: *It should be three rows.* Although the fence is right in front of Stina on the screen, she does not appear to understand what Sabina means (see **Figure 2**).
>
> **Stina:** *What three rows?*
> **Sabina:** *Three lines on these cages*
> **Stina:** *What three rows?* (she still doesn't understand)
> **Sabina:** Look, how I'm building! (Sabina is building a fence, three blocks high)
> Stina then discovers how Sabina is building the fence and says: *Yes, alright!*
> Stina keeps building the fence and after 15 seconds says: *Oh Sabina, I don't have to build on that side because you're already building on it!*

This demonstrates how the children apply different teaching strategies. Here, Sabina serves as a resource by first explaining and then showing how she is building the fence. These findings show that children are willing to help out, ensuring that everyone *really* understands when pursuing joint enterprises. Aligning with a community also involves disagreements and tensions and the children are shown to nurture each other, applying different methods. The most common method appears to be to tell someone off. However, more complex methods involving power are revealed:

> Stina does not contribute to the negotiated joint enterprise and does not listen when repeatedly told to by the others (Nellie whispers something

to Sabina). Stina explains in the video-stimulated recall that the others are using a potion that makes it possible to see when it is night: *They thought I didn't know about it, then Nellie got cross because Sabina didn't turn off the sound and then I understood that they were using that potion because you can hear* (makes drinking noises). Nellie states that she was doing something so that Stina would become more interested: *I thought that if Stina can't build* (Nellie changes the settings so that Stina can't build)*...and I say that I will change the settings again if you promise to contribute more.*

Nellie, a knower in context fosters Stina who is not contributing, through punishment. The knower makes use of the repertoire of resource and competence to change the settings in the game world – being in control. This illustrates how members of a community acquire different statuses and assume different roles.

Learning through performing

Significant for this theme is how the children develop practice by performing while refining their shared repertoire. Children participate in two different kinds of practices, competing and creating, and what they learn is shown to be linked to what the gaming context offers, in line with Wenger's (2010) notion of situated learning. Competitors visit game worlds that are already created in order to participate in competitions in which there are rules to follow. They express the need to refine their skills in order to become better fighters and learn to distinguish between contextual cues of importance in order to uncover enemies. Creators construct the game world, negotiate what will happen and make decisions on what to build, simultaneously. The creators want to develop their contextual knowledge by refining how to sufficiently utilise the resources offered by the game world, as well as their creative skills. Traces of how children perform by using context-specific language and how experienced competitors seek and request information, are here illustrated:

Amelia describes one of the servers, Cubecraft, which they often visit and which, according to her, is one of the most well-known servers: *There's a lot of PVP and things like that.* The researcher asks what PVP is. Anna and Amelia both say: *PVP means that you fight.* Amelia and Anna keep describing the conditions for competing in Cubecraft by using context-specific language. When there's something they can't do, they use Google. Anna explains that she just writes: *How to make a..?* And then YouTube clips appear, from which she can choose from. Amelia uses PVP again and the researcher asks what PVP stands for. Amelia answers: *PVP? I don't know. I haven't searched for it.*

The children appear to have made a meaning out of PVP, from participating and knowing what kind of actions they are expected to take – to fight player versus player, without knowing what the acronym stands for. All the children express that they learned context-specific languages and English in practice. How language causes problems and how problems can be solved in practice, are displayed here:

Sabina and Stina are playing on different iPads. The language is English on Stina's iPad and Swedish on Sabina's. Stina wants to use the Light up potion but can't find it in the inventory and asks for help (Sabina takes the iPad from Sabina). Sabina takes Stina's iPad and starts searching the inventory but can't find it either. Sabina then goes back to her own iPad and looks for it and finds it with the help of the Swedish text. She navigates in the same way with the iPad in English and finds the potion (see **Figure 3**).

Figure 3: QR code of a videoclip illustrating problem solving. Film: Marina Wernholm.

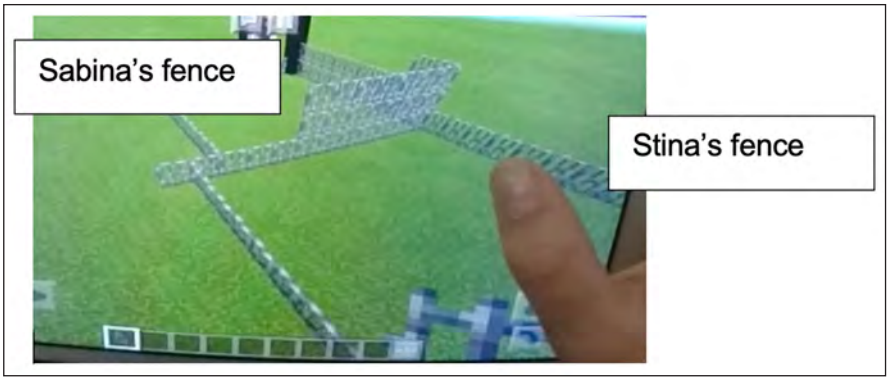

Figure 2: Illustrating the fence. Photo: Marina Wernholm.

