Designing Educational Videogames: Balancing Learning, Assessment, and Fun

Richard N. Van Eck
University of North Dakota

Valerie J. Shute
Florida State University

Lloyd Rieber
University of Georgia

Abstract

In this chapter, we provide advice for instructional designers who wish to design videogames for learning, or what we call educational videogames (EVGs). The design of EVGs has become more common, and more research and guidance exist now than when we first wrote this chapter. Changes in videogame design and technology continue to require adaptation of instructional design practices, yet established theory and practice remain relevant to the design of EVGs. Instructional designers who intend to pursue game design as a professional path need to appreciate the unique aspects of videogame modalities, understand the guiding theoretical and design principles that remain relevant to game design, and know how to adapt existing practice to the unique aspects of this modality as they collaborate with multiple professions.

Introduction

Humans have been using and researching the power of games for learning for centuries: chess was used to teach war strategy in the Middle Ages (Institute of Play, n.d.) and games formed the basis of early childhood education (e.g., Kindergarten; Fröbel, n. d.). The use of games for educational purposes increased with the advent of digital games (games played on a computer or dedicated game consoles) like *Oregon Trail* in the 80s and 90s, (Rawitsch, Heinemann, & Dillenberger, 1971; Bouchard, 1985) and *Sim City* (Wright, 1985) in the 2000s. Research has also shown that EVGs can be very effective learning tools: meta-analyses of EVGs have found that they can result in a 0.33 standard deviation improvement in learning when compared to non-game-based instruction and that theoretically augmented (i.e., well-designed) EVGs account for a 0.37 standard deviation increase in learning when compared to nonaugmented games (Clark, Tanner-Smith, & Killingsworth, 2014).

Despite this increased interest in using and studying videogames in schools, evidence suggests that they are not being used to their full potential. Nearly 75% of K–8 teachers report using digital games in their classrooms and more than 40% of them were doing so to meet local, state, and national standards (Takeuchi & Vaala, 2014). Yet, the vast majority are using what have sometimes been described as "drill and kill" games that focus on lower-level taxonomic outcomes (verbal information and concepts, in Gagné's taxonomy [Gagné, Wager, Golas, & Keller, 2004], and knowledge and application in Bloom's taxonomy [1984]) that can be accomplished in a single classroom session. We argue that there are many instructional strategies and modalities that can address lower levels of learning as, or perhaps more, effectively than EVGs and at much lower cost. The true advantage of videogames as a medium is their potential to address *higher* levels of learning (e.g., rules and problem solving, or synthesis and evaluation) along with other outcomes that are traditionally difficult to address (e.g., attitudes and metacognitive skills).

The reader is (or will soon be!) competent to search the now extensive literature on games and learning. Doing so is an essential step on the journey to becoming competent as an instructional designer who wants to build EVGs for learning. Our goal in this chapter is to address what we see as a significant gap in the literature regarding the design process for building such games: What are the core theories that can guide us, what are the critical features of EVGs, who are the members of the design teams involved, and what does an instructional designer need to know and be able to do to be a productive member of such teams?

As an instructional designer, we are skilled at analyzing a given modality for its ability to support desired strategies and outcomes. Just as we know that textbooks, video, or lecture-based instruction are not appropriate for every learning problem nor every learner, in all venues, nor at all times, neither are games. Games are effective when they align with the instructional outcomes and strategies within the constraints and affordances of the medium, the given environment, and the set of learners.

