

Developing a Model of Collaborative Learning With Minecraft for Social Studies Classrooms Using Role-play Theory and Practice

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Abstract: Minecraft is a multi-user block-building game and 3D virtual world for creating visual structures. We report on two three-week collaborative teaching experiences in a teacher education program in social studies where we experimented with different ways of intertwining block building and role-playing in Minecraft. We created a model for integrating collaborative learning and virtual worlds in social studies classrooms, referred to as collaborative knowledge adaptation. The model consists of three levels: 1) introduction (teacher introducing topic for learning), 2) reconstruction (building in Minecraft and creating a script for role-play), and 3) transformation (acting out role-play and producing a video). Data were collected through interviews, an open-ended questionnaire, and product (video) analysis. We focus our analysis on generic skills interwoven with domain-specific skills and three levels of intersubjectivity toward a shared knowledge object.

Introduction

Minecraft has been rated the most popular digital game among 9–14-year-old children in Norway (girls/boys 9–11 and in the top five for girls/boys 12–14), but teachers' perception of Minecraft as a game and not a learning tool poses a challenge. This challenge is addressed by a new model for using Minecraft in teacher education, which manages to meet the students in their own arena while fulfilling the requirements of the curriculum. We took advantage of the popularity of the game, opportunities for collaboration and creativity enabled by block building and role-playing, and imposed constraints through knowledge-based activities before, after and in parallel with using Minecraft. Our case is a teacher education program in social studies. Research indicates that three-dimensional (3D) virtual worlds can be integrated into a teacher education program to provide preservice teachers with the experiences needed to apply teaching skills in real school settings (Muir, Allen, Rayner, & Cleland, 2013; Mørch, Hartley & Caruso, 2015).

Minecraft is a sandbox game, which means that users in the game interact by creating visual structures using basic blocks (modeled after 1m³ physical construction blocks and in analogy to a child playing in a sandbox) and communicate in parallel, mainly by chat but also by voice via other applications. Children are attracted to Minecraft for several reasons; they mine building blocks and craft tools, combat monsters, and collaborate with peers and allies in one of four different gameplay modes. We used the version of the game called Minecraft Education Edition in creative mode, with many of the gaming elements turned off to emphasize the elementary design acts of placing and breaking blocks in order to accomplish more advanced design tasks, such as reconstructing symbolic buildings of a society (e.g., governmental, industrial, cultural, religious, historical). Role-playing was the final stage of our learning activity and occurred inside or outside the buildings.

Engagement and motivation in learning are often listed as the strengths of using games in education (Gros, 2007; Pivec, 2007). Taking advantage of this potential could be the first step toward helping teachers to bridge the gap between students' life worlds and schools' curricular goals. Next, collaboration and problem solving are important behaviors associated with children's digital game playing (Danby et al., 2018), which have been highlighted as important skills for the 21st century that we refer to as generic skills (Mørch, Eie, & Mifsud, 2018). Students combine generic and domain-specific skills when they learn in Minecraft. The aim of our research is to understand how student teachers organize and perceive the value of generic skills in specific subject areas, and how both types of skills can be practiced in the same lesson and in the same digital learning environment. The most prominent generic skills practiced in our study are information seeking, collaboration, and creativity. Other types of generic skills are communication, critical thinking, decision-making, reading, writing, computational skills, adaptability, personal development, and group effectiveness (Binkley et al., 2012).

Minecraft's technological and pedagogical affordances support a broad range of domain-specific skills, including mathematics, chemistry, computer science, history, and social studies (Nebel, Schneider, & Rey, 2016). The students can both visualize and concretize concepts. For example, the constructive play features in Minecraft inherited from wooden blocks, jigsaw puzzles, and Lego bricks can improve children's spatial abilities (Caldera et al., 1999). Furthermore, Minecraft includes tools that enable children to learn programming by introducing it as one of several techniques for solving practical problems in the game environment and

enhancing the game experience. Finally, research has shown that virtual worlds can motivate children to learn specific concepts through immersion and play, which means that they become involved in a subjective experience of concept understanding that leads to a feeling of participating in a comprehensive, realistic experience (Dede, 2009). The domain (subject area) we focus on in this study is social studies.

