Teachers' Many Roles in Game-Based Learning Projects

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Abstract: This paper examines what roles teachers need to take on when attempting to integrate and use computer games in their educational environments. The task of integrating games into an educational setting is a demanding one, and integrating games as a harmonious part of a bigger ecosystem of learning requires teachers to orchestrate a myriad of complex organizational resources. Historically, the field of digital game-based learning research has had a tendency to focus heavily on the coupling between game designs, previously established learning principles, student engagement, and learning outcomes much to the expense of understanding how games impact the working processes of teachers. Given the significant investments of time and resources teachers need to make in order to conduct game-based learning activities, this research gap is problematic. Teachers needs to have a certain amount of gaming literacy in order to actively supervise, support, and guide their students before, during, and after the play sessions. The teacher also needs to be proficient in setting up play sessions in a limited amount of preparation time and tackle eventual technical difficulties. Beyond these demands, teachers also need to serve as a conduit between the learning context and the play context, and need to know how to continuously contextualize game activities and the content that students experience in the subject matter being taught. This paper describes the outcomes of two five month long studies where Swedish K-12 teachers were introduced to using MinecraftEdu as a classroom activity. The study identifies the different roles that a teacher takes on throughout game-based learning processes, such as technical administrator, game administrator, game tutor, subject matter expert, lecturer, debriefer, and classroom supervisor. Ultimately, the paper highlights the importance of understanding the constraints under which teachers work, and argues that a better understanding of the contexts in which games are to be used, and the roles teachers play during game-based learning scenarios, is a necessary foundation for improving games' viability as educational tools.

Keywords: teacher-led gaming, teacher roles, practical implications of classroom gaming

1. Educational games and teachers

As the body of research that points out the potential educational value of games grows, the interest for including more game-based learning in educational processes has increased (Wastiau, Kearney & Van de Berghe, 2009). The discussions on the topic frequently highlight games' intrinsic educational value, such as their experiential nature or their ability to encourage players to master domains through scaffolding and *flow*-evoking designs (Annetta, 2008; Gee, 2009). However, while games' educational values keep being lauded, examples of games being integrated into educational settings are relatively few (Egenfeldt-Nielsen, 2010; Linehan et al, 2011). A past explanation for this disconnect in the game-based learning community has been that the broader community of educators are averse to games. Recent studies, however, have indicated this to be a false assumption as the majority of teachers in the EU and the US are positive towards the idea of using games as educational activities (Ruggiero, 2013; Wastiau, Kearney & Van de Berghe, 2009).

This paper aims to flesh out another explanation for the lack of game integration in the education sector; namely that games are laborious and resource intensive to use, and that there are few standards established to guide educators through the complex process of integrating games into their working environments. There is plenty of research that explores the educational value of games by juxtaposing their perceived qualities with principles of learning (Berg Marklund, 2014; Egenfeldt-Nielsen, 2006). However, examples of empirical work done to understand the practicalities involved in using educational games (Berg Marklund, 2014), such as the tasks teachers need to perform when integrating games into formal educational contexts (Alklind Taylor & Backlund, 2012; Bourgonjon & Hanghøj, 2011; Egenfeldt-Nielsen, 2008), are comparatively rare (Chee, Mehrotra & Ong, 2014).

This paper specifically focuses on examining the roles that teachers need to take on when implementing and using computer games in their classroom activities. The research was conducted during two five month long projects where the researchers collaborated with K-12 teachers to integrate *MinecraftEdu* into their curriculum. The paper does not discuss the educational effectiveness of game-based learning, but rather how classroom gaming affect, and is affected by, the roles teachers need to take on when using games to educate.

2. Method

This research employs case studies to examine the processes teachers need to go through when implementing and using digital educational games in their working environments. The primary methods used during the case studies conducted for this research have been participatory observation protocols, transcriptions of classroom gaming sessions, and interviews with teachers.