However, videogames are *not* like other modalities, and instructional designers often struggle to recognize the multiple ways in which they differ and to modify their design processes accordingly. First, videogames require interactivity to an extent and in a way that other modalities do not. To be sure, all instructional design processes require us to elicit learner performance and provide feedback *at key points* in the instruction. However, interactivity is a near-continuous feature of the videogame experience: the *sine qua non* of videogames. Designing EVGs therefore requires a comprehensive understanding of how this interactivity modifies instructional design practices. Second, videogames have a specific language with which instructional designers must be well-versed, and a unique toolset which places constraints on the design process. Understanding level design, skill trees, challenge levels, character classes and attributes, distributed point systems, and power-ups, for example, is essential. Third, videogames are not one medium, but many. Massively multiplayer online role-playing games (MMORPGs), single-player first-person shooters, and cooperative action games may share core features, but they can also differ radically. Understanding these differences is crucial when designing different EVGs for different audiences. Fourth, EVGs require a continual balancing act between learning outcomes (and their associated design practices) and play itself. Instructional design places learning at the center of the design process, where the strategies, media, and content are designed *around* the core learning outcomes and objectives. This creates an outcome-centric view of design that often leads instructional designers to "suck the fun" out of games (Prensky, 2004). This has led some in our field to suggest that instead of designing games for specific learning outcomes, perhaps we should be finding games that align with our outcomes and designing ways to use these commercial off-the-shelf (COTS) games for our goals (e.g., Charsky & Mims, 2008; Turcotte, Hein, & Engerman, 2018; Van Eck, 2008). Fifth, and finally, EVGs require diverse design teams comprising graphic artists, voice-over artists, sound designers, videographers, animators, programmers, and measurement experts. Instructional designers typically do not understand the practices, vocabulary, or culture of these design teams, nor do the other team members necessarily understand instructional design. In our experience, learning to negotiate this landscape represents one of the most difficult challenges for the design of EVGs.

It is not possible to address all of these ideas comprehensively here, of course, and we have written about these ideas elsewhere (e.g., Hirumi, Van Eck, Appleman, & Rieber, 2010a; 2010b; 2010c). We hope that by providing an overview of these key principles on game design, based on our collective experiences, we can help you arrive at competency faster than we did by learning it all the hard way!

Educational Theory and EVGs

When games made the leap from analog to digital in the 20th century (first, as arcade machines, then computers, consoles, and now mobile devices), research on their efficacy picked up in earnest. Seminal publications like Patricia Greenfield's *Mind and Media* in 1985 (see Chapter 7) and Jim Gee's *What Video Games Have to Teach Us About Learning and Literacy* (2003) promised to usher in an era of research practice founded on sound theory and experimental design. One of the key pitfalls awaiting new scholars in games for learning, however, lies in assuming that "new" videogames can only be explained by "new" theories. All fields evolve, of course, and new theories emerge and are tested as new learning modalities emerge and as learners continue to evolve. However, this necessary evolution *builds* on rather than *negates* prior research and most learning is effective (or not) for reasons that can be explained by the same set of core theories and precepts of instructional design.

The design of EVGs (or the use of COTS games) can be driven by many theories. Principles of behaviorism (e.g., schedules of reinforcement, stimulus-response latency, and association) help us understand how Jeopardy-style games work for factual information. Constructivist principles (e.g., social negotiation of meaning) help us understand how people make meaning of their experiences in open worlds and MMORPGs. Sociocultural learning theory helps explain how culture mediates and situates knowledge, and of course, many other things like motivation, locus of control, and self-efficacy help predict how people will experience and persevere (or not) in game worlds. In addition to these kinds of theories, there are four that we think are critical to the design of EVGs. The first is the theory of play itself.

We argue that a game is engaging, or fun to play, if it triggers the play phenomenon in the player. So, we must take some time to understand the play phenomenon. Fortunately, much research has been done on play from a multitude of disciplines such as education, psychology, sociology, and anthropology. Making play a co-equal objective of learning via games requires a paradigm shift for most designers—one that is very learner-centered and constructivist in nature. To understand this paradigm, you need to understand the difference between merely "playing" a game and being "at play." The former can be mandated by a teacher to students or a trainer to a group of employees, and these participants can dutifully "play the game." However, these individuals may never have been "at play," meaning that they never entered the conceptual cognitive or cultural space in which play occurs (Huizinga, 1950).

Everyone reading this chapter has probably experienced play within the last 24 hours, even though you may resist, as many adults do, using that word to describe it. You may have experienced play while engaged in a hobby such as gardening, woodworking, photography, painting, or some craft. You may have experienced it while caring for a son or daughter and enjoying each other's company. You may have experienced it while reading a book, playing a musical instrument, or playing a videogame.

Regardless of the activity, it probably happened during your leisure time, although if you are fortunate enough to love your job, it may have happened at work. It was definitely something you *wanted* to do, and you would say that you did it voluntarily. You found the activity intrinsically motivating and so you were not concerned about "getting something" out of it. You were also doing something actively and possibly physically. Finally, you were likely in a state where you were not conscious of yourself or of your place in the world but rather felt wholly absorbed in the activity—you were immersed in it. This state also carried a feeling of being very free from risks. You felt free to try new things or to experiment with different ways of doing or thinking—after all, it was only play. Your awareness of time likely disappeared, and you were probably surprised by how much time had passed when the activity had ended (see Pellegrini, 1995; Rieber, 1996; and Sutton-Smith, 1997, for formal definitions and attributes of play).