Minecraft and related virtual worlds and block-building games are suitable for a variety of teaching methods, including scenario-based learning, incremental and iterative activities, and role-playing (Prasolova-Førland et al., 2013; Westera, Nadolski, Hummel, & Wopereis, 2008). In role-play activities, participants are involved in “as-if” or simulated actions to approximate aspects of a real-life situation that is problematic, impractical, impossible, expensive, or risky to carry out in the real world (Yardley-Matwiejczuk, 1997). Students often blur the distinction between themselves and avatars when they immerse themselves in a 3D learning environment, which makes 3D virtual worlds potential sites for embodied and extended cognition (Pasfield-Neofitou, Huang & Grant, 2015). Educators have used role-play in many different application domains, including healthcare, therapy, organizational change, crisis management, military training, and education (Mørch et al., 2015; Prasolova-Førland et al., 2013; Westera et al., 2008). For example, Mørch et al. (2015) studied collaborative learning and role-play in special education in Second Life and found that combining abstract (conceptual) and concrete (hands-on) learning activities in multiple rounds and debriefing sessions were useful for grounding theoretical concepts in concrete experience. We address the combination of abstract and concrete learning activities in our study. We chose Minecraft instead of Second Life, as Minecraft is better adapted to schools.

Role-play and virtual worlds offer interesting opportunities for computer supported collaborative learning (CSCL) research (Jamaludin, Chee, & Ho, 2009). For example, embodied, enactive, extended, and embedded (4E) learning has been proposed as the theme of the CSCL 2019 conference, combining these elements in collaborative settings. Historical re-enactment is an educational or entertainment activity in which people follow a plan to recreate aspects of a historical event or period. In the study presented here this historical enactment is transferred to Minecraft. Our approach builds on ideas of collaborative knowledge construction (Roschelle & Teasley, 1995; Stahl, 2006), particularly knowledge construction achieved by intersubjectivity and meaning-making (Arnseth & Solheim, 2002; Baker et al., 1999; Suthers, 2006), which can be regarded as a dynamically changing context (Suthers, 2006) toward a shared object (Fugelli, Lahn, & Mørch, 2013), in our case a domain-specific knowledge object. Achieving and maintaining intersubjectivity requires a repertoire of conversational acts like “uptake” to reuse and modify prior contributions in conversation (Medina & Suthers, 2013), as well as models for researchers to analyze and design CSCL tasks at different levels of intersubjectivity (Baker et al., 1999) and guidelines for educators to organize their teaching designs (Matusov, 2000).

This study will therefore address the following research questions:

- How are generic and domain-specific skills practiced in the different learning activities?
- How are intersubjectivity and role-play relevant in learning social studies?

The rest of the paper is organized as follows. First, we describe our theoretical framework and the model we partially derived from the framework. Next, we present the methods we have used for data collection and analysis. Then, we present, analyze, and discuss our data and findings and show how the empirical findings informed the model in important ways.

Theoretical framework: Role-play and prolepsis-driven intersubjectivity

The idea of role-play in learning is to foreground envisionment and exploration of alternative courses of action (Yardley-Matwiejczuk, 1997). For example, a child will envision different scenarios for how she will act in an upcoming school presentation by imagining her audience in front of her in the mirror or in her dreams. When this inner and private (non-observable) hypothetical situation is turned into an observable and organized activity, we have a role-play situation, and new opportunities for teaching and learning occur. Vygotsky (1978) suggested that play is a leading factor in human development, stating that “In play a child always behaves beyond his average age, above his daily behavior; in play it is though he were a head taller than himself” (p. 102). The imaginary situations that children engage in when they play are concrete while involving rules and roles, thus providing a means to iterate between concrete and abstract behavior, which we argue is essential for the effective use of role-play in education. Furthermore, Mead (1932) developed a philosophy of experience, with concepts such as emergence, temporality, and consciousness, in which the past and future are viewed through the lens of the present in interactions with others. Mead (1932) emphasized the novel character latent in both the present and the past (e.g., that historical understandings may involve anticipatory cues that may lead to transformations that in turn may lead to new insights).

