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Using Minecraft to Reconstruct and Roleplay Local History: Intersubjectivity, Temporality, and Tension

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Abstract: This paper presents a design-based study of pupils' use of Minecraft in a whole-day school project in social studies involving three seventh-grade classes, student teachers and amateur historians. We used qualitative methods for data collection and analysis. We followed three groups through the following activities: 1) searching for historical information (introduction), 2) building in Minecraft and creating roleplay scripts (reconstruction), and 3) acting out the scripts and making videos for a class presentation (transformation). The activities combined generic and domain-specific skills practices in different ways. We analyze how these two modes intertwine and argue that the teaching model we used can bridge the gap between learning in and out school. Key concepts used in the analysis are intersubjectivity, tension, and temporality. Our findings indicate that through Minecraft pupils, teachers, and amateur historians contribute to intersubjectivity toward shared knowledge by setting and releasing tensions between generic and domain specific knowledge.

Introduction

An overall aim of our research is to bridge learning in and out of school, i.e. theoretical and practical knowledge. Resnick (1987) uses examples from mathematics to show this educational gap and argues that schools need to focus more on cross-cutting themes such as thinking and learning abilities to motivate children for school learning. Today these general thinking and learning abilities are referred to as generic, soft, or 21st-century skills, and include among others collaboration, problem solving, and creativity (Resnick, 2017; Trilling & Fadel, 2009). The study presented here addresses the educational gap by employing a popular three-dimensional (3D) virtual world in the teaching of history and a teaching model where generic skills are intertwined with subject matter knowledge. Three seventh-grade classes in social studies recreated part of a 19th-century industrial community in Minecraft (Saw Valley River) with its industrial buildings, which were workplaces for those who lived in the municipality of the school during the Industrial Revolution in the time period 1840-90.

Computer-supported collaborative learning (CSCL) shares several characteristics with generic skills. Key features of CSCL are information sharing, interaction between learners, joint meaning-making based on negotiation in the group, and developing common artifacts (Engen et al., 2018; Stahl et al., 2006). Furthermore, Stahl et al. (2006) suggest that the problem of intersubjectivity is of particular relevance for understanding how learning is produced through interaction, advocating for more in-depth interdisciplinary research and arguing that this issue has implications for research methods and for CSCL system design. In the study presented here, collaborative learning is a dynamic process of combining generic and domain-specific skills aimed at developing common artifacts from the perspective of intersubjectivity. Minecraft Education Edition (MEE) is used as a CSCL system in two respects: 1) a design environment for reconstructing historical buildings and 2) roleplaying historical events in the buildings to learn social-studies concepts pertaining to a particular period in time.

The block-building and sandbox game Minecraft serves as a domain-oriented design environment. The users interact by placing and breaking 3D building blocks. Actions in Minecraft (building and destroying) have a persistent effect, keeping areas in the state that the user leaves them and enabling the continuous development of digital artifacts. The notion of block building or a "sandbox game" is analogous to a child playing in a sandbox; the sand's affordances for design are virtually unlimited and have no instructions or objectives, but constraints can be imposed by tools, artifacts, and knowledge-based activities (Mørch & Thomassen, 2016). Furthermore, making and destroying are legitimate actions toward artifacts. The challenges and opportunities of integrating this type of learning environment in three middle-school classrooms are the focus of the paper.

Several studies of Minecraft in education have highlighted the potential of Minecraft to support creativity (Karsenti & Bugmann, 2018; Lorence, 2015). However, studies have indicated several challenges in using MEE in learning environments such as teachers' reluctance to using Minecraft due to the gap between students' and teachers' game knowledge (Kuhn & Stevens, 2017) and lack of focused learning objectives, inflexible curriculum,

and no previous gaming skills (Baek et al., 2020). Callaghan (2016) argues that the pedagogical use of Minecraft promotes conditions that are favorable for learning, not only in relation to creativity but also for collaboration. Cipollone et al. (2015), for example, show that Minecraft gives players an opportunity to be creative in virtual environments that would otherwise be difficult to recreate in the real world. In studying how Minecraft might be integrated into the curricula, Baek et al. (2020) argue that by using Minecraft, students are interested and enthusiastic while acquiring curricular knowledge and skills in subjects such as science, math, social-science, and language-arts and composition classes. Detailed depictions of history in a game that models real-life historical and present conditions are an appealing alternative to static pictures and descriptions used in traditional materials. Students can navigate through the virtual game space and observe the scenes that simulate real-life situations, promoting student interest and engagement (Baek et al., 2020). Spikol and Milrad's (2008) study using mobile technologies for learning local history indicated that giving pupils the possibility to involve themselves in authentic historical settings in which to collaborate with peers gives rise to meaningful learning.

