

Enhancing learning practices by understanding formal and informal ways of using computer games¹

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Introduction

A 12-year-old boy – call him Lucas – is in the middle of a boss fight. This is a challenging test, in which he must beat an enemy harder than any he has encountered before. Through hours and hours of play, he has prepared for this moment. Now, he must combine and apply all of his skills to perform at his very best. If you were to try to speak to him, he would probably be so immersed in the game world that he would not even notice you. Tomorrow at school, however, he will tell his friends how he beat the boss and advanced in the game. He will be considered one of the experts within his peer group. He and his friends will then spend their breaks discussing strategies for the game, perhaps looking up YouTube videos of their favorite Internet celebrities playing the game. If it is anything like I was at that age, he will probably be thinking more on that day about the game than about the lesson his teacher has prepared about European Explorers.

His teacher – call her Sally – notices this. She also knows that Lucas is not a special case; after all, most kids of his age in Norway regularly play digital games (Medietilsynet 2018). Sally would like to know if it is possible to design learning activities for her students in a way that *connects* the learning to what matters to them, making the topics they cover in class seem more relevant. At the same time, she wonders what it is about these computer games that enables an 11-year-old to remember hundreds of Pokémon, as well as details about how they evolve, their strengths, and where to find them (Gee 2005), while they struggle to put letters together correctly or to remember where to place Italy on a map. Perhaps, she thinks, games involve some learning principles that could be utilized when designing her lessons?

Games and game elements permeate much of our society – so much so that some researchers argue that *play* is a key characteristic of the time we live in. Some call this the *ludification of culture* (Frissen et al. 2015), meaning that our culture has become more playful. Do you lack the motivation to exercise? Then grab your cellphone, put on your headphones, and see if it is easier to run when you are being pursued by zombies (Six to Start 2012). Do you want to meet new people in your neighborhood? Go hunting for Pokémon (Niantic 2016), and chat with the fellow collectors you encounter while looking for the rare Pokémon recently spotted near the local supermarket. Even such things as finding a job has been gamified; add a few more details to your professional network profile, and you will level up!

Perhaps, then, it makes sense when designing learning practices to draw on young people's use of computer games and the challenges they entail. That is the idea I wish to explore in this presentation, guided by the following question: "How can the design of learning practices be enhanced by understanding formal and informal ways of using computer games?" This intriguing question relates to interest-driven activities involving new literacy skills. What are the learning properties of computer

games? What are the characteristics of formal learning environments, and how do all of these elements fit together when designing learning practices?

My interpretation of this question involves the following central elements: *designing learning practices*, *computer games*, and *formal and informal* use of computer games. As this is an extensive topic, I had to make some choices in relation to focus. First, while many of the principles that inform game-oriented learning design are applicable to all ages, I have chosen to focus here on *young people's use* of computer games. This relates to a second choice I have made, which is to center the discussion of designing learning practices on *designing for formal learning environments*. Finally, I have interpreted *formal and informal ways of using computer games* as computer game use in *formal settings*, such as classrooms, and in *informal settings*, such as playing or making games at home.

Central game elements for learning

I will begin by exploring the medium at the center of the question: computer games. I use this term here to refer to digital games on consoles of any kind, including TV, handheld devices such as the Nintendo DS or the iPad, and computers.

I will not engage in any further discussion of terminology, as it is more exciting to explore what games *are*. This may seem to be something we intuitively know, but designers and researchers still debate the issue. One common definition is that a game is “a system in which players engage in an artificial conflict, defined by rules, that result in a quantifiable outcome” (Salen and Zimmerman 2004: 80). Putting it more simply, game designer Scott Rogers (2010) defined a game as an activity that requires at least one player, has rules, and has a victory condition. The main building blocks of a game are the *game elements*; these include the game mechanics – what you *do* in the game, the game *story*; the aesthetics – what the game looks like and feels like; and the *technology* used to create the game (Schell 2008).

For present purposes, I will look instead at which elements of computer games are most relevant when designing learning

practices. In this regard, you will probably get somewhat different answers, depending on who you ask (see for example Flanagan and Nissenbaum 2014; Isbister 2016). However, in terms of properties of computer games I consider important for learning design, I would name four in particular: 1) *meaningful choices*; 2) *flow*; 3) *social mechanics*; and 4) *narratives*.

Meaningful choices

Consider first the element of *choices*. The well-known game designer Sid Meier, whose work includes the strategy game *Civilization* used widely in classrooms, is often quoted as saying that “a [good] game is a series of interesting choices” (e.g., Isbister 2016: Kindle location 333). This reflects a key property of computer games that sets them apart from other media: they are interactive. When playing a game, you are not only observing events unfolding, you are actually *playing* as that character, making choices and experiencing the consequences of the choices you make. After all, in what other media do people actually refer to the main character as “I”?

