Tradeoffs in Combining Domain-Specific and Generic Skills' Practice in Minecraft in Social Studies in Teacher Education

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Abstract. In this paper, we describe our efforts to combine generic (domain general) and domain-specific skills' practice in the same digital learning environment. We have implemented part of the social studies subject curriculum for lower secondary education in Norway (grades 8 to 10) in Minecraft for pre-service teacher education. By leveraging Minecraft's affordances for block building and roleplaying, we have created the first version of an integrated learning environment. We conducted a pilot study in an undergraduate pre-service teacher education program and discuss our findings by drawing on empirical data collected from 60 student teachers, using observations, questionnaires, and interviews. Our preliminary findings suggest that the student teachers perceive the use of Minecraft in their teaching as a possible threat to domain-specific knowledge. They also consider generic skills such as design and collaboration important and see the potential in Minecraft as a new way of reaching their students.

Keywords: 3D Virtual World, 21st Century Skills, Collaborative Learning, Design, Minecraft, Pedagogical Affordances, Teacher Education.

1 Introduction

Minecraft has been rated the most popular digital game among 9–14-year-old children in Norway, but teachers' perception of Minecraft as a game and not a tool for learning poses a challenge. We argue that teachers and student teachers need a tool box for meeting the interests of their future students on their own arena as well as fulfilling the requirements of the curriculum; to accomplish this, we explore Minecraft's potential for teaching and learning as it seems to provide affordances for the two requirements. Dikkers [7] suggested that the educational value of learning in digital gaming environments is plentiful, pointing out "it can tell powerful stories, challenge the mind, and convey the thinking of designers" [7, p.10]. We focus on the potential of conveying "the thinking of designers" and give student teachers a new tool to support

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the generic skill of designing in conjunction with learning social studies in lower secondary school.

Children are attracted to Minecraft because of its low threshold to participation and high ceiling for engagement in design and role-playing activities; they mine building blocks and craft tools, combat monsters, and collaborate with peers and allies in one of four different gameplay modes (creative, survival, adventure, spectator) [15]. We used the creative mode with many of the gaming elements turned off in the study we report to emphasize the elementary design acts of placing and breaking basic building blocks to support the design and modelling of symbolic buildings in a society (e.g., governmental, industrial, cultural, religious, historical) and roleplaying inside the buildings to simulate knowledge-based activities.

Generic skills are not associated with any specific subject domain per se, but we rely on them in many domains, and they contribute to overall performance. Recently, they have received worldwide attention. For instance, a Norwegian White Paper with recommendations to the new national curriculum in Norway emphasizes developing students' abilities to explore, create, communicate, interact, and participate [13]. Generic skills (also referred to as 21st century skills) also include problem solving, critical thinking, collaboration, decision-making, cultural awareness, visualization, learning to learn, academic basics (reading and writing; computational skills), adaptability, personal development, and group effectiveness [1,5,11].

Students combine generic (domain general) and domain-specific knowledge and skills when they learn. For example, visualization is used in many areas of mathematics, communication is required for language learning, and reading multiple languages for deep learning in world history and religious studies. When teaching specific subjects, generic skills are often taken for granted. In today's multicultural society, with a greater variety in children's background and interests, strategies to develop integrated learning environments have begun to appear.

The aim of this research is to understand how student teachers perceive the value of generic skills in specific subject areas, in particular design (creation), collaboration, and adaptability, through a dialectical interplay of generic and domain-specific skills practice, exemplified by children building and playing Minecraft and other block-building games. In other words, our focus is on how both types of skills can be practiced in the same lesson and in the same digital learning environment. We address the following research questions in the pilot study:

1. What are student teachers' perceptions of Minecraft for learning purposes?
2. What are the challenges and opportunities for teachers' organization of Minecraft lessons into two distinct activities: generic and domain-specific skills practices?

2 Related Work

Information and communication technology (ICT) in schools is often introduced without taking into account pedagogical requirements, and "pushed" by technology vendors and ICT staff. On the other end, many teachers are looked upon as protecting their classrooms from the changes that follow from new technology, and Dikkers

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introduced the metaphor teachers as conservants for the role of preserving traditional school culture by fighting against outside pressure and lobbyists [7]. This is supported by studies showing that the link between access to new technology and enhanced academic achievement is unclear. A meta-study undertaken by Tamin et al. [16] shows that the use of ICT for learning in school has a relatively small, but positive effect for learning. Consequently, student teachers' digital competence is crucial to take advantage of the new technologies [9]. Furthermore, there are teachers who take an active part in making changes with ICT themselves [14]; many *do* innovate and are always searching for new ideas to improve their teaching with new material and ways of presentation [7]. In other words, should we not start to think of teachers as meta-designers [10] and view education as a design science [12]?

