Guiding Questions for Game-Based Learning

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Karen Schrier

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Abstract

The primary goal of this chapter is to identify the main questions and tensions for researchers, practitioners, and policymakers to navigate when considering why, how, when, who and whether to use and design games for learning. The chapter

K. Schrier (✉)
Marist College, Dutchess County, Poughkeepsie, NY, USA
e-mail: kschrier@gmail.com; Karen.Schrier@marist.edu

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reviews elements related to using games for learning, such as motivation, problem-solving, and story, as well as guiding questions such as "what are the goals?" and "who is the audience?" Finally, future trends in games and learning are considered.

Keywords
Games · Game design · Educational games · Game-based learning · Serious games · Digital games

Introduction

In the free online game, *Spent*, players make choices as an unemployed single parent who needs to make it to the end of the month without running out of money (Roussos and Dovidio 2016). For instance, players may be asked to decide whether to give their child lunch money rather than pack a lunch or pay for the treatment of their pet's illness, put it to sleep, or let their pet suffer, each of which have varying financial and social consequences. The educational goal of the game is to reduce prejudice against the poor and to enable players to "walk in the shoes" of someone who is poor, helping to enhance empathy and care (Roussos and Dovidio 2016).

However, when Roussos and Dovidio tested *Spent*, they found that not only did empathy and positive attitudes *not increase* after playing the game but, for some players, *negative attitudes* toward the poor actually increased after playing *Spent*. People who were already more likely to feel like poverty was a result of choices that are personally controllable had even greater negative attitudes toward the poor after playing *Spent*. Roussos and Dovidio suggest that these results were due partly to how *Spent* was designed as a game, in that the players could control their choices and its consequences and make the right choices to survive a month. Thus, players believed that likewise people who face real-life financial struggles should just make better choices. For those players, playing *Spent* decreased empathy for the poor; however, watching a video of the game being played did not have the same effect, because agency over one's choices was removed (Roussos and Dovidio 2016). On the other hand, the game raised $7,000 for a homeless shelter and enhanced awareness of financial inequities for some players (Farber and Schrier 2017).

Spent failed to meet its educational goals for some of its target audience members. Just as with any instructional experience or activity, whether a conventional lecture or textbook, website, or game, there are strengths and weaknesses, unintended consequences, and serendipitous possibilities inherent in the design of the learning experience. The design of an experience, for example, may even matter more than the medium, in that a specific game (e.g., *Mission US*) may work for a specific educational need (e.g., developing historical empathy for middle school students), while other games would not, just like some textbooks are written appropriately for an audience or topic and some are not (Clark et al. 2016; Schrier 2016c).

Ke (2016) explains that there are typically two areas of learning that are supported by games: (1) skills, such as systems thinking, argumentation, literacy, and

computational thinking, and (2) domains of knowledge, such as health information or history (Ke 2016). In addition, games may support changes in attitude or affect, such as interest or curiosity for a topic or perspective (Squire 2011). Even for those skills and domain areas that games teach well, the same experience may not work for every student or set of conditions. Digital games are never one-size-fits-all solutions, and a successful activity in one classroom may not necessarily be transferrable or scalable.

The primary goal of this chapter is to identify the main questions and tensions for researchers, practitioners, and policymakers to navigate when considering *why*, *how*, *when*, *who*, and *whether* to use and design digital games. What factors should be considered when designing, using, and assessing a game for learning? How do game designers balance fun and accuracy, immersion and transfer, facts and skills, and innovation and tradition in a game? Would a game be the most appropriate way to teach a particular skill, attitude, or topic?

First, the narrative provides a brief overview of game-based learning, shares approaches to using games for education, and identifies six characteristics or elements that should be considered when deciding whether and how to use games for learning. Next, the chapter reviews the key questions and challenges that need to be weighed when deciding whether and which game to use in educational settings.

What Is Game-Based Learning?

Game-based learning comes in many different shapes, sizes, genres, and styles and varies tremendously, from learning what it's like to be President of the United States in iCivics' *Executive Command* to understanding what it's like to be the parent of a terminally ill young son in *That Dragon, Cancer*. In general, game-based learning involves using games for some type of educational purpose – such as a non-digital card game that features historical figures, a digital drawing game that supports creativity, or a word puzzle game that teaches Spanish. Sometimes a game is a central part of a classroom lesson, such as a long-term assignment to craft a historical building like the Taj Mahal in *Minecraft* (Weitze 2016). Other times games may be a shorter activity that leads to further deliberation, such as using *The Migrant Trail* to kick off a discussion on immigration or using *Dys4ia* to reflect on gender identity and marginalization (Schrier 2014). Game-based learning could be as simple and straightforward as playing a "name remembering" game at camp or as complex as transforming an entire class module into an alternate reality game (ARG), such as Darvasi did to teach *One Flew over the Cuckoo's Nest* for his English students (Darvasi 2014).