Many games designed for educational purposes share *simulation* as a central element. This is a useful principle when designing for learning, as it allows players to test connections in a safe environment

and how their choices will affect the game system as a whole. Consider, for example, the game *PeaceMaker*, a government simulation game in which the objective is to find a peaceful solution to the Israel-Palestine conflict (ImpactGames 2007). Here, one plays either as the Israeli prime minister or as the Palestinian president. Throughout the game, the player must make choices about the actions they will take to achieve the game objective. Should I make a speech, or spend money on cultural activities? How do I respond to a suicide bombing or the assassination of a politician? Each action influences what the Israeli and Palestinian people think of you, and what the international community thinks of you. It is not always easy to anticipate the results of your actions, which may sometimes be exactly the opposite of what you expected. Games like these present complex systems in a simplified way, promote empathy, and serve as a point of departure for discussion and reflection (see for example Gee 2007).

Choice

The next aspect of computer games that I consider central to learning is *flow*. You may have experienced this when you engage in an activity you enjoy and become so completely engrossed that you forget about everything around you. Suddenly, you look at your watch and it is *midnight!* What happened? You have experienced what Csíkszentmihályi (2014) calls the state of *flow*. This may happen when you engage in an activity characterized by clear goals, a good balance between the level of challenge and your skill level, and clear and immediate feedback on your actions (Csikszentmihályi, Abuhamdeh and Nakamura 2014) rock-climbing, chess, dance, basketball, music composition. This is central to peo-

ple's enjoyment of challenges and going on to master them. Games are good at this, not least because they can adapt to the player's skill level. For these reasons, flow is central to designing for learning.

Social mechanics

A third key element of computer games is *social mechanics*. Consider first the collaborative element of these games. Earlier research, such as positive psychology, emphasized how collaborating in pursuit of a common goal can create a positive feeling of being part of something meaningful (McGonigal 2011). An example of this is collaborating with your guild on a mission in an online multiplayer game such as *World of Warcraft*. Similarly, in the Facebook game *Half the Sky Movement: The Game*, one uses social mechanics to address-real-world problems (Frima Studio 2013) by inviting and competing with friends to take *action*, donating money for vaccines, or signing a petition. Games can also be played together around the same screen, collaborating or competing with your friends and family. Many game players know the joy of *finally* being able to overcome a sibling in *Mario Kart* (Nintendo 2017) or have experienced the joy and frustration of trying to run a kitchen with their significant other in *Overcooked* (Ghost Town Games 2016). Games that are played alone can also include social elements. By simulating real-world situations, games can lead us to reflect on experiences and situations, almost as if they had actually happened to us (Isbister 2016).

Narratives

A final key element in learning design is *narratives* (Malone 1981; Rieber 1996; Donlinger 2007; Gee 2007). Games researchers hold different views on the importance

of story in games (Egenfeldt-Nielsen, Smith and Tosca 2008), some assigning greater significance to interactive elements. Nevertheless, it can be argued that narratives are at the core of learning from games, providing a *context* for what students learn and promoting reflection on what might have happened if events had played out a little differently, as for instance in a game about a historical event (Simons 2007). For effective learning, however, players need to find the narrative interesting (Rieber 1996). We know, for instance, that young people will work their way through a game in a second language and slightly above their skill level because they find the story so intriguing and really want to know what will happen next.

Returning for a moment to Sally, the teacher presented earlier, perhaps she would think that adding a narrative is an easy way to make this challenging topic easier for my students. However, I would advise her to think carefully, as this is also one of the potential pitfalls of game-oriented learning design, leading in some cases to what has been called *chocolate-covered broccoli* (Laurel 2001). This is what happens when one tries to make a topic more appealing by adding a fun narrative layer to a game without ensuring that it aligns with the game mechanics. This is one reason why many *edutainment* games based on a skill-and-drill formula – memorizing facts, but with a fun layer (Dondlinger 2007) – have such a bad reputation.

In summary, Sally has a toolbox of four game elements that she can use when designing for game-enhanced learning: *meaningful choices*, *flow*, *social mechanics*, and *narratives*. These are central to learning, both when *playing* games and *making* games. I will return to this later.

Computer game use in formal and informal settings

Computer game use in informal settings

Having established what games *are*, and some of the ways in which they can inform learning design, I want to discuss how they are used in different settings – *formal* and *informal* use of computer games. As mentioned earlier, playing computer games is a common pastime; in Norway, 96% of boys and 63% of girls aged 9–18 play computer games. Among nine-year-olds, 93% of both girls and boys play games (Medietilsynet 2018), the most popular of which are the building game *Minecraft* (Mojang 2009) and the football game *FIFA* (EA Sports 1993). For many young people, playing games is a social activity – inviting friends over for a soccer match on their PlayStation, for example, or logging on to a *Minecraft* server to show their newest building project to a friend online.

However, young people's use of computer games is not just about *playing* games; it may also include an element of *creation*. In the case of *Minecraft*, currently one of the most popular games among young people in Norway, players build content – houses, cities, a model of Nidaros cathedral – that can be explored by other players. Similarly, while players over the world have for decades enjoyed jumping around on platforms and mushrooms with Super Mario, the tool *Super Mario Maker* (Nintendo 2015) now allows them to build their own levels. With the newly released Nintendo Labo (Nintendo 2018), players can use cardboard to transform their Nintendo Switch into musical instruments, robots and fishing rods. For aspiring game developers, software such as *Microsoft Kodu* (Microsoft Research 2017), MIT's *Scratch* (MIT Media Lab 2017), and *RPG Maker* (Enterbrain 2011) has made

it possible to make digital games without the technical expertise needed previously.