The methods were employed during two five-month long instances of educational games use in a Swedish K-12 environment, spanning from November 2014 to March 2015. During the field-work, one researcher collaborated with two different teachers, one teacher working with 7th graders and one working in 5th graders, throughout a game-based learning project. The project entailed initial discussions of educational goals and how games related to them, acquiring game software and implementing it in the classroom environments, and orchestrating gaming sessions. During each of these activities the researcher kept a protocol of observations, and interviews as well as classroom gaming sessions were recorded and transcribed.

2.1 Case study setups

The two different cases constitute two different types of classroom setups. The students in the 7th grade were all part of a national program that supplied them with one laptop per individual, whereas the 5th graders had a limited number of computers to share within their class. The classroom sessions were thus structured differently, as the older students had enough hardware to play games as a whole class (all 24 students could play simultaneously), and the younger students played in smaller groups (dividing 24 students into two groups of 12, that shared six computers). Figure 1 shows the different classroom setups.

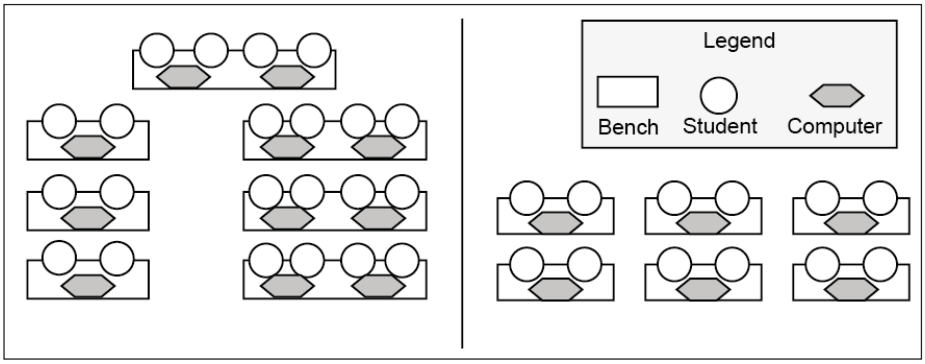

Figure 1: Though the 7th grade students (left) owned one laptop each, they were divided into groups of two and shared one laptop. The 5th grade students (right) worked in groups of two on communal laptops

The two different classes also worked within different subject matters, as the 7th grade class worked with mathematics and geometry, and the 5th grade class worked with medieval history. This informed the structure of the activities the two classes participated in. The purpose of the game-based learning activities with the 7th graders was to let them experiment with length, area, and volumetric scaling in a three-dimensional environment. For the 5th graders, the game-based activities revolved around the research, re-creation, and re-enactment of iconic structures and communities from a specific historical time period (the Middle Ages). As such, the mathematic gaming curriculum focused on heightening students' understanding of geometrical objects and calculations by letting them manipulate and construct those objects first-hand, and the historical curriculum focused on letting students experience and reflect on the taught subject matter through re-creation and re-enactment. Figure 2 shows a snapshot of how these lessons were manifested in the game environment.

The authors would like to emphasise the thoroughly collaborative nature of these game-based learning projects. The field researcher did not passively observe the projects as they unfolded, and played an important part in their execution at several junctures. However, this paper argues that the interventions made by the researcher are interventions that any teacher would need to make in order to integrate games into their classroom environment as well. All interventions were discussed with teachers before they were made, and the interventions served project goals established by the teachers. Since they are likely to be necessary steps in any game-based learning project, the tasks performed by the researcher will thus be analysed as teacher tasks. The outcomes of the studies will be presented below, and examples of the different roles teachers took on during the game-based learning project are coupled with excerpts from transcripts and observation protocols.

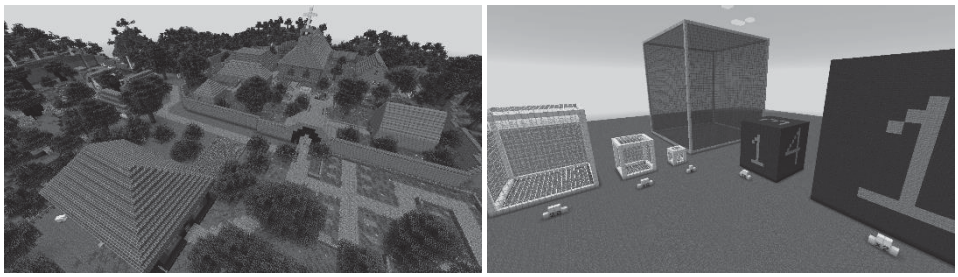

Figure 2: In the history curriculum (left), the students built iconic structures and rudimentary societies from the Medieval Ages (like a monastery and adjoining farms). In the mathematics curriculum (right), the students calculated scale ratios, drew blueprints, and built simple geometric objects and scale models of real-world objects (like the large dice on the right side).