Role-play conversation is different from naturally occurring dialog in that it is scripted and staged (Yardley-Matwiejczuk, 1997). CSCL researchers have adopted the term script for organizing collaborative learning activities (Cesareni, Cacciamani, & Fujita, 2016). We use script in a slightly different way to mean the written text of a roleplay in film production and connected with terms such as scenes, scripts, props, and prolepsis. We draw on the work of Rommetveit (1976) who developed a prolepsis-driven approach to intersubjectivity. According to Rommetveit, intersubjectivity is a temporarily sustained and partially shared social world that depends on access to historical information (common pre-understanding). Participants in conversation collaboratively construct knowledge by expanding a joint space of intersubjectivity, and a technique for this is to issue anticipatory cues (shared prolepsis), such as subtle utterances, incomplete sentences, or deliberately inserted cues. An incomplete utterance invites the listener to actively participate in the co-construction of an expanded intersubjective space to fill in the missing parts (Rommetveit, 1976; Fugelli, Lahn & Mørch, 2013). An example from our case is providing the role-players with an opportunity to understand a historical event in a contemporary context through an utterance, which points toward a future event outside the context that is shared by the participants, thus making the learning episode more meaningful to them.

The theoretical framework helped us construct a model of collaborative knowledge adaptation for the implementation of virtual worlds in social studies classrooms (Table 1). The columns in the table are connected through three crosscutting themes (introduction, reconstruction, transformation) and are either theoretically motivated (columns 2&3), based on empirical findings (columns 1&5), or informed by both theory and data (column 4).

Table 1: Collaborative knowledge adaptation model for integrating virtual worlds in classroom practice

	Activity	Rationale (metaphor of learning)	Temporal orientation (Mead, 1932)	Shared know-ledge object (intersubjectivity)	Type of skill (primary / secondary)
Introduction	Teacher lecturing; students gathering information	Acquisition (Sfard, 1998)	<i>Past:</i> Retrospective views of topic to be learned	<i>Vague:</i> Teacher centered; students with different prior experiences	Domain-specific (primary)
Reconstruction	Collaborative design in Minecraft and roleplay scriptwriting	Participation (Sfard, 1998)	<i>Present:</i> Create new experiences together	<i>Fragmented:</i> Minecraft building vs. role-play script	Generic (primary) and Domain-specific (secondary)
Transformation	Role-playing and video recording	Knowledge creation (Paavola & Hakkarainen, 2005)	<i>Emergent:</i> Potential to connect an historical event with an upcoming event	<i>Focused:</i> Enacting an historical event while immersed in a virtual world learning activity (video recorded)	Domain-specific (primary) and Generic (secondary)

The model is the result of the first iteration of a design experiment. We used part of the model to organize the second iteration; and data we analyze in the next section provide contents for the last two columns (RQ 1&2). The rationale for the model is three metaphors of learning (Sfard, 1998; Paavola & Hakkarainen, 2005), which suggest a sequence of increased complexity of collaborative knowledge construction. We call it collaborative knowledge adaptation, as the first level is domain-specific knowledge introduced by teachers.

Methods

The study was organized as an experimental teaching activity between two educational institutions in Norway (A and B) over a three-week period over two semesters (2017 & 2018). Institution A provided educational resources (15 MA students majoring in education acted as tutors) and institution B organized the design experiment as part of a teacher education course (60 BA student teachers majoring in social studies).

Our interventionist approach follows design-based research principles (DBR) (Hoadley, 2002), in which a teacher and two researchers (the authors) collaborate to ‘engineer innovative educational environments and simultaneously conduct experimental studies of those innovations’ (Brown, 1992). DBR as a methodology allows us to focus on contextual aspects that become ‘relevant in the students’ interactions’ (Krange & Ludvigsen, 2009). This means we do not limit ourselves to the local situation of interaction but take the whole

into account in considering how the technical solution provides a new context for interaction. In the first experiment, the activities were building in Minecraft and role-playing with minimal teacher instructions, and in the second experiment the three-level model presented in Table 1 was used to inform our learning design.

The assignment in the first iteration (case 1) was to create a model of the Norwegian parliament and to engage in collaborative learning by role-playing a political decision-making process inside the building based on a script collaboratively created in small groups (Figure 1). The assignment of the second experiment (case 2) was to create a model of one of the historical buildings along the main river of Oslo and create a role-play of a historical event that is said to have happened in and around the building by its owners, tenants, and workers during industrialization, focusing on the working and living conditions of the 19th century (Figure 2).