Henry Jenkins is among those researchers who argue that young people today are part of a *participatory culture* (Jenkins et al. 2009) in which they are not only being consumers of digital media but also *producers*. In relation to games, this refers not only to *making* games but also to creating blog-posts about computer games, discussing and sharing YouTube videos, collaborating to solve problems in virtual worlds, and participating in game-modding communities. These activities, which Jenkins refers to as *affiliations, expressions, collaborative problem solving* and *circulations* (Jenkins et al. 2009) involve new literacy skills that young people must have if they are to participate fully in contemporary society. This new media culture also poses some challenges (Jenkins et al. 2009; Kafai and Burke 2015). How can we teach young people to create media ethically and to participate in online communities? How can we make sure that everyone has access to these new literacy skills? What is the school's role in this process?

Computer games in semi-formal settings

Before moving on to the use of computer games in formal settings, it seems useful to consider *semi-formal learning* environments such as organized youth clubs, summer camps, and after-school contexts. These sites are often adult-led and organized but are not bound to classroom curricula or testing regimes. Research on creating computer games is often conducted in these contexts (Hayes and Games 2008; Kafai and Burke 2015) and commonly relates to learning programming – for example, using the programming tool *Scratch* in youth clubs (e.g., Peppler and Kafai 2007). The findings from these research projects indicate that

game-making in these settings offers a safe way of exploring alternative career paths (Sheridan, Clark and Peters 2009), increases understanding of computer science (Denner, Werner and Ortiz 2012), and gets girls interested in computer science (Çakır et al. 2017). There is less research on creating games related to topics such as social studies, and semi-formal learning environments also invite more research on how game design can be incorporated into the curriculum.

Computer games in classrooms

Games are widely used in formal learning environments. In 1985, many young people would have been glued to their computer screens while trying to piece together geographical clues to locate the master thief Carmen Sandiego (Broderbund 1985). This early educational computer game was used to teach geography and achieved wide popularity. In Nordic countries, many 90s kids (like myself) fondly remember the game *Backpacker* (TATI Mixedia, Aniware AB and Pan Vision AB 1995) – travelling around the world as quickly as possible, memorizing the cities in countries we visited, and even taking a job sorting fish to pay for our travels.

Decades later, game-based learning research is growing rapidly, including studies of the use of computer games in formal learning settings such as the classroom. There are several reasons for taking games into the classroom: as a point of departure for discussion and reflection, as a safe environment in which to explore difficult concepts, to contribute to skill development, and to provide a narrative context for learning about a given topic (Grof et al. 2016). Games can also be used to *connect* learning to young people's interests, an argument that will be explored in more detail later.

Classroom use includes both commercial off-the-shelf games and games developed specifically for educational purposes. In Bergen, for example, there is an upper secondary school where students play the adventure zombie game *The Walking Dead* (Telltale Games 2012) to discuss moral dilemmas in ethics classes (Staaby 2015). In elementary schools, students learn algebra using the game *DragonBox* (WeWantToKnow AS 2012) or learn to read using *Poio* (Poio AS 2016). For many students, the quiz game *Kahoot!* (Kahoot! 2013) has become one of their favorite parts of the school day, demonstrating that the competitive element of games is a core factor in sustaining student motivation (Wang 2015). Indeed, most students *like* game-based learning; one study found that 93% of students found that games in the classroom were more motivating than text-based approaches and offered a useful way of learning difficult concepts (de Freitas 2006). Creating games is also a popular learning activity in formal settings; designing games has been linked to greater creativity and more positive attitudes to mathematics, as well as being used to refine narrative skills (Robertson and Howells 2008; Eow et al. 2010; Ke 2014).

However, introducing game-based learning into the classroom also involves some challenges. These include demands for testing and resistance from parents (Ito et al. 2013), as well as challenges perceived by students. For example, one study showed that students found it difficult to understand how to frame game-based learning activities in the classroom, which they associated with leisure time rather than school (Lantz-Andersson, Vigmo and Bowen 2016). On the other hand, research on designing games to learn mathematics has shown that students spend more time

working on design elements and creating stories than on discussing mathematical topics (Ke 2014). A study of learning by designing games in a literature class showed that while students became better at collaborating and using technology, their writing skills did not improve (Oldaker 2010). There is some evidence that introducing games into classrooms is challenging because some students may fail to understand the purpose of the activity (Squire 2005).

This raises two important points. First, as noted by Squire (2008), it is not a given that learning will happen when games are introduced into the classroom, and many factors contribute to determining whether this will prove successful. Second, while students may find it motivating when an activity associated with home is introduced into the classroom, they may also find it difficult to understand how the activity aligns with formal learning.