3. Results

In this section, the different roles that the teachers had to manage during two core 'phases' of the game-based learning projects will be presented. The first phase covers the process of integrating the game into the educational setting, and the second phase covers what the process of using the game as a classroom activity entails.

3.1 The conditions of formal education, and their impact on game-based learning processes

An essential step teachers need to take before embarking on any game-based learning project is to assess what they might be able to do given the conditions they are working under. Any formal educational environment consists of elements that can either facilitate or complicate game-based learning processes. In the initial stages of the two case studies, teachers and researchers discussed some of the conditions that were likely to complicate their work, as well as the resources and structures available in their environments that could be valuable assets.

3.1.1 Designing the game-based curriculum

One of the more pressing questions that an educator needs to ask in the initial stages of a game-based learning project is what kinds of gaming sessions their schedule and curriculum allows for. In the studied cases, the curriculum demands and the availability of hardware informed both the choice of game and the plans of how gaming sessions were to be scheduled and conducted. In the class of 7th graders, the abundance of laptops, short period times (45-60 minutes), and the stricter demands and educational goals established in the curriculum made the teacher gravitate towards shorter stand-alone sessions. In the stand-alone session setup, students collaborated in groups of two or played individually on assignments with fixed starting- and end points, which allowed for easier assessments of students' progress. Viewing each classroom session as a stand-alone exercise also had the benefit of allowing for changes in the design of the game assignments according to the rate with which the students mastered both gameplay and details of the taught subject matter. The conditions were quite different in the 5th grade class where the period times were longer (90 minutes), the curriculum goals were less strict, but there was significantly less hardware available. For the younger class, a more long-form collaborative classroom exercise was chosen. Figure 3 shows the basic differences in project structures between the two working processes.

The constraints imposed by curriculum demands and scheduling also play a deciding role when it comes to choosing the type of game to work with. In the studied cases, *MinecraftEdu* was chosen due to its modular nature and accessibility; the game's focus on emergent 'sand-box' play makes it possible for teachers to model gaming challenges after their own educational goals and working conditions (i.e. the game is easily customizable); it runs adequately even on older computers; and it is a title many students are familiar with, thus lowering the barrier to entry for many students. These benefits outweighed the potential drawbacks of the game, such as its low physical, functional, and visual fidelity. For example, it is difficult to create spherical objects in the game (due to its blocky nature), and objects sometimes have little visual resemblance to their real-world counterparts. However, while these types of drawbacks presented some challenges, they were not a major source of concern for the teachers.

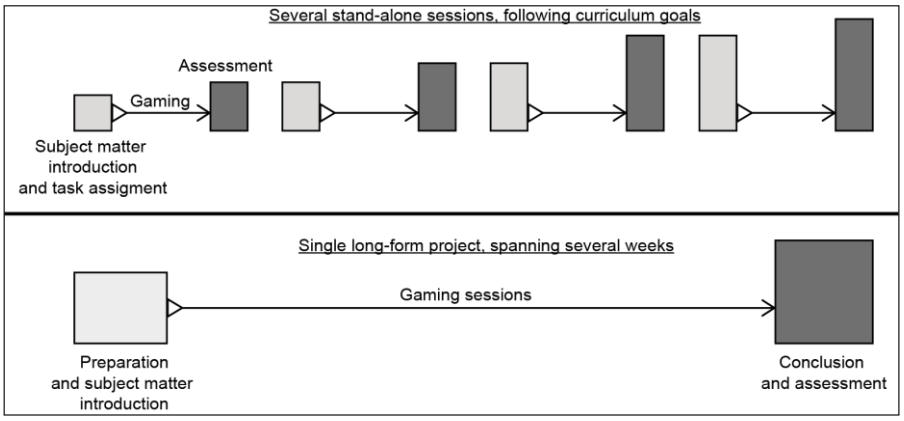

Figure 3: Overviews of the game-based learning projects. The long-form project spanned several weeks of gaming sessions, and more work was done before and after the project to contextualize game content in the subject matter. The stand-alone sessions were more beholden to curriculum demands, and was characterised by smaller assignments, progressively increasing challenge, and continuous assessments