Educators and other educational stakeholders (e.g., parents, state legislators) are often quick to ask "What good is play? Does it lead to some productive outcome or result?" The seminal work of Jean Piaget remains an important starting point for such questions (Phillips, 1981; Piaget, 1951). Piaget felt that play and imitation were core and innate human strategies for cognitive development. With play, a child could rehearse a newly formed concept to make it fit within what he or she already knew and understood (assimilation). As a child experiences new events, activities, ideas, or rituals, imitation is used to build entirely new mental models (accommodation). The child continues in this way to achieve an orderly, balanced world while constantly confronting a changing, shifting environment. Just as the mental processes of assimilation and accommodation continue throughout life, so too do play and imitation remain important cognitive tools for people from childhood through adulthood.

There are other examples of research literature, while not overtly aligning with play, that are clearly in the same camp. The research on self-regulated learning (Zimmerman, 1990, 2008) is one example, especially with its emphasis on an individual actively working toward goals within intrinsically motivating activities. However, the attributes of flow theory proposed by Csikszentmihalyi (1990) are the most similar to that of play, especially in the context of game design. For example, flow theory specifically addresses the need to optimize challenge, which not only improves learning but helps to prevent anxiety and boredom. Activities that induce flow have clear goals, coupled with clear and consistent feedback about whether a person is reaching these goals. Another important attribute of flow is that it takes effort to attain a state of flow, requiring a clear and deliberate investment of sustained attention.

The second key theory to understanding how EVGs are effective is situated cognition (e.g., Brown, Collins, & Duguid, 1989; Lave, 1988), which argues that to "know" something is to "do" something, and that "doing" is inextricably bound to the contexts in which that knowledge is relevant and demonstrated. Instructional designers, by extension, should consider designing learning *environments* that embed the intended learning outcomes. A classic example of situated cognition that is often cited is of children in Brazil who were taught mathematics in a decontextualized manner in school (e.g., lesson and workbooks full of formulas and operations) but actually learned (and demonstrated) mathematics through selling goods on the streets (Carraher, Carraher, & Schliemann, 1985). School exams could not measure this knowledge because the assessment was not embedded in the learning context.

Videogames are a clear example of situated cognition; the intended learning takes place and is assessed in the context of the game. By embedding "knowing" in "doing," situated cognition approaches may also promote transfer of learning. We often hear educators, parents, and politicians lament that students cannot solve "real world" problems, even when they have "demonstrated" the knowledge on (decontextualized) school exams. There is evidence that EVGs designed around these principles can indeed promote transfer of learning (Van Eck & Dempsey, 2002).

One of the key concepts to designing situated cognition learning is authenticity, which refers to the extent to which actions *taken* within that designed environment reflect the actions and processes that would normally occur when *demonstrating* that knowledge in that environment. It also means that the environment *behaves* authentically, in that, actions taken by the learner result in the kinds of responses by the environment (and the people, tools, and resources within it) that would happen in that environment. As you will see in Part III, authenticity and situated cognition are also key concepts for assessment of learning in EVGs. This is not to say that the game must be a fully realized reflection of the real world, of course. There are many aspects of the environment that do not apply to a given learning situation (e.g., one need not experience a virtual world with gravity in order to learn how to react to angry customers in customer service training), and research on simulations has suggested that irrelevant details (seductive details) actually interfere with learning (e.g., Harp & Mayer, 1997). Even *relevant* information may be problematic if the learner's level of expertise is insufficient (e.g., Adcock, Watson, Morrison, & Belfore, 2010).

While "real world" and "authentic" may sound like synonyms, there are important distinctions. Asking a student to solve a word problem about dividing up a *Pokémon* card collection is *not* a real-world example; it is a problem *about* a real-world problem. Putting kids in groups with *actual Pokémon* cards and telling them to work out a fair way to divide them so each person has the same value is probably as close to a real-world problem as we can get in schools. Having those students solve the problem by filling in worksheets or matrices based on provided values is not an *authentic* way of solving the problem; having them decide on the process to use, determine what a fair arbiter of true value is, and build their own value charts *is* as authentic as we can get. Research has shown that instruction built on these principles is effective in promoting initial and long-term learning as well as increasing the likelihood of transfer of learning to new contexts.