In discussing computer game use in informal, semi-formal and formal settings, it is important when designing learning practices to note that these are not entirely separate or static domains, as learning and computer game use may draw on any or all of them. This issue has attracted the interest of researchers in a number of fields, including game studies, education, and literacy studies. For example, Silseth and Erstad (2018) explored how teachers draw on students' leisure experiences to contextualize their classroom teaching, and Potter (2013) advises researchers to work with teachers and students to explore media-based learning at home, at school, and in in-between settings. In my own research, I have also observed the connections between learning at home and at school, and I will return to this issue later.

Design of learning practices

Learning through design

Returning now to Sally, the teacher referred to earlier, how can research on games in *informal*, *semi-formal*, and *formal* learning contexts help to enhance her design of learning practices? In this regard, it is useful to revisit the central elements of *design* and, specifically, designing for learning. While the question can be approached in many ways, Selander and Kress' theoretical approach *Designs for Learning* (Selander 2008a; Selander and Kress 2010) seems especially useful. One of their key ideas is that media cultures and young people's leisure patterns have changed and are now characterized by globalization, digital learning resources, and participation (Selander 2008b). This has implications for how we understand learning and knowledge and for how students' identities are formed. From this perspective, learning is seen as increasing one's ability to engage with the world in a way that is meaningful. In this regard, *design* is central – to *teachers*, who design learning environments and learning practices for students, and to *students*, who design their own paths to learning (Selander and Kress 2010).

So, what is design? According to Selander and Kress (2010), design means creating something new or recreating something to use it in a new way. For teachers, the term *didactic design* refers to how they shape social processes to create a good environment for learning. One model of relevance in this regard is the *Learning Design Sequence* (Selander 2008a). This is often used to explore students' *learning*, but I find it useful as a tool for designing learning practices, as it takes account of the discrete elements that characterize learning in different settings. This model of learning

in *formal* learning environments emphasizes the need to take account of *learning resources*, the *curriculum*, and *institutional norms*. The teacher begins by introducing the students' task. Students then work on this task, often collaboratively and using different forms of media. In so doing, they design their own relationship with knowledge (Selander 2008a), transforming knowledge into something they find meaningful – for example, finding information about Viking kings and turning it into a game. In a third stage, students present and reflect on their work and their process, which also serves as an evaluation stage for the teacher. This framework seems likely to be of use to Sally when designing game-enhanced learning practices.

The idea that designing is a powerful way to learn informs *constructionism*, one of the most prominent ways of thinking about learning by designing computer games. The term was coined by Seymour Papert, a professor at MIT, who first suggested that young people could learn by designing for computers (Papert 1980). He postulated that learning is more effective when people engage in creating an external artifact, based on an activity that they themselves find meaningful (Papert and Harel 1991), such as designing computer games.

Constructionist research on game-making also highlights the *social* and *cultural* dimensions of designing computer games (Peppler and Kafai 2007; Kafai and Burke 2015). The social dimension emphasizes collaborative aspects that include making games to enhance collaborative skills and designing for a larger audience (Kafai and Burke 2015). The cultural aspects of this activity include what it is to be seen as a good gamer in our culture, as well as questions of gender and ethnicity in the context of games and gaming (Kafai and Burke 2015).

For example, Sally might wonder whether, by making games, her students can help to challenge representational stereotypes in games, and what is seen as a good game.

Learning principles in computer games

Having explored the formal and informal uses of computer games and the design of learning practices, it is useful to ask *how* understanding formal and informal ways of using computer games might enhance the design of learning practices. The examples below illustrate how other researchers have explored this question.

Anyone with an interest in game studies or literacy studies is likely to be familiar with the work of the American professor James Paul Gee. Unlike young people today, Gee did not grow up playing computer games. However, his *son* did, and Gee enjoyed observing him and helping him while he played. Eventually, he started playing games himself; he was fascinated by what makes a player invest so much in playing and mastering a game that is long, hard and challenging (Gee 2007). His analysis of games and play led him to formulate a series of design principles used in computer games that also serve as good *learning* principles. As one example, imagine playing the hero in a fantasy action-adventure game. You have recently learned that a horrible wild beast is planning to destroy your beloved village, and you know you cannot allow *that* to happen. Having heard that, somewhere in the village, there is a sword hidden in a secret cave, you go exploring. Luckily, you find it quite quickly, as it is hidden not far from your backyard. You have never held a sword in your life; in fact, you have never even left the village. However, with the help of your friends, you practice repeatedly, cutting weeds and chopping wood until using the sword becomes almost

automatic. Finally, you convince the village elder that you are ready to face the beast. However, when you try to beat the “boss,” you realize that, in spite of all that practice, your skills are no longer enough, and you also need a shield if you are to win.

This principle is called the *cycle of expertise* (Gee 2007). Learners are given a challenging problem; they practice a skill until it is almost routine, but then, they face a new challenge that requires them to rethink how to use their skills and how to integrate them with new knowledge and skills. As a means of facilitating mastery in any domain, this is a useful principle when designing for learning.