3.1.2 Establishing the infrastructure to enable gaming sessions

When it came to integrating the game into the classrooms, the primary concerns for both cases were: the uncertainty of hardware reliability; the teachers' self-admitted low gaming- and technology literacy; and the limited amount of working hours they could feasibly spend on preparing for classroom gaming sessions. In the cases studied, the low game- and technology literacy of the teachers would make it highly unfeasible to start any type of game-based learning if it were not for a couple of ameliorating circumstances: the presence of the researcher, and the teachers' students themselves as both classes had several students who were very proficient with both computers and the used game. The process of game integration thus relied primarily on the researcher, and when the researcher was not present the teachers could get some assistance from the more technology proficient students in the classes.

Establishing an infrastructure that supports gaming involves taking inventory of the resources currently available in the environment and organization, procuring resources that are currently lacking, and making sure that the needed software and hardware is available and prepared for gaming sessions (these steps are outlined below, in Table 1). The details of this process are likely to differ between schools and classrooms since organizational support structures, technological infrastructures, and teachers' technology literacy is different for each individual case. However, comparing the statements from teachers and observations from this study to previous research indicates that these unfavourable conditions for game-based learning are not uncommon (Egenfeldt-Nielsen, 2008; Linehan et al, 2011; Wastiau, Kearney & Van de Berghe, 2009). Thus, establishing a solid infrastructure that allows for reliable and efficient gaming sessions is likely a task that is not specific to the cases studied here, and it is a task that should not be underestimated as it requires significant investments in resources and effort.

3.1.3 Administrative tasks during and around gaming sessions

An inescapable part of using games for educational purposes is the continuous management of the tools that make gaming sessions possible. Computer games are complex pieces of software that require advanced hardware to function reliably and efficiently. Setting up and orchestrating these components in a classroom environment, even for rudimentary game-based learning activities, constitutes a significant time investment and requires a high level of technological proficiency.

Since the characteristics of the two studied cases differed in many ways, the administrative efforts needed to set up and conduct gaming sessions were different. However, while the specific details of the process differed between the cases, there are definite phases that both needed to go through: taking inventory of their current educational environment and processes, implementing the chosen game into their environment, and conducting maintenance between and during gaming sessions. Each of these phases consisted of several smaller activities.

The necessity of performing the individual activities varied between cases as a result of the classroom setups and the availability of hardware, as shown in Table 1.

Table 1: A summary of the steps involved in the three different phases of integrating and using game technology into an educational environment. Some steps were not applicable to both cases (the X marks whether a step were necessary in the corresponding case)

	Activities	7th grade classroom	5th grade classroom
Inventory	Take inventory of available hardware/resources		X
	Evaluate student profiles		X
	Examine curriculum goals	X	X
	Examine game software	X	X
	Establish educational goals to be served by the GBL project	X	X
	Pull in organizational support structures	X	X
Implementation	Prepare hardware		X
	Purchase game licenses	X	X
	Installation of software	X	X
	Prepare the classroom environment		X
	Prepare the game environments		X
Maintenance	Maintenance	X	X
	Setting up servers		X
	Preparing in-game examples	X	
	Saving games and handling backups		X
	Tech-support during game sessions	X	X
	Closing down lessons		X
	Hardware maintenance		X
	Patching and software maintenance	X	X

To provide a few concrete examples of how steps differed between the two cases, the stand-alone exercise design chosen by the 7th grade teacher alleviated the need to prepare the game environments students played in. As the students in those classes also worked on their own computers, the classroom and hardware did not need any notable preparation before game exercises, nor was setting up servers or saving and keeping backups of game data necessary. However, due to the higher amount of computers, the process of installing the game software was longer, more intricate, and more prone to errors. As the stand-alone sessions followed a steady progression of challenges, the classes required preparations of in-game examples of different mathematical expressions in *Minecraft*. That was not necessary in the 5th grade class, since they worked on a long-form creative exercise where students mainly followed their own building plans.