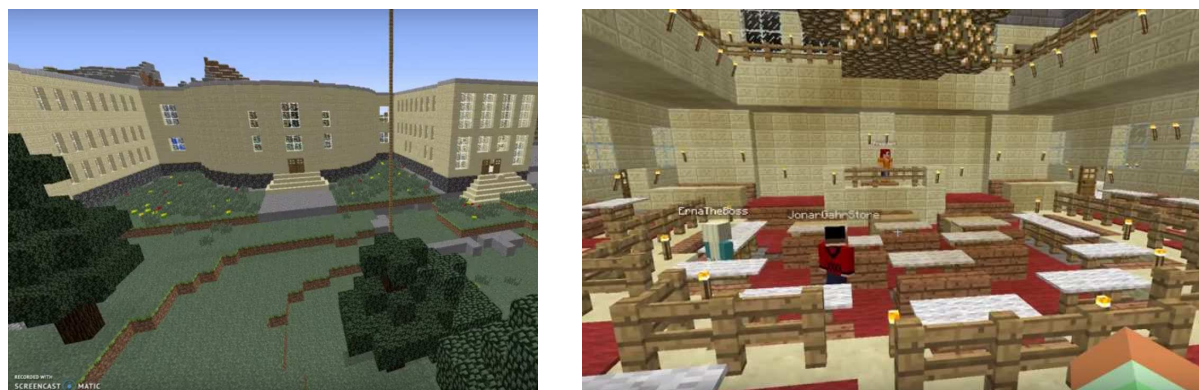


Figure 1. Two video snapshots of Minecraft parliament building (outside and inside, respectively) from case 1.

In both cases, the students were bachelor students, co-located, and worked in groups of three to five individuals. We collected data through an open-ended questionnaire informed by our research questions (N1=37/60; N2=25/40), interviews (in the first case), observation notes, and 25 role-play films (3–5 minutes, both cases). We asked questions about experiences with Minecraft, what activities they found more or less interesting, how they organized collaborative work, the availability of support, would they use Minecraft for own school learning, etc. We thematically coded the answers, following an abductive approach that was partly data-driven and partly theory-driven by our model and research questions (Guest, 2012). We summarize our findings in the next section.



Figure 2. Two video snapshots of Minecraft reconstruction of a textile factory building from case 2.

We identified the following themes in our data: 1) time issues, 2) play vs. learning, 3) technical challenges, 4) generic skills interwoven with domain-specific skills, and 5) knowledge sharing (intersubjectivity). We focus on themes 4 and 5 in this paper.

Results and analysis

A higher percentage of students reported a positive experience using Minecraft in case 2 compared to case 1. Thirteen students (52%) who had not played Minecraft previously indicated that they had satisfactory

knowledge of Minecraft after the three weeks (44% reported previous knowledge of Minecraft). Only one student (4%) claimed that s/he did not master the game after the three-week period (19% in case 1). Findings from interviews in case 1 (Mørch et al., 2018) showed that the student teachers perceive the use of Minecraft in their teaching as a possible threat to domain-specific (social studies) skills practice. However, they consider generic skills important and see the potential in Minecraft as a new way of reaching their students. Our experiences from case 1 made clear to us that the two types of skill (domain specific and generic) were not well integrated in the learning design.

We took the lessons learned from case 1 and started with a domain-specific context on which to base building in Minecraft. The teacher gave a lecture to introduce the social studies topic to the student teachers: the industrial breakthrough in Oslo in the mid-19th century. They were asked to search for information in two ways: through a given list of sources and encouraged to search for additional sources independently. The student teachers were also given an introduction to Minecraft and the generic skills emphasized in the curriculum (information seeking, communication, collaboration). This was followed by an excursion to the river and the industrial area.

Thematic analysis

To address the two research questions, we give examples from our data showing how generic skills are interwoven with domain-specific skills and how intersubjectivity (knowledge sharing) is achieved during the course of the activity at three levels we have labeled introduction, reconstruction, and transformation.