Therefore, we address the following research question:

- How are generic and domain-specific skills intertwined in pupils' use of Minecraft in a seventh-grade social-study (local-history) project?

Integrating intersubjectivity and domain-oriented design environments

We adopt a theory of experience based on temporality and emergence referred to as social consciousness (Mead, 1910). Mead argues "there is a continuity of experience, which is a continuity of presents" (Mead, 1910, p. 1). Mead's interest was in understanding the past in the present as an emergent phenomenon of social reality, during which reconstruction is a central component (Mead, 1929). The past arises in memories and is represented in visual images (Mead, 1929, p. 235). The past is not stable or fixed, according to him, because "[t]he past consists of the relations of the earlier world to an emergent affair – relations which have therefore emerged with the affair. . . . The past thus belongs to a generalized form of experience" (Mead, 1929, p. 5).

This theory inspired the model we use for teaching history with Minecraft, both in terms of levels of temporality and the use of a design environment for reconstruction. Furthermore, we conjecture that when reconstructing the past in the present, tensions (not only relations) in temporality emerge, which we use as analytic concept in the analysis of intersubjectivity. By tension we mean a conflict between two elements that must be resolved to advance development. In our case it is used to align elements of domain specific and generic skills practices and past, present, and future events. We draw on Ludvigsen et al.'s (2010) characterization of horizontal temporality (levels of change according to time scale) and vertical temporality (in-depth discursive analysis on a specific level). In our study, we include dynamic visual artifacts as a context for analyzing discursive practices.

Intersubjectivity is a type of social consciousness, which in the work of Rommetveit (1976) is depicted as an expansive process of communication in a spatial–temporal–interpersonal space. According to Rommetveit, intersubjectivity is a temporarily sustained and partially shared social world that depends on access to historical information (common pre-understanding), which is projected forward by anticipatory cues (shared prolepsis). Participants in conversation collaboratively construct knowledge by expanding intersubjectivity toward the future, the past, social relationships, and specific localities (Rommetveit, 1976). Researchers in computer-supported cooperative work (CSCW) and CSCL have adapted the framework for analyzing technology-mediated communication in distributed work (Fugelli et al., 2013; Stahl, 2016) and collaborative construction of knowledge (Stahl et al., 2006). Technology can support or hinder intersubjectivity, and Suthers (2006) suggests that CSCL systems should be designed to support communication and constrain the activities toward learning trajectories.

Domain-oriented design environments (Fischer, 1994) are digital tools to mediate two interdependent design activities, constructive design, and argumentative design. Constructive design is mainly a visual activity of combining building blocks into functional designs, whereas argumentative design is mainly a verbal activity, including the discussion of desired relations among the design units (Fischer, 1994). The two activities of domain-oriented design environments inspired the design of complementary modes of activity for the teacher and pupils to shift their focus as they engage in different learning activities by toggling between generic and domain-specific skills practices. Mørch, Mifsud & Eie (2019) have developed a teaching model to support this process. The teachers, in collaboration with the researchers, used this model to organize the classroom activities (see Table 1).

Table 1 provides steps for developing intersubjectivity in phases: from a vague object of shared understanding to one that is more complete (ending with a roleplay video). Tensions are inherent in temporal orientations (past, present, and future), in the difference of visual and verbal activities (Fischer, 1994), and in discursive practices (Ludvigsen et al., 2010). From a temporal perspective on social consciousness (Mead, 1929) and intersubjectivity (Rommetveit, 1976) set in a contemporary digital context of sandbox video games, the aim

of reconstruction in our research is to use a domain-oriented design environment (Minecraft) to create the historical context for developing intersubjectivity toward shared knowledge and memorable shared experience.