Minecraft is a sandbox game, which means that users in the game interact by placing and breaking three-dimensional (3D) blocks (modeled after 1 m^3 physical construction blocks) and communicate in parallel, mainly by chat but also by voice via other applications. The open-ended nature of a sandbox game gives students great freedom for explorative activities [15], which makes Minecraft suitable for scenario-based learning, incremental and iterative activities, and role-playing. Minecraft shares similarities with traditional block-building games, in that it has a Lego-like feel and can be used in collaborative learning tasks with peers [4]. However, Minecraft extends Legos in several ways; for instance, it has an unlimited number of building blocks, and users can create new building blocks and tools on the fly. These features make Minecraft useful in a wide range of educational applications, and the constructive play features inherited from wooden blocks, jigsaw puzzles, and Lego bricks can improve different types of skills in children, such as spatial abilities [3]. For instance, Minecraft has been used as a platform and tool in elementary and middle schools to teach scientific topics in mathematics and chemistry by drawing on the spatial affordances of the game [2,3]. Furthermore, Minecraft can be extended with tools that enable children to learn programming in an incremental manner by introducing it as one of several techniques to solve practical problems in the game environment.

Research has shown that Minecraft can motivate children to learn through immersion and play, which means that one becomes involved in a subjective experience that leads to a feeling of participating in a comprehensive, realistic experience [6]. Learning roleplaying teaching methods in a virtual learning environment has positive impact on learning engagement [17].

Mørch et al. [14] studied collaborative learning and roleplay in Second Life and found that carefully designed contexts for collaborative learning can increase the support of a 3D virtual world and that skilled instructors can accomplish the design work as part of course preparation and execution. In addition, combining abstract and concrete learning activities in multiple rounds and debriefing sessions were useful [14]. We address the combination of abstract and concrete learning activities in our study.

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3 Methods

The study was organized as an experimental teaching activity between two educational institutions in Norway (A and B) over a three-week period. Institution A provided educational resources (15 MA students majoring in general education acted as tutors) and institution B (60 BA student teachers majoring in social studies) carried out a joint learning activity defined by an assignment created by institution B. The assignment was to create a model of the Norwegian parliament building and to engage in collaborative learning through the roleplay of a political decision-making process inside the building based on a script collaboratively created in small groups. Thus, the students had to acquire technical skills in using Minecraft in creative mode, detailed knowledge about the parliament building and how the physical structures reflects the political processes as well as how political decision making are played out in democratic society. The students worked in groups of four, and the role-plays were recorded by using a video-capture tool (Screencast-O-Matic).

We collected data by observation, a questionnaire informed by our research questions (N=38 respondents out of 60 participants), and interviews with two students (an experienced player and one without prior experience in Minecraft). We used a version of thematic analysis based on open coding to organize the textual data. We show examples of data representing three themes and summarize our results as points for discussion, as our findings are tentative (pilot study).

4 Data and Analysis

Of all the students teachers (N=60) only a few (N=4) reported previous experience with Minecraft. The questionnaire indicated that most felt they did not get sufficient time to learn how to use the technology during the time allocated for the activity. Thirty percent indicated negative attitudes, such as "I will never use Minecraft" in future teaching practices and described Minecraft as "taking time away from social studies." Despite this negative attitude, most saw a potential in Minecraft, as shown in Excerpt 1 below. However, 47% indicated positive attitudes, including suggesting future practices of Minecraft in their own classroom and outlining motivation as a key reason. Informed by our focus on student teachers' perception of Minecraft for learning purposes and taking into account generic and domain-specific skills, we categorized our data into the following themes: 1) student teachers as protectors of domain-specific knowledge, 2) student teachers finding new ways of reaching their students using popular tools, and 3) combining generic and domain-specific knowledge.

4.1 Student Teachers as Protectors of Domain-Specific Knowledge

According to the questionnaire, several students believed that they did not learn anything (30%). Interestingly, the same students reported that the sessions using Minecraft were fun and that collaboration worked well. However, some students' percep-

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tion of Minecraft was, "You are learning a computer game and not necessarily a subject" (questionnaire).

One student (Eva), who had no previous experience in Minecraft, was somewhat critical at first, but she also identified an area for improvement and a positive experience gained:

"If you bring Minecraft into the classroom, it's important to include the curricular part [domain specific knowledge] [...] to get the curricular learning outcome. Maybe because when we have so much fun, the fun part takes over. The roleplay [of the political process] was kind of, "Okay, done!" in a hurry, and we didn't bother to put much effort into it because the building part was so much more fun." (Excerpt 1: Interview Eva)

Eva's statement is representative of the attitude held by many protecting subject matter practices. She is concerned that the "fun part" (building in Minecraft) might take over at the expense of developing domain-specific knowledge. Many respondents shared her opinion. She expressed her feeling that block-building games, through enacting agency and being engaging and fun, take time away from learning subject matter knowledge, which is the primary objective of schoolteachers, thereby creating a dilemma for the teacher. However, one can question whether student teachers are aware of the pedagogical affordances in Minecraft and related games for training generic skills [8], and others suggests that digital games are in their infancy and need more time to mature, which is why we have not yet seen their optimal integration in formal education [7].