The third theoretical area of relevance to the design of EVGs is the research on problem solving itself. As an instructional outcome, problem solving refers to the ability to synthesize multiple rules and defined concepts and apply them to problems that do not have a known solution. It is generally believed that the only way to promote problem solving is, therefore, to present the learner with multiple problems to solve within a given domain. This is often done in the context of instructional strategies that scaffold problem solving, sometimes called problem-centered or problem-based learning. Problem solving is an oft-cited benefit of videogames but one that is routinely oversimplified. For example, it is important to recognize that there are many different kinds of problems that vary in their cognitive composition, degree of structuredness, and required domain knowledge. Jonassen (2000) has proposed a typology of 11 different types of problems, each of which requires specific design and instructional strategies to promote. It follows that any videogames we design to teach problem solving will differ in game design and instructional strategies. This is hardly a full treatment of any of these areas, of course, but good resources are widely available for those who want to study them further. It is also not necessary to make use of every theory when designing EVGs—there are many different ways to blend these different approaches (e.g., Barret & Johnson, 2010; Borchert, et al., 2010; Van Eck, 2015).

We mentioned in the beginning that one of the biggest challenges facing instructional designers on game design teams is the delicate and complicated dance of designing for learning AND for fun. We turn our attention next to one of the biggest challenges facing designers of games in this regard: one that took decades to resolve effectively and which left a trail littered with videogames that failed to teach, engage, or both.[1] Assuming we are able to modify our design practices to balance game interactivity and fun while remaining true to the intended learning outcomes, how must our assessment design practices also be modified?

Stealth Assessment and Evidence-Centered Design in EVGs

During gameplay, students naturally produce rich sequences of actions while performing complex tasks, drawing on the very competencies that we want to assess (e.g., persistence, spatial skills, understanding Newtonian laws of force and motion). A key challenge for educators who want to use or design EVGs is assessment: making valid inferences about what the student knows, believes, and can do at any point in time and at various levels during the game without disrupting the flow of the game, and by extension, the engagement and learning (see Figure 1).

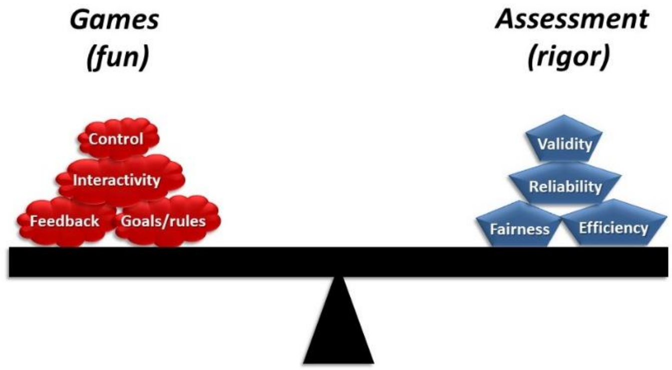

Figure 1. Balancing fun and assessment (Shute et al, 2013).

One way to address this challenge is to use *evidence-centered design,* or ECD (Mislevy, Steinberg, & Almond, 2003). ECD, first posited by Messick (1994) and later formalized by Mislevy and colleagues (e.g., Almond et al., 2015; Mislevy & Haertel, 2006; Mislevy et al., 2003) holds that the assessor must a) define the claims to be made about learners' knowledge, skills, and other attributes (the competency model), b) establish what constitutes valid evidence of a claim and how to measure that evidence (the evidence model), and c) determine the nature and form of tasks or situations that will elicit that evidence (the task model).

Stealth assessment is a specialized implementation of ECD whereby assessment is embedded so deeply into a learning environment (e.g., videogames) that it becomes invisible to the learners (Shute & Ventura, 2013; Shute et al., 2021), which promotes flow

[1] The reader is referred to the literature on "edutainment" games in the 1980s and the discussions of intrinsic and extrinsic motivation, game mechanics, and ludology of the 1990s and early 2000s.

and engagement (Vygotsky, 1978, 1987). This deeply embedded, invisible assessment makes it possible to generate real-time estimates of student competency levels across a wide range of knowledge and skills, which in turn can allow for a) the delivery of timely and targeted formative feedback and/or learning supports/scaffolding (Vygotstky) and b) the presentation of a new task or quest that is at the maximal challenge for the learner's skill level, also known as the zone of proximal development (Vygotsky).