Table 1: A model for teaching with Minecraft in social-studies classrooms (Mørch, Mifsud & Eie, 2019)

Phase (temporality) (*time scale: frame*)	**Skills-practice intertwining** (foreground vs. background)	**Example of tensions** (and techniques for resolving them)
Introduction (oriented toward the past) *(slow: 50 years)*	Domain-specific vs. generic (teacher-centered activity leading to an incomplete object of shared knowledge)	Historical buildings and events vs. searching for relevant information (resolved by amateur historians, online searches, and site visits)
Reconstruction (oriented toward the present) *(inter-mediate: day-hours)*	Generic vs. domain-specific (learner-centered activity leading to a fragmented object)	Minecraft building blocks vs. building architecture pictures (resolved by teacher's scaffolding and pupils' creativity)
Transformation (oriented toward the future/out of school) *(fast: minutes)*	Domain-specific vs. generic (learner-centered activity leading to a focused object; varying degrees of quality)	Enacting social concepts in roleplay vs. Minecraft stage props (resolved by personalization and humor)

Research design and methods

The pupils used Minecraft as an educational game to learn about a social-studies topic, 19th-century forestry industrialization and timber trade in eastern Norway. The topic was adapted for a one-day school project, where pre-service teachers from a nearby teacher-education college participated in the activity. Three senior citizens with in-depth knowledge of local history (industrial, architectural, and labor history) were invited by the school to give an introductory presentation on the topic, and we refer to them as amateur historians. We used aspects of design-based research (DBR) to organize the activity (Brown, 1992; Hoadley, 2002). Our intervention is based on three previous iterations in a teacher-education program using the same model to prepare the student teachers to teach seventh-grade pupils social-studies topics using a virtual world that builds on pupils' prior (out-of-school) experiences (Mørch, Mifsud & Eie, 2019), and adapted in this iteration by a new location (school rather than university), theory refinement, and scaffolding by amateur historians. The pupils' work was not assessed by grades, but was discussed in the classroom by student teachers, amateur historians, and researchers.

We collected data from three seventh-grade classes (N=80) using field notes, video observations (three groups of four pupils each), and audio-recorded interviews (12 pupils). After transcribing the data, six researchers participated in a data-analysis workshop to code the material. We used a version of thematic analysis based on abductive classification to organize the textual data (Reichertz, 2014). The model (Table 1) provides three overarching themes (introduction, reconstruction, transformation) and our conceptual framework provides additional analytic concepts (intersubjectivity, temporality, tension). Several themes emerged during data categorization and we profile the following: scaffolding, cooperation, collaboration, problem solving, creativity, humor, domain knowledge. The transcript notation we used includes these symbols: (..) short pause, ((text)) comment by researcher, [..] excluded (non-audible) speech, and :: abruption of talk. The nine extracts presented below are chosen to illustrate the different phases as well as to highlight the intertwining of generic and domain-specific practices during collaborative learning as it developed over time. The names of participants are fictitious.

Data and empirical analysis

In this section we show a series of data extracts, organized in three subsections according to the three phases, and illustrating similarities and differences of three groups' collaborative learning. We focus in-depth on one group (Group 2) in the second subsection to show how the group worked and shifted focus as the work changed over time.

Introduction

In the beginning of the assignment, the pupils were engaged in information seeking and knowledge acquisition. We present this theme (introduction) from three different perspectives in order to foreground multiple methods for information seeking. The data below (see Table 2) are from two interviews (Groups 1 & 3) and from video observation (Group 2).

Table 2: Extract 1 (Wood Factory), Extract 2 (Sawmill Factory), and Extract 3 (Steel Factory)