3.2 Conducting classroom sessions

Once the conditions necessary for game-based classroom activities are met, the teachers can start becoming more focused on conducting said activities. Classroom gaming requires the teacher to be versatile as they need to carry out the necessary preparations before gaming sessions, but also act as game administrators during them. During exercises, the teacher also needs to tutor students both in the taught subject matter and in the gameplay of the chosen game, and will also need to step into an authoritative role whenever necessary to keep students focused.

3.2.1 The teacher as gaming tutor

Beyond the practicalities of ensuring that game sessions run reliably from an administrative perspective, the teacher also needs to be able to guide and support students' gaming experiences during gaming activities. Being a game tutor for students entails several responsibilities for the teacher, and given the variation in individual students' proficiencies and interests this task can be rather difficult.

The heterogeneity of a K-12 classroom as a gaming audience cannot be understated. Each individual student has their own levels of gaming literacy, gaming preferences, subject matter knowledge, motor skills, motivations to play and learn, socio-economical background, and general interests. In both of the studied cases, a large portion

of the teachers' and researcher's classroom interventions consisted of helping students launch the game, and subsequently to understand the basic interface and concepts of *Minecraft*. As an example, in an observation protocol from a gaming session with the 7th grade class on the 22nd of January, the researcher described their role the following way: "*A lot of students (around a fourth of the class) still don't know how to start the game or how to play, how to interpret 'blocks' as units of measurement, how to choose and place blocks in the game interface, or even how to steer their avatar (the combination of WASD steering and mouse movement is difficult for many), I spend a lot of time running around and managing those issues*."

In this example, some students had problems launching their game and navigating a game interface that some might consider self-evident. Building on this, the collection of transcript excerpts below show how severely students' grasp and approach to the game can vary in a single class during the same gaming session (translated from Swedish, all students are given pseudonyms):

Excerpts from a transcript of a 7th grade classroom gaming session, February 27th

Jonas:	Minecraft on highest settings - I'm running that on my computer at home. Desktop rig. No lag. Here you get lag at the lowest settings...
Sif:	[To researcher] You have to help me, I don't know where I need to go [to start the game]... is it this one?
Pete:	[To classmate] What program are you using? WorldLevel?
Wallace:	It's spelled "WorldEdit". But you have to know... you have to write it into google.
Wallace:	You can check out tutorials on YouTube of how to install it.
Pete:	Alright, WorldEdit. Here it is.
Rose:	I'm getting pretty good at this.
Rose:	Wait, I forgot how to do this...
	[...]
Rose:	This is the second time I'm playing Minecraft!

The heterogeneity of K-12 students can make classroom sessions difficult to design and monitor as the students who have never played a computer game before needs to be able to collaborate and communicate with students who are very proficient players. As the excerpt shows, students' proficiency in using technology and playing games can differ severely in a classroom. While some students are struggling with the basic interface, others are advanced enough to complain about hardware performance, or will start to modify the game in order to elevate their gameplay further since the basic game is not engaging enough.

3.2.2 The teacher as authority and enforcer of educational modes of play

Novice students' are not the only ones that require guidance, as more proficient players also frequently need to be guided towards productive collaborations with their classmates. In previous studies, Frank (2012) has shown that proficient players can become overly focused on self-actualization through mastery of game mechanics or achievement of game goals, to the exclusion of engaging with the subject matter that the game is intended to represent. A constructive and focused student-to-student discourse is reliant on the gaming activity remaining 'framed' as an educational activity that students partake in by playing with a reflexive and analytical mind-set. During both studied cases, student groups frequently became unfocused when the act of gameplay separated itself from the educational goals of the classroom sessions. After a classroom activity on the 20th of March, the 7th grade teacher reported that: "*Sometimes the game is more enticing than working and focusing on the assignment. For example, a friend might look for facts about the [subject matter topic], so meanwhile [the other student] can play around freely in the Minecraft world*." These behaviours emerged quite frequently in the transcripts as well:

Excerpt from 7th grade classroom transcript, February 27th

[Anna and James are meant to be building a scale replica of a real-world object inside of Minecraft, the exercise has been going on for nine minutes, James has been spending most of the time using TNT to blow up things in their Minecraft world, while Anna has been trying to get him to work on the assignment]	
James:	I'm going to do an awesome thing.
Silence, lots of mouse clicks	
Anna:	Teacher! Can we get some help?
Pause, the teacher comes over	
Anna:	What do you mean by "Settle on a scale"?
Teacher:	Have you decided how to scale the object you're building?
Anna:	Yes.
Teacher:	Have you decided how 'large' your blocks are [in Minecraft]?
Anna:	No.
[…]	
Teacher:	You need to decide the measurements of your blocks.
James:	Oh, how large they're going to be?
[From this point, James joins in on the discussion of the assignment]	

In situations such as these, the teacher's presence seemed to help reinforce the educational framing of the gaming activity. There are several other examples in the transcripts of the teacher being called upon to mediate these situations. In many of the examples, the teacher is utilized by some students as a 'technique' to get their more game-focused working partners to focus on the class assignment. These situations most frequently occurred in groupings where students with clear "gamer" personalities were matched with less game-proficient students.

3.2.3 The teacher as subject matter anchor

One commonly recurring challenge the teacher tackled during gaming sessions was to bridge the gap between the game content and the details of the subject matter the game is intended to teach. By necessity, games often make compromises in physical-, task-, and functional fidelity (Liu, Macchiarella & Vincenzi, 2009). Games rely a lot on abstractions and representations, and players continuously 'translate' game actions to real-world actions – if the game action is very dissimilar to the real-world action, there is always a risk that things get lost in translation. If a game is not specifically designed to teach the details of the subject matter with a high level of authenticity and fidelity, the task falls on the teacher to draw connections between the game content and the subject matter (Alklind Taylor & Backlund, 2012).

In situations where there is a disconnect between the game's presentation of an action or object and its real-world counterpart, the teacher needs to step in and provide context to fill the gap. Due to the low-fidelity nature of *Minecraft*, both in terms of visuals and object functions, disconnects can occur rather frequently. The modes of interaction presented by the game are very rudimentary, and the objects the players interact with are also visually and functionally minimalistic. When working with complex themes and concepts (e.g. history, social sciences, ecology, biology, etc.) in such minimalist environments, students need to collectively 'pretend' that certain objects should be interpreted and used a certain way. For example, the students in the 5th grade class used "Spider Webs" as puffs of smoke due to their visual similarity to tiny white clouds, even though the mechanics of the object share no similarities to smoke. Conversely, students sometimes disregarded an object's visuals if the functionality it represented was in line with what they aimed to convey. For example, students relied on the "Chest" object as a universal symbol for 'storage', and used it as such even when its visuals clashed with the setting. Some students are very adept at negotiating what qualities of objects they should 'see' and which ones they should disregard, but just as is the case with gaming proficiency – this skill varies radically between individual students. The below transcript excerpt contains a situation in which students have trouble seeing past small disconnects between game content and the subject matter:

Excerpt from 5th grade classroom transcript, February 3rd - clashes between game visuals and subject matter

[Julie and Louise, two inexperienced players, are building part of a monastery, they want a bookshelf in their building (it's a building where they would be thematically appropriate), so they place one down, a brief silence follows, and the following exchange takes place]
Louise: A little bit too colourful, right?
[…]
Julie: Let's remove them.
Louise: Yeah.
They go quiet, mouse clicks are heard, the teacher comes up to the group
Teacher: Why did you remove them?
Louise: It looked a bit weird.
Julie: Yes.
Teacher: A little bit too modern?
Julie and Louise: Yeah.
Teacher: Well, there are modern-looking book spines in there, but you can try to imagine that they're the type of books they would have back then.