Stealth assessment is a particular type of learning analytics that is unobtrusive and focuses on assessment as well as support of learning (based on the results from ongoing assessments). Learning analytics generally reflect the collection, analysis, and interpretation of data to optimize educational experiences and outcomes (see Baker et al., 2021). Data may come from various platforms, but typically involves the analysis of historical data to understand trends and inform future educational strategies. Assessment may be a part of learning analytics, but it is not the sole focus. Both learning analytics and stealth assessment employ artificial intelligence (AI) technologies (the use of advanced algorithms and machine learning models to process large datasets, identify patterns, and make predictions or decisions) to capture, accumulate, and make inferences about learning. One effective AI tool that stealth assessment often uses to accumulate evidence includes Bayesian networks (e.g., Pearl, 1988) to deal with uncertainty. For more details on the what-how-why of using Bayes nets to accumulate evidence in digital environments to make inferences about evolving competency levels, see Almond et al., 2015.

In videogames with stealth assessment, the competency model is created at the outset of the design process specifying competency-model variables (everything the designer wants to measure during assessment). The task model specifies learning tasks that are intended to provide observable evidence about the targeted (unobservable) competencies. The interaction of the competency model and task model is realized through the evidence model, which serves as the bridge between the two. The evidence model translates what the student says or does, and expresses that information in a psychometric model showing how that evidence relates to the competency-model variables. Because this happens in real-time, the competency model is frequently updated during gameplay, resulting in probability distributions for competency-model variables for a particular learner. These probability distributions can then be used by the stealth assessment engine (see Rahimi, Almond, & Shute, 2023) to a) generate tasks that are pitched at optimal challenge levels, b) provide some learning or affective support as warranted, c) post a current summary of competency level estimates on the game dashboard (e.g., Rahimi & Shute, 2021), and so on. More complete descriptions of stealth assessment in two different EVGs are detailed in Shute and Wang (2016).

In addition to the benefits already described, we advocate the use of stealth assessment in EVGs for several other reasons. First, it is designed to be unobtrusive and therefore frees learners from test anxiety commonly associated with traditional tests, which in turn improves reliability and validity of assessment. Second, because stealth assessment is designed using ECD-based models, the evidence model comprises data that are far more granular (and thus more specific and useful) regarding the target competencies than is possible with conventional types of assessment. Third, because scoring in stealth assessment is automated, teachers do not need to spend so much time calculating scores and grades, thus freeing them up to individualize feedback and learning in other ways. Finally, stealth assessment competency models, once developed and validated, can be reused in other learning or gaming environments with only minor tweaks (e.g., see Sun et al., 2019). Current findings across numerous stealth assessment research reports suggest that stealth assessment a) is a theoretically grounded and psychometrically sound method to assess, support, and investigate learning in technology-rich environments (see Rahimi & Shute, 2023), and b) significantly improves learning (and not at the expense of enjoyment) regardless of gender or ethnicity (see Shute et al., 2020).

In summary, ECD provides the conceptual underpinnings for assessment via various models (e.g., competency, evidence) which are used by the stealth assessment engine to assess and support learning. Moreover, stealth assessment uses both AI technologies (to accumulate evidence and make inferences) and learning analytics (to automatically score in-game actions). Stealth assessment further embeds these ongoing, formative assessments directly into the digital learning environment (e.g., a well-designed game), blurring the distinction between learning and assessment. By interacting with an EVG, students continually produce rich sequences of actions which are captured as data points in log files. The captured data are automatically scored by in-game rubrics (i.e., the evidence identification part of the evidence model) and aggregated in real-time by Bayesian networks (or other statistical models), which show evolving mastery levels on targeted competencies. Stealth assessment is intended to help teachers facilitate learning, in a fun and engaging manner, of educationally valuable skills – many of which are not currently supported in school (e.g., creativity, persistence). By providing integrated and automated assessment tools, teachers are more likely to use the game. Shute, Lu, and Rahimi (2021) provide detailed information about the specific steps needed to develop a stealth assessment.