Group 1 (00:28:57) Interview	**Group 2** (00:10:33) Video	**Group 3** (00:00:13) Interview
1. Interviewer: How did you know it started to burn in the Wood Factory? **2. Daniel**: It said so on a website. I think it was Wikipedia. It said it started to burn, and people came here to talk about it. **3. Interviewer**: Who were those guys? **4. Anna**: It was ((researchers)). We got pictures and ((building)) measurements from them. **5. Daniel**: And we used information about what we thought had happened in the factory. **6. Anna**: And when we got the measurements, we copied them from a sheet of paper [..].	**1. Student teacher:** Do you know where the Sawmill Factory is located? Is it here in ((City A))? **2. Lisa**: It's in ((Town B)). **3. Student teacher:** In ((Town B))? **4. Lisa**: Yes. **5. Student teacher:** Because then you can say that you are in ((Town B)) and that the timber comes from the nearby forest. It is useful to include some of the historical information, such as where the logs come from and the process of cutting them into planks.	**1. Kris**: We asked the pro how it was. **2. Interviewer**: The pensioners you mean? Those who came here? You asked him questions and then you created something afterward? **3. Kris**: Yes. **4. Thea**: And then we made something up. We got this ((sheet of paper with the building's measurements)), but before we could start, we went through how it ((working life)) was at the time. It was someone who explained all these things for us ((about buildings and working life)).

Group 1 sought information about the Wood Factory and cited multiple sources, including Wikipedia and building measurements they received from one of the researchers (Extract 1). They mentioned later in the interview that building the factory in Minecraft required more domain knowledge than scripting the roleplay, which could be a reason why they gathered information from multiple sources. Group 2 could not find any historical information about their building, the Sawmill. In this group, the student teacher played a central role by suggesting they look for information about the industrialization process of making planks from logs felled in the nearby forest (Extract 2). Group 3 was the most positive toward the information provided by the pensioners (amateur historians), asking one of them questions and using the information combined with their own ideas (Extract 3). Analyzing and comparing these extracts, we see that the three groups were able to find domain knowledge and start the process of developing intersubjectivity. Group 1 focused on a fire that broke out in the Wood Factory, Group 2 on the log-cutting process, and Group 3 on the working conditions in the Steel Factory.

Reconstruction

After having acquired knowledge of the buildings and important events, the next step for the three groups was to reconstruct the buildings in Minecraft and write a script for the roleplay. In this section, we focus on the building process and compare three extracts of the same group (see Table 3), showing how the pupils gradually learned to work together with the help of the student teacher. We illustrate how Group 2 developed their MEE building (Sawmill Factory) in parallel with building their understanding and how they incorporated historical information through negotiation supported by scaffolding, cooperation, and collaboration:

Table 3: Extract 4 (Scaffolding), Extract 5 (Cooperation), and Extract 6 (Collaboration)

Group 2 (00:18:16) Scaffolding	**Group 2** (00:22:22) Cooperation	**Group 2** (00:23:22) Collab.
Jon: Should we have red on the top? **Geir**: Should we use red terracotta ((searching MEE inventory, writes "red" in the search bar for options))? **Jon**: Or red wood? **Geir**: Or red concrete? **Student teacher**: Remember how it ((the building)) looked like then	**Lisa**: But we were going to have a wooden floor, didn't we? **Gro**: Yes, I'll find it. **Lisa**: What type of wood? **Gro**: Oak wood! **Student teacher**: What if you two ((Lisa and Gro)) start to build the wooden floor, given you aren't as experienced as the other guys?	**Geir**: Maybe we should choose a red block (..)? **Jon:** I think you can do it as it is (..). If you take the windows in the middle (..) assuming we have six spaces in between. **Geir:** Six spaces? **Jon:** It's not that many windows in the picture

(..). Was it made of wood or concrete? **Geir**: I think it was made of wood. Do we have any red wood ((writes "wood" in the MEE search bar))? **Student teacher**: You can also use red wool as well if you want red (..) but does everybody ((referring to the whole group)) agree that the building should be red? **Jon**: Yes, it was ((red)) on the picture ((Geir places "red wool" in the search bar)).	Then you ((Jon and Geir)) can start on the roof? **Jon**: Where is the floor on the picture ((Jon opens OneNote and looks at photo in Fig. 1))? **Student teacher**: ((Repeats his former comment)) If you ((Jon and Geir)) could start with the roof and the windows, then the rest of the group ((Lisa and Gro)) can start with the floor, given that you guys are more experienced.	((looks at the picture of the building, Fig. 1 middle))? **Geir:** Should I take the other side ((of the building))? **Jon:** Let us see how it will look first. **Geir:** We are going for six spaces? **Jon:** Or five? **Geir:** Is it on the fifth or the sixth ((asking for a confirmation of options))?