The Quest to Learn school in New York is among those that have attempted to design a curriculum based on computer games principles. The school’s learning philosophy draws on seven principles inspired by game-based learning (Quest to Learn 2017). First, *everyone is a participant* and can contribute to activities in different ways. Second, the aim is to *create a challenging environment*, and third, the approach encourages *learning by doing*. Other principles include giving students *immediate feedback*; attempting to *reframe failures at iterations*; *stressing interconnectedness* of work, skill, and knowledge, both in and outside communities; and *allowing for play*. Like our hero who must learn new skills and battle monsters, the school introduces *mission levels*, in which students build up skills and competence (for example, in mathematics) before having to use those skills on a boss level (Quest to Learn 2017). In some ways, this is not unlike what is commonly known as a test, but there is a key difference: if you do not succeed on a boss level, you can simply go back, refine your skills, and try again, which is an interesting way of reducing the fear of failure.

Connected learning

Having looked at how gameplay can yield design principles for learning, it is interesting to consider whether computer games can inform learning design in other ways. Computer games are an important feature of young people's leisure activities, and I noted earlier that researchers have explored how learning can be rendered more relevant by drawing on their interests. In this regard, researchers like Mizuko Ito and her colleagues have argued for *connected learning*, which they argue is achieved when a young person can link their personal passions and interests to academic achievement, supported by peers and caring adults (Ito et al. 2013). This includes utilizing the potential of digital media, linking home and school learning contexts, and supporting peer learning – for example, by drawing on young people's use of computer games.

- In playing computer games, then, media production, popular culture, and students' own experiences become fuel for their learning activities.

While this sounds like a wonderful idea, it is important to be aware of some challenges and pitfalls when connecting learning to young people's interests. For example, Jenkins has argued that turning an element that young people care or are excited about into a formal education activity introduces vulnerability (Jenkins, Ito and Boyd 2016). For example, imagine that Lucas, the boy introduced at the outset, is seen within his peer group as an expert in making small games, employing easy-to-use software such as RPG Maker. This is one of his favorite spare-time activities – something he feels he is *good* at, and an important part of his identity. By bringing this skill into

the classroom, it is suddenly exposed to the scrutiny of teachers and peers, and is perhaps subject to evaluation by curriculum standards. For Lucas, this may not necessarily be a positive experience.

Game design in the classroom

Having explored formal and informal uses of computer games, and how these might enhance learning design, I will now explore this further by referring to some examples from my own PhD project, where I studied 11 and 12-year-old students who collaborated to design their own computer games, based on history topics from their social studies curriculum.

I noted previously how categories such as informal, semi-formal and formal learning are not necessarily static. In my own research, I observed how students orient themselves to these domains.² Data from all stages of the project revealed the interplay between leisure and school. One interesting example was a dialog between the teacher, Katherine, and one of her students, Alvin. With his friend Mathias, Alvin was making a computer game about the Viking age, and as they worked on the dialogue between the characters, Katherine came over, looked at the screen, and corrected their grammar. When the student replied "But this isn't school," Katherine quickly pointed out that this is *absolutely school*. At that point, the student acknowledged that *yes*, he knows it is school.

This is an example of how the *teacher* was able to keep the activity within the borders of classroom learning, even though her student challenged this. More interesting, however, was the way in which the *students* themselves either drew on their leisure experience or challenged other students who attempted to do so. In another example, Sander had been practicing his game

design skills at home and made a huge mansion. This was not applauded by Robin because they did not *have* houses of that kind during that time period. On the other hand, when showing his game to Sander, Simon referenced a character from a well-known computer game: "Here's Link from Zelda!" He expected Sander to understand the reference, and Sander's reply proved that he did.

In summary, students would sometimes draw on their leisure experiences, and sometimes, they would *stop* each other from doing so. In some cases, this was something they had to negotiate, often with different results. For example, one question that came up surprisingly often was whether it was acceptable to add pubs to the game. When Simon created a pub, he was quickly stopped: "It is not a pub anymore, Marion wouldn't let me. Now, it is a house." In contrast, Scott's pub remained in the game, based on the following reasoning. We are making a game about the Middle Ages, and beer was important at that time; if you did not brew beer, you would be put in jail. So, of course, you need to include a pub in the game!

Bridges and borders

These examples show how the students constructed *bridges* between their interests and academic learning while also protecting the *borders* of classroom learning. I will argue that this is a key consideration when designing learning practices that draw on young people's use of computer games. I use the term *bridges* to convey how students themselves connect their interests to academic learning. In playing computer games, then, media production, popular culture, and students' own experiences become fuel for their learning activities. However, as I have shown, this may prompt

other students to challenge such attempts, based on the social norms and values of the classroom.

To explore this issue, I have used the term *borders* as a metaphor. In game studies, the term *magic circle* is often used to explore the border that exists between play and ordinary life (Huizinga 1955). This formulation has been criticized as too static, and more dynamic alternatives have been suggested, such as Goffman's (1974) *activity frames* (Consalvo 2009). However, I believe the term *borders* is useful, as it draws attention to how students distinguish domains such as home and school. It has been argued that when two separate domains meet (e.g., home and school), tensions can be *expected* to occur (see for example Akkerman and Bakker 2011), but I will argue instead that opportunities for learning arise when these bridges and borders *meet* – more specifically, when students *reframe* some element of their interests or their experience of gaming in an effort to align it with the classroom context. For example, when Marcus, Samantha and June were making a game about European Explorers, Marcus suggested that they should look at pictures of ships from the history-themed game *Assassin's Creed* for inspiration. After searching for images using Google, Samantha picked up the textbook and showed them an image of a boat from the appropriate time period. They then compared the images from *Assassin's Creed* with those in the book to ensure the historical accuracy of the boat in their game.