A simplified example from our own experience may help to illustrate how stealth assessment plays out in the real-world design of EVGs. In a game called *Rusty vs. Radon* (2018), the goal was to address radon (a carcinogenic, colorless, odorless gas found in many homes) education, specifically the need for and process by which homeowners test and remediate their homes for radon. We hypothesized that a game in which middle school students learn about radon, paired with free radon test kits, would result in change agency efforts by the children to get their parents to test for radon in the home (something that is rarely done). We generated radon education objectives and selected those best suited to game play, reserving the rest for more formal education. In the game, students play Rusty, a junkyard robot who performs home inspections with his companion Oz, a cute cartoon worm. Oz can perform instant inspections of plumbing and wiring in homes from the inside, but he is 1000 times more sensitive to radon than humans are, so any exposure to radon levels can make him sick or kill him. Therefore, Rusty has to do the radon testing *first* to determine whether it is safe for Oz to enter the home to complete the inspection. The manner in which he does so (i.e., the observable in-game behaviors feeding the evidence model) must reflect the best practices associated with radon testing and thus the learning principles that underly that process (the competency model).

We developed a stealth assessment approach based on ECD principles. Our game focused on understanding radon, characterized by four principles: radon is invisible, radon is heavier than air, radon can be very dangerous, and radon can be high (or low) in one home and low (or high) in the neighboring home. We used these principles to specify our competency model: always test a house for radon (radon is invisible), always test the basement first (because radon is heavier than air), do not test the first floor if the basement is low (radon is heavier than air), do not expose people to high radon or to homes where the radon is unknown (radon is dangerous), and always test every home (radon can vary from house to house). Our evidence model comprised whether radon testing occurred, which floors were tested, what order each floor was tested, whether Oz was invited into the house, and whether every home was tested. Table 1 presents the optimal and suboptimal sequences that represent various levels of competency.

Table 1. Simplified stealth assessment table for radon testing for a home with high (basement) and low radon (1st floor).

Seq.	Floor Tested 1st	Floor Tested 2nd	Thinking Bonus	Not Tested	Oz to Basement (B)?	Oz to 1st Floor?
1	1	B	-1	–	Yes (-5) No (+5)	Yes (-5) No (+5)
2	1	–	-3	B	Yes (-5) No (0)	Yes (-5) No (+5)
3	B	1	+10	–	Yes (-5) No (+5)	Yes (-5) No (+5)
4	B	–	-5	1	Yes (-5) No (+5)	Yes (-5) No (-5)
5	–	–	-7	B 1	Yes (-10) No (0)	Yes (-10) No (-10)

Summary and Conclusion

Our goal for this chapter was to help you identify the theories and tools you will need and the challenges you will face as part of an educational game design team. We described how play theory, situated cognition and learning, authentic learning, and the literature on problem solving are necessary for instructional designers who want to develop EVGs. We then described how ECD and stealth assessment are critical tools in this endeavor—we encourage you to pursue the additional readings and resources on these topics that we have provided in this chapter. We also alluded to the uniqueness of videogames as a modality and of the culture and language of the gaming community, which leads us to our final advice to you. If you are not yourself a game player, begin playing videogames to become conversant in their language, culture, and features. Start with AAA[2] console (e.g., Sony PlayStation, Xbox Series X) and computer games. You can begin with precursors to today's modern blockbusters (e.g., *Halo*, *Gears of War*, *Call of Duty*, the Tom Clancy series, and *Left for Dead*). Play videogames both as a single player as well as cooperatively to understand how different the experiences can be. Explore MMORPGs like *World of Warcraft*. Then, move forward in time to modern day videogames to see how the technology and game features continue to evolve. Videogames like those in the *Divinity*, *Sacred*, and *Elder Scrolls* series are good intermediary videogames to play before moving on to modern classics such as *Elden Ring* and the Dark Souls series of videogames. You will need a lot of help, so find experienced players who are willing to help guide you. Take advantage of all of the "cheats" and "walkthroughs" and online help you can find. In doing so, you will learn a lot about the social culture, the nature of help and support in

[2] AAA (triple-a") refers to videogames that are produced by major game publishers who have large budgets and are thus able to develop and market complex, high-quality games. AAA games generally have higher popularity, sales, and distrubutions as a result.