We can formally define games, as Juul has done in *Half Real: Video Games between Real Rules and Fictional Worlds*, as having a "rule-based formal system; with variable and quantifiable outcomes; where different outcomes are assigned different values; where the player exerts effort in order to influence the outcome; the player feels emotionally attached to the outcome; and the consequences of the activity are optional and negotiable" (Juul 2005, p. 13). However, whether an

experience is fully "a game," is gamelike, has some playable aspects, or is inspired by but is not actually a game does not matter as much as whether it is useful, effective, and appropriate for the educational experience, needs, audience, and context. As such, what it means to be "game-based learning" continues to evolve, and the role of information technology in creating, offering, and experiencing games is also varied and evolving. The word "digital" will not be used throughout the chapter, but it should be understood that the chapter will focus on digital game-based learning as key area in educational technology that has emerged since the last edition of the handbook. Despite the focus on digital games, however, many of the guiding questions and research can apply to all types of games, including non-digital ones.

Why Digital Games for Learning?

Over the past two decades, there has been an explosion in the use of, design of, and research on digital games and learning, with people using games in classrooms, museums, libraries, and after-school programs and even at home for educational purposes (Schrier 2016a). For instance, more games are being played in the classroom than ever before, with 74% of K-8 teachers using games and 55% of teachers using games at least once a week in the classroom (Takeuchi and Vaala 2014). The Entertainment Software Association found that 63% of American households have at least one person playing video games at least 3 h per week (ESA 2016).

Moreover, empirical studies have suggested the potential of using digital games for learning (Sitzmann 2011; Wouters et al. 2013), though there is little consistency among the methodologies used to measure effectiveness. (For example, many are case studies, were not randomized properly, or have small sample sizes (Crocco et al. 2016; Brom et al. 2016).) In a study with a large data set that uses quantitative measures, Crocco et al. analyzed the use of game-based lessons in English, Math, and Science courses (2016) against control (nongame lessons) courses. Their findings suggested that games correlated with increased enjoyment of learning and that enjoyment also related to deep learning and higher-order thinking, suggesting that games can support learning through increased enjoyment (Crocco et al. 2016). But seemingly in contrast, in a meta-analysis of the cognitive and motivational aspects of games for learning, Wouters et al. (2013) compared games to conventional instruction methods (skill and drill practice, lectures, reading, and websites). Their results suggested that the games were more effective in learning (from a cognitive perspective) and retention, but not in motivation (Wouters et al. 2013).

Another recent meta-analysis of game-based learning research, supported by a Microsoft/SRI International grant for GlassLab Research and conducted by Clark et al. (2014, 2016), found that digital games can support learning better than nongame conditions in terms of cognitive learning outcomes. The design of the game, rather than the medium of "games" itself, was more important to whether the environment supported learning (Clark et al. 2016). Thus, whether a game is successful and effective is complex and often relies on the design and the context within which it is used.

When rationalizing the use of educational games, proponents often mention the increasingly large number of people playing games and using games in learning. They may point to case studies of using games in the classroom (Farber 2015), books on games and learning (Gee 2003), or evangelists for games (McGonigal 2011). However, games have always been connected to learning. Play has always been a way that people learn about each other, connect, understand and share ideas, and contribute to humanity (Schrier 2016c). That said, games should not be used because they are trendy, popular, or *seem* like more fun than other activities. They should be used because they are the most appropriate design solution and contribute to the best experience for specific educational needs. The next section describes six different characteristics of games for learning that may be useful when deciding whether and how to use or design a particular game.

Game Elements to Consider

Educators and researchers have investigated key aspects of games that can contribute to learning. These include motivation, fun and engagement, social interactions, problem-solving, and story, as well as games as systems and tools, which will be outlined in the next sections.

Motivation

Motivation relates to how people decide what to do and why to do it and is defined as moving someone to do something, like play a game (Ryan and Deci 2000). Games, if well designed, can be motivating for players, which make them potentially useful for activating learning, though the relationship among motivation, engagement, games, and learning is complex (Wouters et al. 2013). Eseryel et al. (2011) investigated McLarin's Adventure, an educational massively multiplayer online game (MMOG) geared toward eighth and ninth graders, and their findings suggested that enhanced engagement in the game resulted in better learning outcomes. They found that providing appropriately timed and balanced challenges throughout the game experience related to more engagement and motivation in the game (Eseryel et al. 2011).