In Extract 4, Jon and Geir discussed the options for the red building blocks to match the building (see Figure 1). The student teacher reminded them that they should refer to the material the real building consisted of. Geir believed it was made of painted red wood and asked if there were any red wooden blocks in the MEE inventory. The student teacher also suggested that they could use red wool, a versatile MEE building block, if everybody in the group agreed, implying the block's color was more important than its functionality, to which Jon answered yes, referring to a picture they had received earlier (see Figure 1, middle). In Extract 5 (see Table 3, middle), the student teacher advised the group to split the work into subtasks, and suggested the boys take the roof and the girls the floor. The student teacher assumed that the girls had less experience playing Minecraft and that the roof was more difficult to construct. In Extract 6, Jon and Geir discussed the distance between the building's windows to determine how many they could fit on one of the walls. The photo that the pupils used as a reference shows four windows on one side (see Figure 1, middle), but the pupils created seven (see Figure 1, right). The historical photos they received from the amateur historian did not cover the entire building, leaving the rest to the pupil's imagination, own interpretation, or their searching for additional information on their own (e.g., as a comparison, Group 1 used Google Maps to look for a current picture to see more detail).

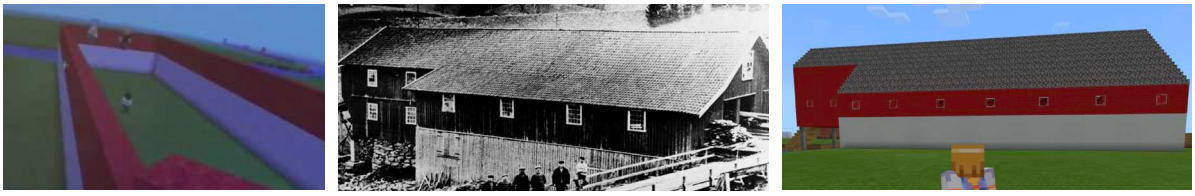

Figure 1. Two screen snapshots in the development of Group 2's MEE building (left and right) and a photograph of the historical building that served as model (middle). They were told the color was red.

In analyzing the data material from the three groups' reconstruction activities, we see that intersubjectivity is now knowledge-based, but remains fragmented. For example, domain-specific knowledge and scaffolding played a central role to help the pupils to cope with the challenges of relying solely on generic skills and help the group work closer together (e.g., problem solving, division of labor, collaboration). The student teacher suggested in two rounds that Group 2 should divide their work based on perceived gameplay experience. All the groups tried to create buildings that resembled the pictures they received from the amateur historians and from other sources when this was insufficient. All the groups met challenges when trying to recreate certain parts of the buildings, sometimes leading to creative workarounds, such as Group 1 creating a restaurant-like seating area outside their building, or Group 2 increasing the number of windows along a wall (Extract 6).

Transformation

In the last phase of the assignment, transformation, the pupils roleplayed historical events set to the scenery of the 19th-century industrial architecture they had created in Minecraft. We will present this theme from three different perspectives in order to foreground the degree of seriousness and domain-knowledge accuracy (or alternatively the lack of it and the inclusion of humor and entertainment) in the roleplay, as we see in Extracts 7–9 in Table 4:

Table 4: Extract 7 (Building on fire), Extract 8 (Work accident), and Extract 9 (Exploitation)

Group 1 (00:25:50–6)	**Group 2** (00:36:32–3)	**Group 3** (00:15:21–6)
Iris: What are we going to produce in the factory today? **Anna**: Probably a door. **Daniel**: OK, let's start! **Nils**: I have to use the restroom (..). I have to use the restroom (..). I have to use the restroom (..). **Anna**: Look, a fire has started to burn! **Daniel**: Let's get out of here ((everybody leaves the building))! **Anna**: We have to get out of here now! **Nils**: I have to use the restroom (..)! I have to use the restroom!	**Student teacher**: Have you started planning the roleplay yet? What are you going to say? **Gro**: Yes, we have started, but we are not yet finished. **Lisa**: ((Laughs)) It ends with Kaare dying (..). ((Starts reading the script from OneNote document.)) It starts when he arrives at work for the first time. The day after, he comes to work as usual and does not sense any danger. He goes to the cutting machine to start his work (..). Ouch (..)! What happened (..)? I cut off my hand (..) **Geir**: The story is not very long ((Lisa opens Minecraft)). **Lisa**: No, we don't have enough!	**Kris**: Albert ((manager)), we haven't received our wages in over three months ((walks straight across the MEE screen toward a table higher up)). **Mikkel**: Too bad for you guys. **Kris**: Why are you so cranky all the time? **Mikkel**: Why do you ask so many questions? **Kris**: Because I'm curious. **Mikkel**: Please leave, now ((narrator voice says, "One minute later in the roleplay"))! **Thea**: Arne ((worker)) contacted me and said you don't give these folks their wages, but you have to do that, otherwise you will be arrested.