Concluding summary

In conclusion, the main consideration when designing learning practices based on computer games is how young people's use of these games in a leisure context changes in

a formal learning setting. When used for educational purposes, these activities are no longer *only* voluntary or for fun, which is one of the core characteristics of play. Instead, the requirement is to learn something, to build skills, or to achieve competency objectives. This is not necessarily a negative; on the contrary, it offers possibilities for the learning designer to exploit the strengths of computer games *and* the strengths of the classroom. Based on existing research and on my own research to date, I contend that the following four aspects of formal learning are central to game-oriented learning design.

- 1) Formal learning in the classroom provides many opportunities for collaborative learning. Students can learn from each other, collaborating to achieve a higher level of competency than on their own. This strength can be exploited when designing learning tasks, including both playing and designing games.
- 2) Because learning activities in the classroom are shaped by the curriculum, students often discuss, reflect on, and build knowledge in a way that is accurate for the subject, even though the task is based on students' interests.
- 3) A classroom has access to *artifacts*. This means that learning design should take account not only of what students do on the screen but also of what happens *around* the screen. In other words, utilize students' access to textbooks, digital learning resources, and maps on the wall when designing learning practices based on games.
- 4) The teacher's presence in the classroom provides opportunities to develop

clear goals for activities and to set guidelines for collaboration, guiding the students while they work and help them to reflect on the process and on the final product.

So, if Sally sought my advice about designing game-based learning practices for her classroom, I would probably suggest the following. Returning to *Designs for Learning* (Selander 2008a; Selander and Kress 2010), I would advise her to begin by clearly introducing the aim of the activity, including how it will be evaluated and what resources are available. The students would then understand what is expected of them, helping them to frame the task as a school activity and reducing their vulnerability in bringing something they care about into a classroom context.

The second stage is to get students working on their task. For the given topic, they should learn by *making* a game, based on information they find using the available artifacts. They should discuss and reshape this information for the game they are making, *making* and *designing for* interesting choices in the process. By working together, the social aspect of games is utilized.

In *playing* a game about the same topic, they can play together, drawing on each other's strengths and knowledge to advance, and collaborating to solve challenges. As noted previously, they are likely to be more motivated if the game has an interesting narrative.

In the final stage, the students should discuss and reflect on the products they have made. If they are making a game, students can conduct a *playtest* of each other's games. Here, the teacher can contribute by facilitating discussion of their games, as well as the process of creating them. This offers a way of initiating a fruitful discussion

about important literacy skills in the contemporary media environment. If the students have *played* a game, this can provide a starting point for reflection and discussion. How does the game present historical events and game characters? What might have happened if events had played out a little differently?

In exploring the formal, semi-formal, and informal uses of computer games, I have considered the importance of games in young people's lives and how game-related practices are linked to digital literacy skills. I have explored the interactive, narrative, and social properties of games that make them useful for learning. At the same time, I have argued that introducing com-

puter games from a leisure context into a formal learning environment presents certain challenges, and I have suggested how these challenges might be reduced by exploiting the strengths of formal learning.

There remains a need for further research on how to best integrate the learning possibilities offered by computer games with the curriculum. Fortunately for teachers and students alike, this body of research continues to grow, enhancing our understanding of the challenges and benefits of computer games for learning and the rapid developments in both games and game design tools, and creating exciting opportunities for game-enhanced learning practices in the future.

Notes

¹ This is a slightly edited version of my trial lecture on 15 June 2018 at the Norwegian University of Science and Technology, Department of Education and Lifelong Learning. The title was: "How can the design of learning practices be enhanced by understanding formal and in-formal ways of using computer games?" A summary of the thesis can be found in the present issue of *Barn*.

² The examples briefly mentioned here are presented in more detail in my PhD thesis *Students as game designers: Exploring collaborative game-based learning activities in the classroom*, and in the corresponding articles.

References

- Akkerman, S. F. and Bakker, A. 2011. Boundary crossing and boundary objects. *Review of Educational Research* 81(2): 132–169. doi: 10.3102/0034654311404435.
- Broderbund 1985. Where in the world is Carmen Sandiego [Computer game]. Eugene, OR: Broderbund.
- Çakır, N. A., Gass, A., Foster, A. and Lee, F. J. 2017. Development of a game-design workshop to promote young girls' interest towards computing through identity exploration. *Computers & Education* 108: 115–130. doi: 10.1016/j.compedu.2017.02.002.
- Consalvo, M. 2009. There is no magic circle. *Games and Culture* 4(4): 408–417. doi: 10.1177/1555412009343575.
- Csikszentmihalyi, M. 2014. *Flow and the Foundations of Positive Psychology: The Collected Works of Mihaly Csikszentmihalyi*. E-book. Dordrecht: Springer. doi: 10.1007/978-94-017-9088-8.
- Csikszentmihalyi, M., Abuhamedh, S. and Nakamura, J. 2014. Flow. In M. Csikszentmihalyi. *Flow and the Foundations of Positive Psychology*. doi: 10.1007/978-94-017-9088-8.
- de Freitas, S. I. 2006. Using games and simulations for supporting learning. *Learning, Media and Technology* 31(4): 343–358. doi: 10.1080/17439880601021967.