Introduction

The students worked in groups after the initial orientation by the teacher. They searched for information through books and the Internet to understand the task. One student elaborated on the process: “We collaborated on finding images of the building from all angles and had a discussion at the physical site” (Student 9). During the excursion to the river and the industrial area, the students measured the perimeter of the building and took photos as preparatory work for the reconstruction to follow. This part of the activity was mainly about acquiring domain-specific (social studies, historical) knowledge and using information seeking as the main generic skill (excluding the basic skills of reading and writing). One student said, “[It took us] around three to four hours to find information about the building, its history, and activity” (Student 18).

Intersubjectivity was not achieved at this level, which we call the “vague object.” Based on our observations, the students, despite knowing of or about each other from previous classes and course assignments, were just beginning to work together on this task. The group efforts included gathering information from various sources (books, Internet texts, pictures of buildings) and preparing the group members for the next level of the activity.

Reconstruction

The most prominent observed skills practiced at this level were collaboration, cooperation, and design. The students divided the work based on their interests and found that building and creating a role-play scenario were equally important. In their responses to the questionnaire, the students reported that two to three individuals from each group built in Minecraft while two to three wrote the script. As one student noted, “We collaborated well, and split the [task] into different parts. We all contributed toward both building and the role-play [script] but focused on different subtasks” (Student 9). The two subtasks (building and scriptwriting) were interdependent because Minecraft structures provided the scenery for the role-play script and the script defined actions and interactions in the buildings. The students liked this way of working, as it allowed them to be creative and focus on an area they had experience with or interest in while simultaneously contributing to the common goal. As one student put it, they had “the possibility to create something, be creative, and learn to collaborate in groups. The pupils who have problems at school can shine in such an arena” (Student 7). Both tasks made use of knowledge acquired from phase 1, but during role-play planning, the students had to find more detailed information about the historical event so that their re-enactment would be recognizable to viewers outside the group.

Our observation notes and questionnaire data show that two strands of shared knowledge were established at this level: one associated with building in Minecraft and the other scenario development. However, they were not yet integrated and we characterize intersubjectivity as a fragmented knowledge object.

Transformation

In this phase, the students used what they had created in the previous phase through a roleplay (historical re-enactment) set in the given time epoch (mid-19th century work and life in Norway). The generic skills of

creativity, communication, and collaboration were the most prominent ones observed at this level. For example, creativity had the effect of generating enthusiasm not only within the group but also among the audience, who later watched the video in a plenum session, or as one student put it, “A more enjoyable variation in role-play where pupils can practice other skills such as filmmaking, etc. ... In addition [the pupils] can practice collaboration in film creation” (Student 7). The use of shared prolepsis as a film technique for expanding the space of intersubjectivity among a group of interlocutors and viewers was observed in a few of the videos and is illustrated by the following example:

Turn	Actor	Utterance
1	Owner	Yes, indeed, that is a very nice bridge. I will of course maintain it in a good way. Hmm, I think it would be a good idea to introduce a <u>toll</u> collection system, so I can finance maintenance work.
2	Attorney	<u>Toll</u> ?
3	Owner	Yes, it will be the first toll road in Norway, and with regards to this bridge, which you say is the main crossing between here and Akershus Fortress, I think it's a good idea.



Figure 3. Role-play scene/Minecraft video image.

The extract is part of a dialog between two interlocutors (Owner & Attorney), the owner of the property on which a bridge is located and a legal representative of the government, regarding who should pay for maintenance of the bridge, as the Owner has newly purchased the property. During the exchange, the Owner suggests imposing a toll for crossing the bridge to finance maintenance costs, which comes as a surprise to the Attorney since it is one of a few passage points between west and east in Oslo. The discussion is interesting in that it shows an important event in history, but, by using the word “toll,” the exchange not only takes up and elaborates previous information, but spawns a new line of discourse, connecting the conversation to another event, a current debate in Norway regarding who should finance a new road system around Oslo and other cities (end users vs. central authorities). The students are doing more than recreating history; they are pointing toward a future event they can relate to, which is why we have labeled this level of intersubjectivity *transformation*. It provides a way for students to personalize their collaborative learning efforts in creative ways. Five out of 25 videos included proleptic instances in their role-plays, although there were no instructions to do so. We discuss the implications below.

The two strands of knowledge (Minecraft building and scenario development) are integrated at this level in the three- to five-minute role-play, which are recorded on video and called a focused knowledge object.