On the other hand, games are not automatically motivating. There are a number of challenges to consider. Game players may be pulled in many directions – school, extracurriculars, and family obligations – in addition to entertainment and other game choices. Educational games may not be as visually appealing, narratively engaging, or dynamically designed as their mainstream counterparts. Different types of motivations – intrinsic and extrinsic (Deci and Ryan 2000) – may have differential results in games and learning (Malone 1981). Ryan and Deci's (2000) self-determination theory explores two motivation types: intrinsic (e.g., driven by something inherently interesting) and extrinsic motivation (e.g., due to external factors or objects). Ryan and Deci's research generally suggested people were more likely to practice skills or acquire knowledge if they felt more connected to others, more competent, and had autonomy over their choices and behaviors (Ryan and Deci 2000).

Moreover, people may be motivated by different aspects of gaming. Yee and Ducheneaut's Quantic Foundry, a company that focuses on surveying game players to understand their motivations, found that men are more likely motivated by competition (e.g., rankings, match wins) and destruction (e.g., explosions, car chases, guns), whereas women are more motivated by fantasy (e.g., acting a role in another world) and completion (e.g., finishing missions, collecting). Younger players are more likely to be driven by competition than older (above 35 years old) players, who are more driven by completion and fantasy (Yee et al. 2016).

Fun and Engagement

Should learning games be fun first and educational second? Researchers are split on whether the pedagogical aspects of the game should be prioritized over fun (Ravyse et al. 2017) or whether games and simulations need to be entertaining to be useful, educational, or effective (Crocco et al. 2016; Ravyse et al. 2017). Some researchers point to the importance of fun in educational game design (Habgood and Ainsworth 2011), and most game designers prioritize fun as the top aim of any game (Koster 2004), although what actually counts as "fun" may not be the same for everyone, and the difficult challenges in a game (e.g. Papert's "hard fun") may be what is actually fun (Bogost 2015). Educators should ensure that the balance of fun and work, and entertainment and learning, is appropriately maintained for each student throughout the experience.

Csikszentmihalyi (1990) describes a type of engagement with games – which he calls "flow" – where the player is immersed deeply in the experience. Achieving flow may be integral to learning. Educators need to ensure that, even if players are deeply immersed in a game, they are also engaged in learning and able to transfer any new knowledge to nongame environments.

Moreover, games are sometimes framed as being fun and frivolous, and this perception matters in whether games are acceptable for educational purposes and whether they are taken as "serious" learning environments. If a game is perceived as too fun, players may not take the content seriously enough. In *Beyond Pleasure and Pain*, E. Tory Higgins (2012) describes a study where some participants were encouraged to have fun while learning the material, and other participants were told that the task would be tedious and serious. Participants were also divided by high and low importance: some received instructions that the task was of high importance, and others were told it was not. Those people in the "high importance and high fun" group actually had a lower performance than those in the "high importance and low fun" one. So, while we may expect fun to be motivating and enhance our performance, because people expect that learning will be serious and not fun, this ended up hurting performance (Higgins 2012). Educators need to set and monitor expectations, frame game playing experiences as learning experiences, and also reflect on the game afterward to ensure that students deem a game as highly important and serious, even if it is also fun.

Social Interactions

Not all learning is best accomplished with other people (or even other devices or tools, such as computers, or nonhumans), but when properly designed, games can be particularly adept at enabling social interaction, helping people connect, and expanding community. Some educational goals may benefit from the ways that games can help to support collaboration through a game or around a game (such as in the case of players actively sharing resources or tasks in forums or social media). "Many in-game and out-of-game practices acculturate users, such as problem solving together on a quest, engaging in debates and other social events, or participating on fan sites and blogs" (Schrier 2016c, p. 105, citing work by Steinkuehler, Jenkins, and Gee). Players (such as those of *World of Warcraft*) may develop shared norms and practices through these communities (Steinkuehler 2007) and may also engage in peer-to-peer mentorship (Steinkuehler and Oh 2012), which all contribute to epistemic learning, a type of learning in which people adapt to the vocabularies, tools, values, and norms of a community by participating in it (such as through games) (Shaffer 2006; Squire 2011). Feeling a sense of belonging and inclusion in a game community may also contribute to learning (McGonigal 2011; Schrier 2016c).