- Denner, J., Werner, L. and Ortiz, E. 2012. Computer games created by middle school girls: Can they be used to measure understanding of computer science concepts? *Computers and Education* 58(1): 240–249. doi: 10.1016/j.compedu.2011.08.006.
- Dondlinger, M. J. 2007. Educational video game design: A review of the literature. *Journal of Applied Educational Technology* 4(1): 21–31. doi: 10.1108/10748120410540463.
- EA Sports 1993. FIFA.
- Egenfeldt-Nielsen, S., Smith, J. H. and Tosca, S. P. 2008. *Understanding Video Games: The Essential Introduction*. New York: Routledge.
- Enterbrain 2011. RPG Maker [Computer software]. <<http://www.rpgmakerweb.com/>>.
- Eow, Y. L., Ali, W. Z. bte W., Mahmud, R. bt., and Baki, R. 2010. Computer games development and appreciative learning approach in enhancing students' creative perception. *Computers & Education* 54(1): 146–161. doi: 10.1016/j.compedu.2009.07.019.
- Flanagan, M. and Nissenbaum, H. 2014. *Values at Play in Digital Games*. Cambridge, MA and London, England: The MIT Press.
- Frima Studio 2013. Half the Sky Movement: The Game. <<https://www.facebook.com/HalftheGame>>.
- Frissen, V., Lammes, S., de Lange, M., de Mul, J., and Raessens, J. 2015. *Playful Identities: The Ludification of Digital Media Cultures*. Amsterdam: Amsterdam University Press.
- Gee, J. P. 2005. *Situated Language and Learning: A Critique of Traditional Schooling*. E-book. New York and London: Routledge.
- Gee, J. P. 2007. *What Video Games Have To Teach Us About Learning and Literacy*, 2nd ed. New York: Palgrave MacMillan.
- Ghost Town Games 2016, Overcooked [Computer game].
- Goffman, E. 1974. *Frame Analysis: An Essay on the Organization of Experience*. New York: Harper & Row.
- Grof, J., McCall, J., Darvasi, P., & Gilbert, Z. 2016. Using Games in the Classroom. In Schrier, K. (ed.) *Learning, Education and Games. Volume two: Bringing games into educational contexts*. ETC Press.
- Hayes, E. R. and Games, I. A. 2008. Making computer games and design thinking: A review of current software and strategies. *Games and Culture* 3(3–4): 309–332. doi: 10.1177/1555412008317312.
- Huizinga, J. 1955. *Homo Ludens. A Study of the Play-Element in Culture*. Boston: Beacon Press.
- ImpactGames 2007. PeaceMaker [Computer game]. Pittsburgh, PA: ImpactGames.
- Isbister, K. 2016. *How Games Move Us: Emotion by Design*. Cambridge, MA: MIT Press.
- Ito, M., Gutiérrez, K., Livingstone, S., Penuel, B., Rhodes, J., Salen, K., Schor, J., Sefton-Green, J. and Watkins, S. C. 2013. *Connected Learning: An Agenda for Research and Design*. Irvine, CA.
- Jenkins, H., Purushotma, R., Weigel, M., Clinton, K. and Robison, A. J. 2009. *Confronting the Challenges of Participatory Culture: Media Education for the 21st Century*. Cambridge, MA and London, England: MIT Press.
- Jenkins, H., Ito, M. and Boyd, D. 2016. *Participatory Culture in a Networked Era: A Conversation on Youth, Learning, Commerce, and Politics*. Kindle Ed. Cambridge, UK and Malden, USA: Polity Press.
- Kafai, Y. B. and Burke, Q. 2015. Constructionist Gaming: Understanding the Benefits of Making Games for Learning. *Educational Psychologist* 50(4): 313–334. doi: 10.1080/00461520.2015.1124022.
- Kahoot! 2013. Kahoot! [app].
- Ke, F. 2014. An implementation of design-based learning through creating educational computer games: A case study on mathematics learning during design and computing. *Computers & Education* 73: 26–39. doi: 10.1016/j.compedu.2013.12.010.