videogames (just-in-time, just-for-me, just enough). Pay close attention to the game features like skill trees, which allow you to "invest" game points earned to unlock additional powers and to build a character with specialized powers that reflect your personal style of game play. Learn how videogames allow players to set difficulty levels and how videogames become progressively more challenging (the task model) as player expertise (the competency model) increases. Understand the dynamics of character classes (e.g., magician, barbarian, archer), attributes (e.g., wisdom, intelligence, strength, dexterity), and equipment (e.g., armor, weapons) as well as how the choices you make as a player result in wildly divergent approaches to game play. Finally, learn how economies (e.g., gold, merchants) and reward systems influence behavior and play style during videogames. All of these features have analogs in educational game design if carefully and creatively considered.

Once you have a handle on the core features that are common to most AAA games, we also encourage you to explore other innovative, creative, and unusual games. Games like *The Last of Us*, *Fallout*, and *Hard Rain* are critically acclaimed AAA games that defy convention and tell complex, emotional stories. EVGs like *That Dragon, Cancer*, and *Brukel* use compelling, true stories to create powerful and engaging games about love, grief, family, and history. These kinds of videogames suggest new and innovative game features that have relevance to the design of EVGs.

Well-designed EVGs are a potentially powerful vehicle to support learning, particularly in relation to new competencies not currently embraced by our educational system but needed to succeed in the 21st century. Making effective use of games as a learning modality requires us to understand the nature of play and interactivity, the primary theoretical models that are compatible with videogames, the nature of game play from the player perspective, and the implications for changed design and assessment practices in EVGs. Mastering this knowledge means we are better prepared to navigate the challenges of collaborating with others in the design of good EVGs that are both fun to play AND effective learning modalities. We wish you success in your education videogame design experiences, of course, but remember to play and have fun along the way!

Summary of Key Principles and Practices

1. Good games trigger the play phenomenon in the players.
2. Videogames make extensive use of interactivity which requires instructional designers to have both a personal and professional understanding of videogames.
3. The design of games requires instructional designers to work with multi-disciplinary teams with different values, vocabularies, culture, goals, and design practices.
4. Despite the continual evolution of game technology, core theoretical frameworks remain critical to the design of learning games.
5. There are many kinds of games, each with their own features and characteristics which must be aligned with principles of instructional design in order to take best advantage of the modality.
6. Assessment of learning in games requires a fundamental shift in our thinking about assessment, from responses to external "test questions" to embedded actions and patterns within games.
7. Good games for learning can use the information from ongoing stealth assessments to provide timely and targeted feedback to players and present new game tasks that suit the student's current skill level.
8. Good games for learning, like all good learning activities, should be active, goal-oriented (with goals valued by the players), contextualized, and designed with adaptive challenge and support.

Gaming and Learning: Application Questions

1. Design a non-digital game with everyday objects found in your home, workplace, or classroom (e.g., paper cups, paper clips, ping pong balls, etc.). Ask friends, students or co-workers to play it, then ask them if they think the game is any fun. Ask them for ideas to improve the game. Using any of their ideas, and others you thought of, redesign the game and ask another group of friends to play this new version. Is the game more fun? Try to list or chart out the design process you experienced. Does the game have any value for learning? If not, what is missing?
2. Choose a learning theory that you feel is compatible with games. What kind of videogame do you think it would be most compatible with? Why? What are the design implications of adopting that theory for a given game? Name one example of a specific design element in a game that is compatible with your theory.
3. Identify an instructional outcome at the level of problem solving and try to come up with a narrative description of a game that could promote that outcome. How would you make it situated? Authentic? Where would it take place, who would be involved, and what would it look and feel like?
4. Using the game idea from number three, above, or for another game idea/outcome of your choice, describe an approach to stealth assessment that could be built into that game. Be specific in addressing how it aligns with your learning outcome, how you would measure it, how you could integrate it surreptitiously, and how it could be used for assessment, to modify game performance in some way, or both.
5. If you have not played any/many AAA console games, find a friend or family member who does and ask them to help you get started with a game. Keep a diary of your experiences, describing things like:
    - What is the player experience like?
    - Do you find yourself frustrated while you are learning?
    - How do the features of the game help drive engagement?
    - Which do you see aligning with established instructional design principles and practices?
    - What are the implications for how you approach the design process (i.e., what has to change in your current practice in order to be successful)?

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