Social interactions can also motivate further game playing, problem-solving, and make each greater than the sum of its parts (Eseryel et al. 2014; Yee 2006). For instance, in a study, players who shared a computer while playing a game were more motivated and had higher learning outcomes, possibly because they had to articulate their ideas and moves collaboratively, helping to reinforce their learning and engage them in the game (Inkpen 1994).

When supporting social interaction, caution is warranted. Certain types of online gaming communities can also be deleterious and discourage or demotivate learning. Particular games and gaming cultures may be rife with bullying, harassment, and toxic communication and may feel exclusionary or demotivating. Competitive social interactions may be welcoming to some but not others. For example, in an exergaming study by Song et al. (2013), players who were already driven by competition were more motivated to play, but those that were not driven by this were less motivated to play (Song et al. 2013).

Not all games are designed to support social interaction, whether informal sharing outside of the game or intense collaboration or competition within the game (Schrier 2016c). To enhance learning, educators and researchers are encouraged to think about how to appropriately add a social dimension, such as using social media, wikis and blogs, or journaling with pair-share groups.

Problem-Solving

Games at their core involve problem-solving or the process of finding solutions to problems (e.g., avoiding enemies in *Super Mario Run* or collecting enough Pokémon creatures in *Pokémon Go*). The game serves as a manifestation of a "problem space" (Jonassen 2000), where the game's rules and boundaries constrain and encourage

certain solutions to be created in that space. Games may be particularly effective for practicing problem-solving because they can enable players to experience cause and effect by observing what is rewarded or punished within the game (Schrier 2016c). Players can test out hypotheses about how to solve a particular game's problems (e.g., avoiding enemies in *Super Mario Run*), such as through trial and error (e.g., jumping and seeing what happens), in-game tutorials (e.g., watching an example of jumping over enemies), educated strategies (e.g., trying jumping because it worked in the original *Super Mario Brothers*), or observing other players (e.g., watching videos of other people playing the game). Gee explains how games spur players to go through a cycle of questioning and probing the world, which he calls the "probe, hypothesize, reprobe, rethink cycle" (Gee 2003, p. 90). Games can also serve as microworlds, where players can iteratively push on a game's boundaries and explore causes and effects, which helps players test out solutions to problems (Papert 1993).

Games have been credited in honing players' problem-solving skills, such as by encouraging alternate paths, providing stories or analogies, or encouraging the sharing and deliberation of different perspectives among players. Games can help people move beyond functional fixedness or being fixated on the typical problem and solution. But games are not necessarily appropriately designed for all types of problem-solving, and problem types need to be matched to game play, audience, and contexts (Schrier 2016c).

Story

Not all games have or need an explicit story or narrative, but those that do can be particularly motivating for some players, such as those that are driven by fantasy (Malone 1980; Yee 2006) and immersion. Malone discusses fantasy as a key motivator for games, for instance, and uses Walt Disney World to illustrate how children experience fantasy worlds, see themselves in fantasy roles, or fulfill wishes through play (Malone 1980, 1981).

Story can work in different ways. People may be motivated to experience, complete, or co-create a story or narrative experience (Schrier 2016c). Shum et al. describe how story can help situate data and elements of a problem to provide meaningful context and illustrate its human dimensions (Shum et al. 2012). Providing a story context for a problem can also help by showing new perspectives or reframing the problem so people do not get stuck applying conventional or ineffective problem-solving methods. Story can also help make abstract concepts and problems more personally meaningful and relevant (Schrier 2016c). Teachers can also have students write their own stories about playing the game or even expand on the characters or interactions in the game. However, not all games need to have a significant story, and not all students will be motivated by story elements (Yee et al. 2016).

Games as Systems and Tools

Real-world concepts and topics, whether related to economics, history, ethics, literature, anthropology, or biology, require authentic tools, models, and epistemologies

to interact with them. To act like a scientist, for instance, you need to be able to use real-world scientific data and study real-world organisms or physical properties. You need to use tools and processes such as microscopes or mass spectrometry. You need to understand how scientists know and interact with the world, the typical language and terms used, and norms and values of the profession. Biological processes, such as photosynthesis, and social policies, such as immigration, are often not straightforward concepts but complex "living, breathing" social, cultural, economic, political, and scientific systems with many interconnecting parts, which, to be fully understood, need to be embraced holistically and systemically.