- Lantz-Andersson, A., Vigmo, S. and Bowen, R. 2016. Students' frame shifting – resonances of social media in schooling. *Learning Media and Technology* 41(2): 371–395. doi: 10.1080/17439884.2015.1051051.
- Laurel, B. 2001. *Utopian Entrepreneur*. Cambridge: MIT Press.
- Malone, T. W. 1981. Toward a theory of intrinsically motivating instruction. *Cognitive Science: A Multidisciplinary Journal* 4: 333–369. doi: 10.1207/s15516709cog0504.
- McGonigal, J. 2011. *Reality is Broken: Why Games Make Us Better and How They Can Change the World*. New York: Penguin Press.
- Medietilsynet 2018. *Dataspill*, accessed 14 September 2018, <<http://www.medietilsynet.no/barn-og-medier/dataspill/>>.
- Microsoft Research 2017. Kodu [Computer software]. <<https://www.kodugamelab.com/>>.
- MIT Media Lab 2017. Scratch [Computer program]. MIT Media Lab. <<https://scratch.mit.edu/>>.
- Mojang 2009. Minecraft [Computer game]. Mojang. <<https://minecraft.net/nb-no/>>.
- Niantic 2016. Pokémon Go. [App]
- Nintendo 2015. Super Mario Maker [Wii U game]. Nintendo.
- Nintendo 2017. Mario Kart [Computer game].
- Nintendo 2018. Nintendo Labo [Switch game].
- Oldaker, A. 2010. Creating Video Games in a Middle School Language Arts Classroom: A Narrative Account. *Voices from the Middle*, 17(3), 19–26.
- Papert, S. 1980. *Mindstorms: Children, Computers, and Powerful Ideas*. New York: Basic Books.
- Papert, S. and Harel, I. 1991. Situating constructionism. In S. Papert and I. Harel, eds. *Constructionism*. Norwood, NJ: Ablex.
- Peppler, K. A. and Kafai, Y. B. 2007. From SuperGoo to Scratch: exploring creative digital media production in informal learning. *Learning, Media and Technology* 32(2): 149–166. doi: 10.1080/17439880701343337.
- Poio AS 2016. Poio [app].
- Potter, J. 2013. Media education: Researching new literacy at home, at school and in between. In L. Whitaker, ed. *The Children's Media Yearbook 2013*. London: Children's Media Foundation.
- Quest to Learn 2017. *About Q2L*, accessed 7 September 2017, <<http://www.q2l.org/about/>>.
- Rieber, L. P. 1996. Seriously considering play: Designing interactive learning environments based on the blending of microworlds, simulations, and games. *Educational Technology Research and Development* 44(2): 43–58. doi: 10.1007/BF02300540.
- Robertson, J. and Howells, C. 2008. Computer game design: Opportunities for successful learning. *Computers & Education* 50(2): 559–578. doi: 10.1016/j.compedu.2007.09.020.
- Rogers, S. 2010. *Level Up! The Guide to Great Video Game Design*, 2nd ed. New York: John Wiley & Sons.
- Salen, K. and Zimmerman, E. 2004. *Rules of Play: Game Design Fundamentals*. Cambridge, MA: MIT Press.
- Schell, J. 2008. *The Art of Game Design: A Book of Lenses*. Boca Raton, FL: CRC Press.
- Selander, S. 2008a. Designs for Learning – A theoretical perspective. *Designs for Learning* 1(1): 10–22. doi: 10.1080/14626260802312673.
- Selander, S. 2008b. Designs of Learning and the Formation and Transformation of Knowledge in an Era of Globalization. *Studies in Philosophy and Education* 27(4): 267–281. doi: 10.1007/s11217-007-9068-9.
- Selander, S. and Kress, G. 2010. *Design för lärande: ett multimodalt perspektiv [Designs for Learning: A multimodal perspective]*. Stockholm: Norstedts.

- Sheridan, K., Clark, K. and Peters, E. 2009. How scientific inquiry emerges from game design. In I. Gibson et al., eds. *Society for Information Technology & Teacher Education International Conference 2009*. Charleston, SC, USA: Association for the Advancement of Computing in Education (AACE).
- Silseth, K. and Erstad, O. 2018. Connecting to the outside: Cultural resources teachers use when contextualizing instruction. *Learning, Culture and Social Interaction* 17(22): 56–68. doi: 10.1016/j.lcsi.2017.12.002.
- Simons, J. 2007. Narrative, games, and theory. *Game Studies. The International Journal of Computer Game Research* 7(1). <<http://www.gamestudies.org/0701/articles/simons>>.
- Six to Start 2012. *Zombies, Run!* [App].
- Squire, K. (2005). Changing the game: What happens when video games enter the classroom? *Innovate: Journal of Online Education*, 1(6).
- Squire, K. 2008. Open-ended video games: A model for developing learning for the interactive age. In K. Salen, ed. *The Ecology of Games: Connecting Youth, Games, and Learning. The John D. and Catherine T. MacArthur Foundation Series on Digital Media and Learning*. Cambridge, MA: MIT Press. doi: 10.1162/dmal.9780262693646.167.
- Staab, T. 2015. Zombie-based critical learning – Teaching moral philosophy with the walking dead. *Well Played: A Journal on Video Games, Value and Meaning* 4(2): 76–91.
- TATI Mixedia, Aniware AB and Pan Vision AB 1995. *BackPacker* [Computer Game].
- Telltale Games 2012. *The Walking Dead*.
- Wang, A. I. 2015. The wear out effect of a game-based student response system. *Computers and Education* 82: 217–227. doi: 10.1016/j.compedu.2014.11.004.
- WeWantToKnow AS 2012. *Dragonbox* [app].

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