General discussion

We discuss our findings in terms of the research questions we raised in the introduction.

How are generic and domain-specific skills practiced in the different learning activities?

One of our aims has been to understand how student teachers organize and perceive the value of generic skills in specific subject areas. We addressed this through a model of collaborative knowledge adaptation (Table 1). This model engages the students at different levels of collaborative learning. For example, developing the role-play required in-depth studies of historical sources, which put domain-specific skills practice in the foreground (level 1). Throughout the planning of the role-play, the students had to take a detour and pose “as-if” questions to envision working conditions, class struggles, labor strikes, or rivalries between factory owners. Generic skills (Binkley et al., 2012; Danby et al., 2018) thus became important for the elaboration of domain-specific skills practice: reconstructing historical events through collaborative design in Minecraft and roleplay script writing together (level 2: generic skills practice in foreground and domain-specific in background) and enacting the historical knowledge in creative ways in the role-plays with generic skills in the background (level 3). The data from the open-ended questionnaire indicate that all students found it useful to start with domain-specific skills

and that both the creation of buildings in Minecraft and role-plays (developing and enacting) were equally important.

How are intersubjectivity and role-play relevant in learning social studies?

Historical knowledge and intersubjectivity have several common features. For example, they are temporary processes that must be periodically updated to sustain, and they are never complete, nor fully shared. Moreover, there are multiple didactical strengths in creating and playing out a historical role-play at different temporal levels. First, the students get a “current” perspective rather than a retrospective. While role-playing, the students get involved as actors and are thus enabled to see history through multiple perspectives and to develop an understanding of historical presentations as constructs (Seixas & Morton, 2013). Second, through role-play the students are creating micro-stories about humans and their environments in the past. These micro-stories can help to develop the students’ historical empathy. The interplay between the micro- and macro-stories will enhance the historical overview and provide a deeper understanding of the past (Kvande & Naastad, 2013).

Matusov (2001) suggested three aspects of intersubjectivity when developing a guide for teaching design: 1) intersubjectivity as having something in common, 2) intersubjectivity as coordination of participants’ contributions, and 3) intersubjectivity as human agency. Our model is inspired in part by these aspects, but it differs in that we make use of role-play and building in a virtual world. Our model can also be compared with the five cycles of enactive role-play sessions proposed by Jamaludin, Chee, and Ho (2009). However, their domain is different from ours, debating moral issues as argumentative dialog rather than techniques for expansion of intersubjectivity. Medina and Suthers (2013) suggested “uptake” as an analytic approach for doing CCSL research. We have expanded the repertoire with “prolepsis,” as a way to project a conversation forward. Our approach builds on the framework of Fugelli, Lahn, and Mørch (2013), who conceptualize intersubjectivity as a knowledge object trajectory from incomplete to more complete. We propose three key events along this trajectory (vague, fragmented, focused), aligned with temporal orientations: past, present, and future (emergent).

Conclusions, shortcomings, and directions for further work

Our prior experience shows that student teachers tend to value domain-specific skills over generic skills. Therefore, models are needed that emphasize and integrate both types of skills. Towards that end, we have developed the collaborative knowledge adaptation model for integrating virtual worlds in social studies classrooms using a design-based research approach with two iterations, where the results of the first iteration informed the second. The model is based on a combination of empirical findings and theories of role-play and intersubjectivity. The model puts focus on enactment, as in historical re-enactment to address the CSCL 2019 conference theme of 4E learning. We proposed a new conversational act to expand the space of intersubjectivity for small group conversation (shared prolepsis) and gave an example of a new way to use role-play in CSCL.

We plan to continue to develop and test our model in several iterations. We have identified the following shortcomings and directions for further work: (1) The whole activity is time consuming compared to conventional teaching practice; (2) The model is presented as linear, but levels 2 and 3 depend on the previous level, and information may have to be updated (e.g., improving the building based on the role-play); (3) Video recording of collaborative design in Minecraft and script development; (4) Different criteria for evaluating the video products; and (5) The model will undergo four new iterations in higher education and be tested in two experiments in 7th grade classrooms during the 2019-2020 school year, when our student teachers will use Minecraft with 12-year-old pupils in preservice training.

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