Likewise, games themselves are dynamic systems that can help situate meaning and simulate the complexity of various concepts, skills, and issues. "Players enter and explore within a game world, which is a deliberately designed system based on a set of rules, assumptions, and values" and which is further influenced by the addition of human players, their game play, the communities that emerge, and their own unique activities (Schrier 2016c, p. 39). While games cannot possibly simulate or model every corner of a dynamic system, they can realistically reimagine aspects of complex processes, skills, actions, and information within an authentic context, situate learning, and bring people together (Schrier 2016c).

Games can also function as tools by which to authentically explore systems and topics and to practice particular skills, attitudes, and perspectives (Shaffer 2006). For example, participants in *Foldit* can use authentic 3-D models of proteins, just as scientists would, and players in *Reverse The Odds* use real images of cancerous tumor cells to make judgments and classifications. Furthermore, players can design and co-create games as tools to help construct their own understanding of various topics, such as by making a game that models healthy interpersonal behaviors or designing one that authentically reflects gravity on the moon.

Guiding Questions for Studying and Using Game-Based Learning

This section explores various tensions, challenges, and questions to consider when studying the impacts of, or implementing, games for learning.

What Are the Goals?

A primary challenge in designing, using, and assessing games for learning is establishing goals and ensuring that both educational goals and game goals are appropriately matched. Weitze (2014) describes game goals as "objectives . . . what we strive for . . . [and are] fundamental to games" (p. 226). In a game, there are immediate, pragmatic goals (e.g., finish a level) and sub-goals (e.g., jump over an obstacle). There is also an ultimate game goal, ultimate outcome (Fullerton 2014), or end result needed to complete, accomplish, or reach to win the game. In a well-designed game, players know that they have reached game goal(s) through in-game

feedback, such as points, rewards, trophies, badges, unlocked levels, or progression of some kind (Weitze 2014).

Learning or educational goals, on the other hand, relate to a measurable change in skills, knowledge, abilities, information, attitude, feeling, and/or connection (Weitze 2014). In particular, curricular goals concerning knowledge, skills, and attitudes relate to those aspects of a curriculum that need to be covered or taught in a given activity, module, and/or time frame (Weitze 2014). Students and teachers may determine when learning goals have been reached through a combination of assessments, such as exams, completion of assignments, reflection exercises, observation of behavior, progression to more complex activities, or the successful application of learning to real-world processes (Weitze 2014).

As may be apparent, game goals, educational and curricular goals, are not necessarily the same and may diverge significantly. When designing games for learning, all relevant goals should work together appropriately and be "concrete. . .challenging but achievable. . .rewarding. . . balance[d] in the short- and long-term" (Weitze 2014, p. 231; Whitton 2009). Weitze describes a number of methods for orchestrating goals, such as the Q Design Pack for Games and Learning (Salen et al. 2011) and Smiley-Model (Weitze and Ørngreen 2012). For instance, in the Smiley-Model, designers can use the game goal, rules, choices, challenges, and feedback to intertwine with the learning goal (Weitze 2014).

Who Is the Audience?

Another key consideration is understanding the audience: who are the learners, what is their current skill level and expertise, what is their prior experience with games and gaming, and what do they enjoy learning, playing, and doing?

First, consider what motivates learners in terms of the games they want to play. Bartle (1996) describes four different player types (killers, achievers, socializers, and explorers). Achievers care about meeting goals and rising above challenges (similar to achievement in learning). Explorers want to discover the virtual world and push boundaries; socializers want to interact with others; and killers want to compete, show off, and wield power (Richard 2014; Bartle 1996). Building on this model, Quantic Foundry identified distinct player motivations for digital games, such as competition, destruction, challenge, story, and design, and four clusters of motivations for board games (e.g., conflict, strategy, immersion, and social fun) (Yee et al. 2016). Likewise, Radoff (2011) considers how different types of feedback may motivate a player. Quantitative feedback may be points, badges, monetary rewards, or leaderboard statistics; qualitative feedback may be stories, smiley faces, strengthened bonds, jokes, gifts, or character development (Richard 2014; Radoff 2011). Vandenberghe (2012) began to match the "Big Five" personality types to elements of play, such as novelty (openness), challenge (conscientiousness), stimulation (extroversion), harmony (agreeableness), and threat (neuroticism) (Richard 2014).

Thus, knowing what drives and motivates a learner can help with matching that individual to the correct type of game or learning experience. Beyond considering

player motivation types, players can also be matched based on hobbies, interests, or personality and just as with any learning experience, their "reading ability, learning curve, cognitive ability, learning style, and physical ability, as well as tactile desires" (Richard 2014, p. 209) – though all factors do not need to be simultaneously considered to make an appropriate match.