4.2 Student Teachers Finding New Ways of Reaching their Students Using Popular Tools

The questionnaire results indicate that some student teachers (30%) were skeptical toward games, stating that games do not belong in schools. While some students (37%) found Minecraft difficult to use (e.g., encountered technical problems), several highlighted the opportunities Minecraft gives for engaging students in subject matter activities: Furthermore, student teachers highlighted: "The possibilities are that you can vary teaching, and it's fun for those who have used it [Minecraft] previously." Eva's views from the interview support this point:

"I was very positive coming into this project because there are many, let's say 11-year olds, who can relate to Minecraft. And in that way you can reach students who may think your class is boring ... to reach them with other teaching methods. And Minecraft is something completely different from what we do in school." (Excerpt 2: Interview Eva)

Eva points out that Minecraft is popular because children can relate to it via prior experiences. If this familiarity in using a powerful tool can be transferred to a school setting, she believes that easily distracted students will be more engaged in learning activities. Eva also said that using games could lead to new challenges, as the "fun part" can take over (see Excerpt 1). However, she points out later in the interview that the most important part of the learning activity is to focus on subject matter, meaning that the building activity must be integrated to serve teachers' primary goals.

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The student teachers in our study indicated the need for a toolbox of teaching methods to reach children and motivate their learning. Such a toolbox must be designed to be both flexible and usable, so that users can apply the tools for teaching purposes and integrate them in a broad learning context. One such teaching method is roleplay [18]. Teachers have used roleplay with virtual worlds in different subject areas (e.g., literature, history, drama) and for professional training (e.g., health care, therapy, organizational change, crisis management, military training, special education) [14], and in collaboration in small and large groups. A well-designed roleplaying game provides a platform for developing both social skills and domain-specific knowledge, and when debriefing follows the learning activity, the learning outcome will be strengthened [14,18].

4.3 Combining Generic and Domain-Specific Knowledge

Our findings thus far indicate that student teachers can be described as protectors of domain-specific knowledge (see section 4.1). At the same time, students express the need for a toolbox that both enables them to vary their teaching methods as well as reach the students through their interests (see section 4.2). The results from the questionnaire indicated that students gave Minecraft's learning outcomes a low score and collaboration and problem solving a high score. This implies a dilemma for teachers, where a possible solution is to raise awareness of the value of generic skills to student teachers. Jonas expresses it in the following way:

"[…] this project is about much more than learning skills in Minecraft; it's about learning how to give the children a tool for understanding something else [subject area knowledge].The point is not that we learn Minecraft, nor is the point that the pupils learn Minecraft. Minecraft can be learned in their spare time. The point is to have a tool that will allow them to understand something else, for instance political processes in the Parliament, what the Parliament is, and how it works. That should be the focus. I am not saying that subject-specific topics were not in focus, only that it didn't have to be Minecraft. It could be Legos. But then you have to have tons of Lego bricks. With Minecraft you don't need tons of Legos." (Excerpt 3: Interview Jonas)

Jonas emphasizes that Minecraft is like digital Legos with an unlimited number of bricks that easily snap and come in different types (colors, hardness, material, etc.). New building blocks can be created by crafting (graphical composition tables) and by writing program code. Understanding the specific topic taught (political processes in parliamentary practice) should be emphasized, according to Jonas, and the interaction between the two modes, building and roleplaying, should be more seamless.

Both Jonas and Eva noted a disconnect between the two parts of the assignment: The building of the Parliament and the roleplay of the political decision-making process inside it. To develop the script for the roleplay and making both the avatars and the dialogue credible, domain-specific skills are needed. We found, however, that the technical aspects of the building process took most of the students' attention (see Fig. 1 & Fig. 2), and much less work was put into learning about political decision-making processes and creating a credible roleplay script. As a result, the students did not have

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sufficient time to carry out the roleplay and to acquire the necessary domain-specific skills.

Fig. 1. A model of parliament building ("Storting") as seen from outside.

Fig. 2. Parliament building on the inside during roleplaying.

5 Results and Discussion

Our preliminary findings suggest that the student teachers perceive the use of Minecraft in their teaching as a possible threat to domain-specific knowledge. At the same time, they consider generic skills important and see the potential in Minecraft as a

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new way of reaching their students. However, our informants stated that our current attempts to integrate generic and domain-specific skills practices are insufficient; the transitions between the two modes are not seamless, which indicates that we need to work harder to create a complementary/dialectic relationship between the two modes.

We suggest that future research should start with creating a subject-specific context on which to base Minecraft building activity. This knowledge domain context could be created by students and teachers in collaboration and precede roleplay and building. To preserve institutionally established practices, we suggest continuing with the roleplay by developing the first version of the script. Hopefully, this will encourage students to carry out a research-like process before they start first round of building in Minecraft. At the same time, there should be an increased awareness of generic skills in our communication with student teachers so that these skills are not taken for granted. In addition to designing and building, Minecraft might be a tool for learning a range of generic skills like collaboration, problem solving, creativity, and adaptability in concert with domain-specific skills. This indicates several areas for further research.

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