In this example, the visual representation of bookshelves in the game (being slightly modern) clashes with the subject matter (medieval history). This can be viewed as an example of limited physical fidelity being troublesome to negotiate and challenging the collective act of 'pretending'. However, disconnects can also occur when students encounter situations where the game's functional fidelity is low:

Excerpt from 5th grade classroom transcript, February 3rd - drawing on subject matter details to guide gameplay

[Julie and Louise are debating what type of door to have on their building]
Julie: Now I'll attach a door.
[…]
Julie: Wooden door or Steel door?
Louise: Eeeeh…
Julie: What kinds of doors did they have?
Pause
Louise: Yeah, what door is most fitting?
Julie: [Asks the researcher] Should we have a wooden door or an iron door?
Researcher: I feel like wood was much more common. It's really difficult to create things out of metal, especially so during those days.
Louise: Yeah.
Julie: Let's go with the wooden one.

The teacher's task in these situations is to maintain the established 'contract' that state that the fiction of the subject matter is to be maintained, even when the game itself does not enforce it in any way or even tempts students to break it. For example, steel doors are no more difficult to access or place in *Minecraft* than wooden ones, making them functionally similar, but by discussing the subject matter the students start imposing constraints in service of subject matter adherence.

4. Conclusion and discussion

By collaborating with teachers during a game-based learning project, this research could reveal several important roles that teachers need to take on when integrating and using games in their educational environment. The skillsets needed to perform the roles well were also found to be quite diverse as they involved technological know-how, gaming literacy, subject matter expertise, and naturally a strong pedagogical foundation.

At the outset of a game-based learning project, the teacher needs to be able to review the conditions of their educational environment. Organizational support structures, availability of hardware and software, and the availability of other resources or obstacles, need to be considered before the game-based learning curriculum is designed. Basic practicalities like class schedules, educational goals as stated by national curricula, and technological infrastructure all inform what type of game can (or should) be used, as well as the design of gaming sessions and assignments. These findings, in contrast to the ones made by Chee, Mehrotra and Ong (2014) whom suggests that "*the key challenges teachers face are not technology centric but practice centric*" (p. 313), identify technology availability and literacy as a major bottleneck and guiding factor in the integration of digital game-based learning in schools.

When actually conducting the classroom gaming sessions, the teachers need to take on another set of roles. During a typical gaming session, teachers need to act as game administrators, lecturers, game tutors, subject matter anchors, and authority figures that keep students in an educational mode of play. In a big classroom, it can be difficult for teachers with low gaming literacy to spot situations where novice students are struggling with the game interface, or when students are not working towards educational goals. However, being game literate does not necessarily entail game mastery, but rather that the teacher can understand gaming and game content in order to make use of it. As put by Bourgonjon and Hanghøj (2011), "*teachers don't necessarily need to become experts with every new medium, but at the very least need to know what is going on […] in order to participate"* (p. 71).

Gaming literacy is not only important for gaming sessions, but also for the teacher to be able to plan and conduct contextualising activities 'around' their gaming sessions. For example, the 5th grade teacher introduced the students to the medieval history concepts they were going to be working on in *Minecraft* long before the gaming sessions started. After the gaming project was over, the teacher also pulled aspects of the buildings and societies the students had created into other school-work. Although these surrounding exercises were not highlighted in this research, they played an important role in exploring more intricate details of the subject matters. Constructive learning situations arose occasionally during gameplay as well, but the surrounding exercises provided the necessary contextual knowledge that allowed such situations to occur. The gameplay itself did not

have much intrinsic educational value, but when it was contextualized appropriately and executed purposefully, it played an interesting and valuable part of larger learning processes.

This paper has shown that game-based learning processes are demanding on teachers, requiring them to take on many different roles, each of which requires a specific skillset. Integrating games into formal educational settings is a laborious and complex process. This is partly due to the fact that schools are not structured for game-based learning, making the process an up-hill struggle, but it is also due to games not being sufficiently accommodating for the needs of teachers or the many characteristics an educational context may have. For game-based learning to move forward, teachers need to have a better understanding of games and how to work with them, and game creators need to understand teachers' working conditions and know how to accommodate for the varying characteristics of formal educational settings with their products.

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