Other audience factors to consider include the accessibility of the game, the game's technology, and the culture that emerges from and around the game (Richard 2014). Gaming cultures emerge from or around a game and may include political or cultural views expressed in the game; or implicit biases or values may be negotiated through the game. For instance, does the game support an inclusive learning environment or will players feel marginalized by a game's genre: representations of race, sexuality, or gender? Does each player and player type have an equitable chance of engaging in the experience and attaining its goals?

What Is the Context for the Game?

The context of the game – how it is played, where it is played, with whom it is played, and how the game is framed – all affects its success, efficacy, and acceptance as an educational experience. Gee distinguishes between the little "g" game and big "G" Game. "Everything in-game is the game, with a small 'g.' The context around play is part of the Game, with a big 'G.' That is, it is not only the physical environment around the game but also the virtual environment," as well as the learning context (Simkins 2014, p. 268, citing Gee 2012). Rarely should a game be viewed as a stand-alone activity (just the "g"); rather, it should be considered as part of a larger learning experience alongside other types of interactions, activities, lessons, topics, exercises, and assessments, as well as in relation to the broader environment and communities surrounding it (the big "G").

Factors related to the educator can affect the success of a game in a classroom, such as a teacher's beliefs and attitudes about games, their professional development and training, and the teacher's prior experience with games and game-based learning (Groff et al. 2016). Teachers, for instance, may have trouble deciding whether a game is appropriate for a particular educational need or whether the content within the game is accurate and design effective (Kirriemuir and McFarlane 2004; Groff et al. 2016). Moreover, educators may not have the necessary game literacy (Zimmerman 2008) or design understanding to look more deeply into of the game and understand how it works; what values, misconceptions, or biases it may express or magnify; or how students may cheat, hack, bully, or otherwise transgress in the game (Consalvo 2007). They may not know how to question or interrogate the game with students even if they have a lot of experience with a particular game.

Another important consideration is the physical place where a game is played. Playing a game in a dinosaur museum, where students are able to also see bones, preserved tails and features, or teeth up close, is different than playing a game about virtual dinosaurs in a classroom or at home. Playing a location-based mobile game as a pair while walking around the site of the Battle of Lexington (as with

Schrier's *Reliving the Revolution* (Schrier 2014)) is different than sitting at a computer, virtually walking around a historic site (as with *Mission US* or *Past/Present*).

Moreover, the type of support that is provided also matters. A busy after-school program, with only one teacher to support many individual student needs of different ages, is a different environment than a small preschool classroom with three teachers who can collaboratively guide a game. An outdoor camp game for high school students that involves physically exploring a large forest may need different types of support than an improv game for college theater students. A game needs to be shaped to the context and needs different types of facilitation to enforce any boundaries, rules, and norms.

The communities that emerge around and within games also affect the context through which a game is played (Kafai and Fields 2009; Steinkuehler 2007; Shaffer 2006). Jenkins et al. describe "participatory cultures," where people are actively creating, reconfiguring, revising, and reconstituting media and collectively participating in worlds such as games, where they are creating new avatars, story lines, or fan materials (Jenkins et al. 2006). The spaces where participants, players, and fans interact may be sanctioned by the game designers or even unsanctioned, and this affects the context of the game.

Thus, just as with any educational activity or experience, educators and designers must consider the dynamic and evolving interaction among students, place, expertise, educator, community, and other factors. Continuing to evaluate and reevaluate the context, and adjusting the experience, is part of the new role of the teacher-as-designer of learning experiences with games.

Practical and Technological Considerations

Practical and technological factors such as cost of the game, length of setup, time of game play, platform and technology used to create and play the game, length of class period or educational experience, and technology available to the students all make a game more or less feasible for learning. These pragmatic considerations need to be fixed or acted upon before moving to other considerations, such as curricular fit or audience's needs. If the technology itself does not work or cannot be accessed, we cannot even consider how to include it for educational use.

Certain platforms may be better at teaching and encouraging particular skills or interactions. For instance, a networked game (such as a console or browser-based game that has multiplayer options) may support certain social interactions in a virtual world, whereas a mobile or non-digital game may encourage real-world social interactions. On the other hand, a single-player computer game may be better at investigating individual performance on a skill or concept, depending on its design.

The platform used also has implications for accessibility, inclusion, context, equity, design, and learning in general. *Minecraft* accessed from an in-class private server may provide a safer "walled off" environment than playing on an open server with virtual strangers. Students with different sensory needs, neurotypes, or abilities

may be affected negatively by an intense virtual reality game, one with too many players, one that requires rapid hand or physical movements, or one that does not involve tactile interactions, depending on needs.