Sabina solves the problem by using her own iPad as a 'map', handling both iPads. Thus, the children contribute to their practice by performing different actions and skills. If children do not act, there is no practice. Each member has a unique place and gains a unique identity, as the children jointly develop shared ways of doing things in the community:

> Nellie explains that they are good at different things and that she is best at constructing things with electricity. Meanwhile, Stina and Sabina are better at coming up with ideas. Nellie says: *They have NEVER started to build something using electricity, they just expect me to do it..*

This also illustrates the underlying assumptions in a social practice. It is not articulated that Nellie should solve issues with electricity. The excerpt is a trace of how the community's social history of learning is reflected in practice. Mechanisms in the game world also contribute to making the practice what it is. Children cannot control the animals' actions. Here, the mechanism puts the children in the position of making ethical decisions without time to consider, since they need to act immediately:

> The polar bears are jumping over the fence, escaping from the enclosure. Nellie explains in the video-stimulated recall why she acted instantly, and started building a higher fence: *Stina had built a hillock* (points at the screen) *for the ice bears, but it was too high so they were able to jump over the fence and were starting to escape.*

This illustrates how children have the freedom to act in favour of helping others or not. These kinds of findings indicate that it is possible for children to develop their ethical compass when playing Minecraft.

Learning through struggling

Significant for this theme is how the children are persistent in performing actions, investing time and making efforts. The children state that they are driven by their interests and a desire to refine their skills and thereby to achieve their goals. This behavior can be explained by referring to grit, which entails committing to challenging projects, staying focused on their objectives, working strenuously on challenges and maintaining an effort and interest over time despite failure and adversity (Duckworth & Eskreis-Winkler, 2015; Duckworth et al., 2007). Participation in digital gaming communities appears to encourage and nourish the expression of grit, since, according to Wenger (2009), communities seek to refine their practice through participants mastering their shared repertoire. Handling digital tools forms part of this repertoire and all of the children stated that they struggled with learning how to handle the keyboard:

> Amelia describes how she has learnt how to handle the keyboard and find the right keys: *It took a while for me to learn. First, I was sitting like this and watching* (she demonstrates by placing her hands as if they were on a keyboard, looking at her hands and up and down again at her fingers). *Oops, now I fell down, like this. And now I died! (laughs).* Now she is able to find the correct keys without looking at her fingers. She says she is really fast when she strikes the keys, which is very important when fighting.

Children refine their skills by training and investing time. It has been shown that the learning trajectory of handling the keyboard impacts the children's gameplay; the faster they can strike the keys, the better they can fighter. Data shows that common minor mistakes, are instantly adjusted or erased by the children. However, the children also reflect upon making mistakes and failing:

> Amelia: *I was down in a cave and was mining my way up, when I heard a sound but I didn't know what it was. And then lava came pouring down on my head…so I died and then I thought:* ***Next time*** *I'm down in a cave and hear that sound I won't move upwards!* She shares how she now deals with failing now, when competing: *If I do something that makes me lose– I mean die– then I will think about it the* ***next time*** *and then I probably won't act in the same way, but will act differently.*

The children often use the expression *next time*, when talking about their failures, which indicates that they maintain their level of effort and interest, despite their failures. This is also an example of a child's reflected experience of making mistakes and failing, and how this might lead to refining their abilities. Making mistakes and failing appear to be the conditions for improving skills and refining abilities in digital gaming communities, in addition to being acknowledged by the others. This is explained by Dewey (1938/2015) that what a person has learnt in one situation becomes an instrument of dealing effectively with new situations that arise. The community benefits when the players become more competent. All the children could relate to how they themselves have refined their shared repertoire this way, and state that an awareness of this struggle and being persistent eventually pay off.

Children succeed in achieving goals due to their struggle and hard efforts. Even though failure leads to disappointments or disagreements, the children still appear to show an interest in pursuing their goals, in this case, to eventually win a game:

> Anna explains why they did not give up, even though they kept losing their games: *It was still fun!*

Having fun and feeling a sense of belonging appear to motivate the children to pursue joint enterprises. The children in the different communities state that they have different goals, e.g. to win competitions or to build something. However, their mindset appears to be the same, to not give up easily – competitors or creators:

> *We'd been playing for about a month without winning. We didn't give up!*
>
> *First, I usually rethink, what else might I need and if I can't figure that out I usually think: How can I do it in another way? You can, of course, destroy it and not care about it* (laughs) *but that's not what I do. I could keep trying for hours.*

Children express their awareness that being persistent eventually pays off. According to the children, there is always a new chance. They are not limited in the number of times they can try something out. They have all succeeded in achieving goals and have enjoyed their own success and this familiar feeling appears to motivate them in their struggle to pursue joint enterprises.