Comparing the three roleplays, it seems the groups had different approaches and expectations with regards to domain knowledge. Group 1 used domain knowledge as a basis for their roleplay (Extract 7) with a fire as the second act of their roleplay, following a door-production scene. They also included a humorous element that was important for two of the group members. Group 2 could not find any historical information on their building, the Sawmill Factory, but they included elements of the industrialization process that started in a nearby forest. In the final act (Extract 8), one of the characters was injured in a log-cutting machine. The lack of a safe work environment was commented on by the amateur historians as an important element of that time, after the group's presentation. The third group (Extract 9) brought up a societal issue (exploitation of workers by factory leaders) illustrated by a dialog between a worker and his manager. The group was praised for its use of domain knowledge. The roleplays were created for video and the intersubjectivity was focused, but the quality of shared knowledge varied. Comparing the three groups along a scale of foregrounding entertainment and domain knowledge, Group 1 chose entertainment, Group 3 aimed for domain-knowledge accuracy, and Group 2 was in between the other two.

Discussion

In this section, we address the research question, *how are generic and domain-specific skills intertwined in pupils' use of Minecraft in a seventh-grade social-studies (local-history) project?* We discuss this from the two perspectives identified through the empirical analysis and informed by our conceptual framework: 1) Tensions in temporality and contextual reconstruction, and 2) setting and releasing tension.

Tensions in temporality and contextual reconstruction

The pupils relied on different techniques of information seeking to find information about the historical buildings, which was an essential generic skill in the beginning of the project. When the pupils discussed features of the buildings (see for example Table 1 and Extracts 2 & 3 in Table 2), we see that they try to connect the historical information of the buildings that are still in use, to the historical buildings they learned about and reconstructed in Minecraft, despite some of the buildings having a new function today (e.g. the place they know as Mall used to be Steel Factory). This approach to understanding history is in line with Mead's theory of temporality (Mead, 1929), which suggests that people reconstruct the past in the present aided by visual imagery and the images serve as a context for their understanding. In reconstructing the buildings in Minecraft, the pupils created "history in the present" (Ludvigsen et al., 2010, p. 109) and they relied on pictures from the past and present buildings.

In designing the buildings, the pupils spent considerable time finding the right building blocks (generic practice in foreground) and creating buildings that could be used in the knowledge-based roleplay (demonstrating domain knowledge). This discrepancy between generic and domain specific practices became a challenge for all the groups, which we refer to as a tension of context and understanding, or contextual reconstruction. The groups differed in how they emphasized context vs. understanding along a scale from picking good building blocks and

scripts to demonstrating recognizable historical events and proper use of domain-specific concepts. For example, Group 1 demonstrates in Table 4 the concept of *door-production* (Extract 7), Group 2, *safety at work* (Extract 8), and Group 3, *exploitation* and *class struggle* (Extract 9). After each roleplay, this became a topic of discussion, when classmates and amateur historians praised each group but also gave them a constructive critique for what they could have done better (e.g., using concepts associated with more significant historic events and less humor). The amateur historians made important contributions to the activity of Group 3. Kris referred to them as 'pros' (see Extract 3 in Table 2), and Mikkel said later in the same interview "The pro taught us more about local history than the teacher." This indicates a tension between different epistemic positions, paralleling studies in community planning involving longtime residents and professionals (city planners). Resolving the tension by mutual adaptation led to new knowledge (Taylor, 2020). The lessons learned from these studies were used to design experimental teaching lessons for public schools in the same neighborhoods to teach about local history.