The length of time for completing a game can vary widely. Although longer games may be difficult to incorporate into classroom or more structured learning environments, the payoff for an extended experience with the game may be valuable. Groff et al. note that "Although more work may be involved to leverage these games successfully, they also offer the potential of developing 21st century skills, such as problem solving, decision-making, planning, strategy, and collaboration" (2016, p. 23, citing Klopfer et al. 2009).

Students may also be able to work with teachers, researchers, or designers to create games. For instance, younger students may use programs such as *Scratch*, *GameStar Mechanic*, or *Minecraft* to create or modify games as part of an assignment (Nolin 2016). Older and adult students may use Construct 2, GameSalad, Unity, Unreal, Twine, Metaverse AR, or ARIS to create games (see Nolin 2016; Chen 2016 for more details on each platform).

Curricular Considerations

The curricular objectives and domains of knowledge covered by a game can also affect its design and use. For instance, the educational objectives of a game, and any curricular needs of the learning experience, affect the need for accuracy in the game, the capability for authentic practice, level of literacy needed to play or learn from playing, skill development possibilities, support for creative and critical thinking, as well as the way domain knowledge can be applied within and beyond the game.

The extent to which game accuracy and precision matters, for example, depends on the game and learning goals and the types of skills, facts, topics, themes, approaches, or attitudes you aim to teach. When teaching students how to manage resources or to consider broader history themes, such as the balancing of resources toward religion, culture, military, and economic growth, then the COTS game *Civilization* may be appropriate and would not necessarily need to maintain a high accuracy to real historic events (Squire and Barab 2004; Squire and Durga 2006). Too much detail or connection to the real world in certain contexts may stifle the flexibility, creativity, and experimentation needed to learn a particular concept. What works well in real life or even in a book or video may not perfectly translate to a virtual space or non-digital gaming environment.

For instance, in *Mission US*, students can explore different moments and events from history, such as the Revolutionary War or the Underground Railroad (Schrier 2014; Farber and Schrier 2017). Enabling an authentic practice of relevant skills, such as argumentation or perspective-taking, may be more important than providing historically accurate or overly realistic scenarios (Schrier 2014).

Likewise, games can enable interaction with authentic scientific tools and models to help teach computational and technical skills (including "problem solving, algorithms, modeling, and abstraction" (Werner et al. 2014, p. 38a). Other games may

provide opportunities for dialogue or discourse or even musical, artistic, and physical interactions to learn relevant skills and behaviors. For instance, Kognito creates dialogue-based games, where players work through practice conversations (such as about a family member suffering from PTSD or about a doctor working with a family on healthy eating behaviors).

Assessment and Evaluation

One of the most important and challenging aspects of using and designing a game for learning is understanding whether it is effective, accessible, and useful for students, meets educational needs and goals, and teaches the appropriate skills, concepts, attitudes, or topics. Simkins (2014) recommends three questions that need to be considered to help in shaping any assessment plan: what are the learning goals of the game, how is the game played (mechanics, elements, game goals, game play), and what is the context of play? Assessment of games in learning is similar to other types of educational assessment, with pros and cons for different methodologies. Gibson and Webb (2013) argue that assessment should move from summative types to assessments that are "continual, diagnostic, and formative" and consider the "personal growth of the student, impact on social issues, and cultural importance" (p. 17).

Quantitative methodologies focus on measuring with a goal of replicating, verifying, and comparing results across and between students (Simkins 2014). Simkins describes some possible quantitative methodologies such as pre- and post-game examinations or eye tracking of what students are doing in a game. Qualitative methodologies "involve collecting data on what people are doing within their context. . .[could] involve a very close read of the actions, speech, practices, and behaviors. . .[and the] environment, social, cultural, and physical" context (Simkins 2014, p. 279). The Department of Education (DoE) also suggests the benefit of collecting and making use of student-learning data in real time so that educators and schools can make more effective, data-driven decisions and can better support differentiated learning, accessibility and greater feedback, inclusion, and transparency (USDOE 2010).

There are different aspects of games that can be assessed, such as whether in-game goals were completed, whether learning goals were reached, whether game play was effective in supporting goal completion, and how the in-game and out-of-game context encouraged learning. Any assessment is affected not only by the learning attained but also the context of the game and assessment(s) given, the students/people being assessed, the person providing the assessment, and other factors (Simkins 2014). Assessment does not need to take place outside of the game (such as through an exam or paper written using concepts or skills used in a game). The game itself can incorporate assessment through its play. For instance, the DoE describes how a virtual world, River City, assessed student scientific inquiry and communication skills in situ (USDOE 2010; Dede 2009).