Learning through enacting participatory identities

Significant for this theme is how the children represent the learning self in the ongoing process of becoming a knower in context constantly interacting with the community through communication and actions. Data reveal how they position themselves by manifesting competence and this appears to motivate them to learn. It is not possible for the children to pretend that they know how something is done because the others ask for immediate proof:

> The children have planned to create a new world, in which they will build a zoo. The other children want Stina to create the world, something she did not appear to expect: *But wait do you want ME to create a world?* (she sounds surprised and looks at the screen, without doing anything). *But can you help me*? (she turns her smartphone so that Nellie can see it). *Nellie can you help me?* (Stina places the smartphone in front of Nellie). Nellie says: *What, don't you know how to create a new world?*

The children enact participatory identities by also creating an avatar, whose actions mediates the children's competencies and skills. This avatar can be created in a variety of ways, free or with real money. The children appear to take many different aspects into account when creating an avatar, e.g. a resemblance to themselves or something else might be important:

> I've got brown trousers. My clothes have natural colors because then you can hide more easily.

This is how a more experienced player reasons when designing an avatar, based on reflected experiences and thinking strategically. The children adopt strategies for learning that probably also have bearing in other contexts. One strategy that stands out in data is using questions. The children turn to more knowledgeable people, who explain or show them what to do. Consequently, the children also gain experience of being someone who knows and teaches others. Asking questions also poses a risk because the question will reveal what you don't know. The children reflect on their learning, in relation to their skills, and how their skills have developed:

> Amelia describes herself as being sloppy when starting to compete and states that it took a long time for her to learn how to do everything. She explains: *Now I look really carefully and I'm very focused so that I don't miss that someone might be aiming at me. You know the longbows are shining, so then you look carefully if you can see something that's shining.* She describes how she scans the environment.

This is a good example of how a knower in context learns to refine skills when enacting participatory identities. Thus, more experienced competitors are able to refine their participation, and this requires being focused and distinguishing between contextual cues of importance in the environment. It is possible for a knower in context to control the game world by changing the settings and becoming the operator when creating. Not only does the operator control the game world, but also what other children are allowed to perform. One of the operators states: *Then I'm in control of the world.* Data reveal that not all the children possess the knowledge to become an operator. Based on the findings of this study, the conclusion is drawn that knowledge is also power in digital gaming communities. The five themes that characterize learning in children's out-of-school digital gaming communities are illustrated here as components of a tentative conceptual framework (see **Figure 4**).

Wenger's (1998/2008) conceptual framework has been explored and elaborated on, making it more useful as a thinking tool for understanding learning in children's out-of-school digital gaming communities.

Discussion

This study has been inspired by Halverson's proposal to shift the focus on education from 'what works' to 'what's happening' and 'what's possible (Halverson, 2012, p. 5). The findings reveal that conditions for how children shape their social relationships, identities and learn are changing (see also Ito et al., 2019; Schmidt, 2020). I will here discuss how children define, negotiate and develop their shared repertoire. These characteristics appear to be of significance when designing for learning in school.

In the process of defining a shared repertoire, children's previous knowledge and experiences can become resources (Schmidt, 2020; Wernholm & Vigmo, 2015). This study furthers our knowledge on how children also integrate their experience of the game world into the real world, in comparison with previous research (Dezuanni & O'Mara, 2017). If we want children to develop experiences for elaborated understanding and to reflect upon differences and similarities, they must be offered the opportunity to integrate their experience of different worlds. The findings here indicate how children develop strategies for learning that appear to have a bearing in other contexts, for example, asking questions and distinguishing between contextual cues of importance, strengthening previous results (Berg Marklund, 2015; Halverson, 2012). Today's children constitute their learning identities by integrating a variety of participatory identities with the learning self (Dezuanni & O'Mara, 2017; Wernholm, 2018).