Setting and releasing tension

Group 2 did not find information about the Sawmill Factory online and was told by the student teacher to seek information about the wood industrialization process (see Extract 2 in Table 2). The two boys in the group had more experience in Minecraft than the girls, but both pairs needed frequent scaffolding. For example, before the two boys could decide on the better building block to use (wood or wool), the student teacher reminded them about the material the physical building was made of (see Figure 1, middle). This became a constraint for the pupils because their design would be compared and measured against this building (*setting tension*). Furthermore, the student teacher wanted to include the entire group in the deliberation process, and by intervening, he opened up a space for the two other members to join the discussion (*releasing tension*). By releasing tension, we mean that domain knowledge is put in the background and inclusion of all (a generic skill) is prioritized. Therefore, by setting and releasing tensions at appropriate times, the pupils were guided by the student teacher to resolve their discrepancies and move forward in their collaborative learning process.

In Extract 5, Group 2's division of labor separated the activities of two subgroups, partly as a result of scaffolding by the student teacher but later resolved when they completed the roleplay. The roleplay emphasized an important concern for workers, preventing accidents (Extract 7). However, as this topic did not specifically refer to a known event, it can be understood as a situation of releasing tension too soon (e.g., not spending enough time searching for reliable knowledge), which would be more appropriately handled by a knowledgeable person.

Humor was another way of releasing tension for the groups. Despite the effort of some members of Group 1 to use domain knowledge in their roleplay, the inclusion of humor in the script appeared to be important for Daniel and Nils as a form of entertainment for the whole class to enjoy (see Extract 7 in Table 4). Even though they knew humor might jeopardize the knowledge basis of their roleplay, they found it acceptable in their current setting. The roleplay created by Group 3 was dominated by domain knowledge (Extract 9, Table 4). The characters showcased a societal issue of exploitation and class struggle that may indicate a tension between the past and the future in terms of labor rights; later on (in 1920s), the workers in the Steel Factory formed a labor union.

In summary, we have used temporality and tension as analytic concepts to understand the development of intersubjectivity in three classrooms and to identify focus shifts in the pupils' collaborative learning with Minecraft in their efforts to learn about their own local history. Tensions are relations between one or more elements that can be classified as typical gaming activities and one or more elements that belong to school activities. We used these concepts to identify when the pupils switch from generic skills practice (gaming activities in the foreground) to domain knowledge practice (school activities in the foreground). Tensions are released when domain knowledge are put in the background. Frequent focus shifts stimulated the collaborative learning process, which we also supported by a teaching model. Shared knowledge was the result of the process for 2/3 of groups.

Conclusions, limitations, and directions for further work

Our research aims to contribute to bridging the educational gap of practical and theoretical knowledge in a school setting and we have used a popular digital game and a teaching model towards that end. While building in Minecraft does not help one become a better carpenter or mason, it can help one learn digital skills, history and landscape, and it can lower the threshold to theoretical knowledge. We consider our design experiment to be moderately successful based on motivation of pupils and teachers and the feedback by amateur historians.

Limitations: 1) Our qualitative approach draws on a small sample of the total population of 90 pupils with the risk of over-generalization by neglecting possible emergent phenomena and instead relying on our conceptual framework for interpretation. 2) Lack of gaming experience can prevent teachers from intervening in situations such as putting buildings on fire, explosion, invisible avatars, and fireworks. These elements can be turned off to avoid classroom disturbances, but it requires Minecraft expertise. The teacher students had learned Minecraft in a social-studies class the previous semester, but in the heat of the moment for a pre-service teacher

it turned out to be a challenge. 3) The time spent obtaining reliable knowledge and ensuring accuracy in historical buildings and events, varied considerably among the groups.

The dilemma of providing relevant games vs. interesting educational tasks is not straightforward to resolve, and our tentative hypothesis is the former is easier than the latter. We have argued that finding the right balance of generic skill practice and domain knowledge as part of a dynamic process of developing intersubjectivity toward shared knowledge in parallel with building in Minecraft to gain practical experience is a step forward. Future work is a final iteration of DBR in same school to address some of the limitations.

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