Assessment and reassessment are part of any well-designed game because players need feedback to know if goals and tasks are complete. The fact that the player has

reached particular goals in a game could be in itself a useful assessment of the player's status and learning needs. For instance, Gibson and Webb (2013) identify specific types of assessment that may be relevant to games, such as investigating students' decisions in a game, commenting on peer students' game creations, and/or responding to a prompt through the creation of a game or interactive project. In other words, the act of playing and/or interrogating the game is a form of assessment.

Balancing Needs and Perspectives

Game design is a series of trade-offs and mini-solutions to an enormous number of questions that need to be weighed, such as designing flexible game play versus maintaining strict accuracy or enabling deep immersion in the game versus ensuring the ability to transfer learning to outside contexts. The decision about what type of game to use – for example, whether commercial-off-the-shelf (COTS) entertainment games or those focused on educational purposes – may also be rife with further questions and consequences. When representing an event from history or a physics property in a game for additional examples, there are a seemingly infinite number of ways to simulate something, with give-and-take decisions among many different constraints, such as accuracy, resources, expertise, time, platform needs, audience needs, game play desires, etc.

Choosing whom to include on a decision-making or design team may also involve trade-offs in budgets, technological limitations, resources, and expertise. For instance, educational games often include educators and researchers on their teams alongside game designers such as *Mission US: For Crown or Colony* (Schrier 2014; Farber and Schrier 2017). Many big-budget entertainment-focused games use large teams of people such as designers, developers, artists, musicians, and storytellers, whereas games specifically made for education often have smaller budgets, less resources, and fewer people (Schrier 2016c). Strong teams for educational game development combine expertise in game development, storytelling, art, and design, as well as in education, curriculum development, subject-area expertise, and assessment. Different stakeholders and perspectives need to work together to collaboratively decide how to navigate practical, creative, and educational tensions and questions while also meeting goals, standards, and metrics.

The Future of Games and Learning

This chapter brings up a number of questions relevant to game-based learning. Yet, the answers are not always obvious and will continue to evolve alongside technological, cultural, social, and economic changes. For example, expensive, immersive technologies such as those related to virtual reality are growing in use alongside cheaper and DIY (do it yourself) technologies, such as *Arduino*, *Raspberry Pi*, and *littleBits*, which will increase the types of digital and highly interactive educational experiences educators can create, as well as alter who has access to these types of

experiences (Schrier 2016b). Likewise, robots and robotics, as well as wearable technologies, interactive displays, context-aware technologies, and connected objects ("the Internet of Things") are starting to be used within or alongside games to teach and support learning. For instance, students are learning how to program using robots and other interactive objects and technologies, which could also be used to create and support game play (McGill 2012).

Mobile and tablet usage is becoming more widespread, though inequities still exist, and knowing which educational apps and games to access and how best to use them in educational settings will require additional research and experience. Large data sets (big data and learning analytics) are also being used more frequently for predicting behavior and assessing learning – both in games and in other types of educational activities. The increased usage of data will affect the types of questions that will get asked as well as the types of methodologies and approaches available for considering, using, and studying games and learning. A new divide – the data divide – has been emerging (Boyd and Crawford 2012) between those who can use, analyze, and maintain the data culled from educational games and those who cannot. Ethical questions (such as those related to data use, privacy, transparency, equity, accessibility, and algorithm creation) need to be considered alongside pedagogical and design questions.

In addition to teaching content areas and topic-related skills (e.g., math facts and literacy), other types of skills have also become vital, such as computational thinking, twenty-first century and civic-minded skills such as argumentation, perspective-taking, media literacy and media fluency, and identifying biases. Game-based learning may be another way to show students how to separate fact from fiction, understand and evaluate viewpoints, and analyze information (Schrier 2014).

Finally, educators need to find innovative ways to engage students in solving real-world problems and creating new knowledge. Educators can use games also to help uncover solutions to real-world complex issues, such as poverty, war, or climate change. Games, and their ability to simulate intricate systems, invite collaboration and cooperation and show people how to think through problems in new ways, may help people uncover new truths, and consider new perspectives. Game-based learning has the potential to not only help people acquire knowledge but also to reveal new understandings of humanity, our world, and our past, present, and future.

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