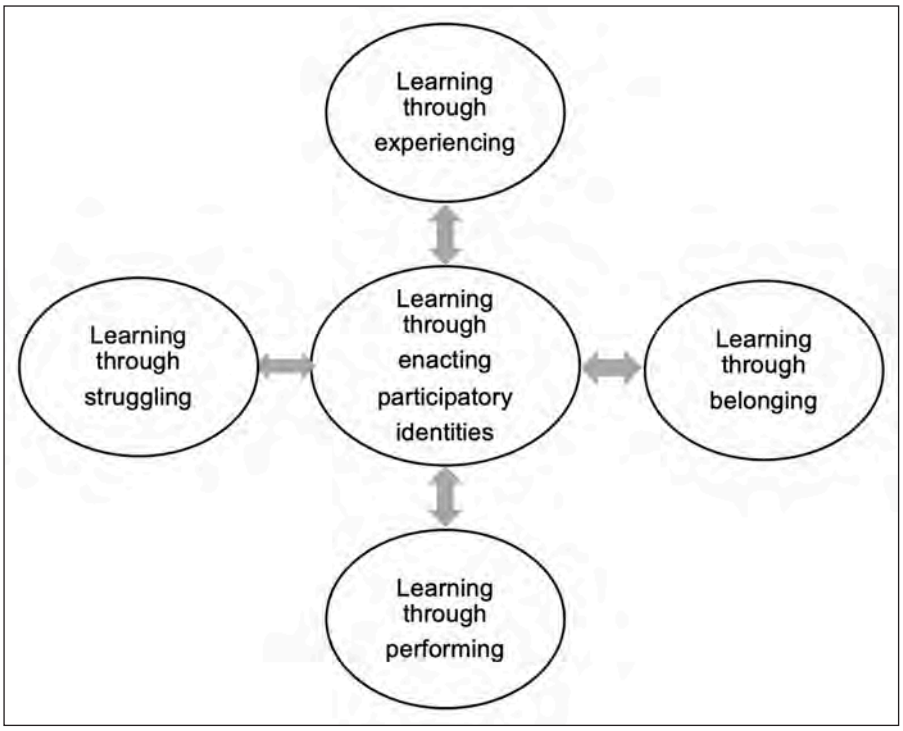

Figure 4: Five components that characterize learning in children's out-of-school digital gaming communities. Designed by: Marina Wernholm.

When negotiating the children are shown to act as subjects and manifest their views in a variety of ways, for example, by performing actions, formulating certain pieces of information and mastering certain skills cf. Wenger (1998/2008). The results show how the children put a variety of modes into play in order to represent the knowledge and understanding of which they are bearers, for example, by speaking, showing, performing, etc, supporting previous research (Dezuanni, 2018). They learn to negotiate, collaborate, resist and align with the collective.

If it is of greater importance for the children to learn how to give and receive help than to know everything by themselves this is very unlike the conditions for learning in school, and indicates why it becomes difficult for many children to learn in traditional school settings (cf. Rowan & Prestridge, 2017). The children express that they learn from their mistakes and make use of these experiences when facing new situations, which are dealt with more effectively. I think school practices would benefit from these kinds of mindsets, by supporting a child who fails and letting children reflect upon how their mistakes might eventually lead to an elaborated understanding. However, in the global education measurement industry, the focus is on learning outcomes and a limited number of pre-specified criteria (what works). The chances of making mistakes and failing appear to be limited. Another aspect of importance to the future of education is that participation in digital gaming communities appears to nourish the expression of grit, which entails committing to challenging projects, honouring commitments, working strenuously on challenges as well as maintaining an effort and interest over time, despite failure and adversity (Duckworth & Eskreis-Winkler, 2015; Duckworth et al., 2007). A question of relevance for the future is how children's expression of grit from their out-of-school learning can be transferred to activities in school practice? The findings here suggest that this also includes an acceptance of mistakes and failures. This should be taken into account when building upon children's out-of-school learning in school so that *all* children's knowledge and skills are acknowledged and every child can contribute to developing the school practice, by trying out and refining their shared repertoire (cf. Schmidt, 2020).

Conclusion

Many children's learning in digital gaming communities occur in a hybrid reality, where the physical and digital worlds are so intertwined that it is no longer fruitful to think of them as separate. Thus, a point of consideration for schools is how to connect these children's learning experiences and spaces for learning with the learning pathways offered in school. Here the framework can assist stakeholders in their work to connect children's out-of-school learning experiences, by considering and acknowledging the whole range of experiences of todays' children in order to support their learning in school.

There is also a need to address the limitations, significance of methodology and contributions of this study. Limitations concern the small-scale nature of the study, which involved a limited number of participants. However, exploring 'what' s happening' when a small group of children participate in digital gaming is of value, since their digital game play informs and relates to a wider complex social phenomenon. This study also applies a new combination of methods for exploring 'children's out-of-school teaching and learning journeys'. It is essential for researchers to keep up with the pace of children's development and to continue exploring children' s experience

of learning in new practices (Ito et al., 2019; Stephen & Edwards, 2018). Thus, there appears to be a need for these kinds of small-scale studies, in which tentative conceptual frameworks are constructed, in order to be further explored and developed by other researchers.

Note

[1] ERIC, Sociological Abstract, SAGE Journals online and Taylor & Francis. For a more detailed description see Appendix 1.

Additional File

The additional file for this article can be found as follows:

- **Appendix 1.** Question: What empirical research has been conducted on children's learning in digital gaming communities? DOI: https://doi.org/10.16993/dfl.164.s1

Competing Interests

The author has no competing interests to declare.

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