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Pedagogical Gamification: Principles of Video Games that Can Enhance Teaching

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Edutainment products have long tried to harness the "fun" quotient of games and video games for education, but the principles of gamification have only recently begun to be better understood and operationalized for business and education. The concepts that underpin successful games can be put to use in online as well as face-to-face classes, resulting in educational experiences that have the best of both worlds: a game-based overlay without becoming too technical. This chapter explains the concepts involved in successful games and provides ideas for translating those principles into practice in the classroom (or online) environment.

The term *gamification* has become increasingly popular, chiefly among businesses that are using the concept with their products. Defined simply, gamification refers to transforming a boring or mundane task into a fun one by applying the principles that make games engaging. By adding elements such as competition between various users, an otherwise-boring process can become interesting, sometimes even addictive. An often-cited example of gamification is the mobile phone application Foursquare, which allows users to "check in" electronically wherever they are. The

resulting data are a bounty for advertisers who buy banners within the Foursquare app to target their messages with much greater precision. After all, by definition they know exactly where their potential customers are at that moment. Users are willing to forfeit their privacy in large part because of the gamelike elements of the application. Whoever checks in to a given location the most often across repeated visits earns the badge of "mayor" of that place, in the process "ousting" the previous mayor. Simple competitiveness drives heavy use, particularly when participants are vying with their real-life friends who use the same app.

As more companies turn to gamification to increase consumer awareness and use of their products, the principles of successful conversion to game-based processes are becoming increasingly well understood. This chapter examines how higher education might benefit from those principles and isolate best practices in gamification that translate well to classroom instruction.

Brief History of Gamification

It has not escaped the attention of educational theorists and instructional designers that consumers like to play games. Some of the earliest types of software in the 1980s were specifically meant to combine education and entertainment holistically (Gustavo, Fung, Mallet, Posel, & Fleiszer, 2008; Whitton, 2011), but "edutainment" products failed to generate as many sales as more traditional games, and the category waned as CD-ROM products were phased out. Software was difficult and expensive to build, and the high barriers to entry kept the playing field relatively lightly populated.

In more recent years, technology has begun to catch up. The rise of social networks and the concomitant explosion in mobile computing coincided with a surge in smaller games. Best-sellers like Angry Birds were not as graphics intensive or as complicated as most PC-based or console-based games, so it was all but inevitable that app-based games proliferated quickly in the smart phone and tablet era. Such games are not as expensive to build as the edutainment titles that were attempted two decades prior, and the tools used to construct games became faster and ever simpler to use, adding yet more incentive for others to build games and saturate the market.

The potent combination of mobile computing and social networks gave rise to a particular kind of social gaming, injecting a new dimension into the gaming experience. Most games of the previous twenty years offered a single-player game at the core of the primary experience: the

player competed against the game itself rather than against other people. That balance shifted with social networks, as can be seen in the success of Facebook games such as FarmVille and Mafia Wars, which rely on the use of other players in cooperative contexts. The console-based video game industry also turned to social gaming, increasingly relying on multiplayer options using the Internet, such as Xbox Live and PlayStation Network.

Ninety-seven percent of American teenagers now play games at least once a week (Lenhart et al., 2008). When examined on a planetary scale, we spend 3 billion hours every week playing games (McGonigal, 2011). Given the groundwork laid by gaming in other facets of life, it is little surprise that augmented reality and game-based learning is poised to increase dramatically in education in the coming years (Johnson, Smith, Willis, Levine, & Haywood, 2011). Indeed, the expectation of many leading theorists is that video games will be, or in some cases should already have been, adopted as a primary learning tool in formal education (Gee, 2003; Kirkley & Kirkley, 2004; Prensky, 2001). It seems likely that students entering college now and in the future will increasingly expect elements of game-based learning to be integrated into the curriculum, rendering gamification a subject of primary relevance for faculty developers.

Five Principles of Gamification

To establish the concepts of gamification means to examine what makes games fun. This is no small task, and there is little agreement among scholars or game creators. Ralph Koster (2004) identifies the brain's unquenchable search for patterns and constant process of selection as the main drivers determining the enjoyability of a given activity, while Rick Raymer (2011) points to rewards as the primer driver of fun.

The lack of agreement makes it difficult to identify with certainty the best practices for using the underlying principles of successful games, with the result that various scales proliferate. McDaniel and Telep (2009) attempt to isolate ten guidelines: use existing resources, ask students to produce, avoid being overly prescriptive, be aware of nonelectronic options, focus on learning rather than technology, provide lead-up and debriefing, embrace interdisciplinarity, use games seriously in other contexts, use virtual worlds, and playtest often. Sarah Smith-Robbins (2011) points to a goal, obstacles, and collaboration or competition as the main ingredients of a game. Michele Dickey (2005) identifies clear tasks, constant feedback, and advancing levels of challenge as crucial to

gamification. However, many of the categories that scholars have created can be combined, giving rise to fewer overall principles. This study narrows the field to five principles of gamification:

- ○ Display progress.
- ○ Maximize competition.
- ○ Calibrate difficulty carefully.
- ○ Provide diversions.
- ○ Employ narrative elements.

Display Progress

Games of all stripes share a common core of progression toward a task, from leveling up to simply advancing through different stages. Without progress, an activity would be monotonous, the very opposite of fun. As Gee (2009) points out, players who have a personal stake in the goal are more motivated to complete it. Thus, progress must be displayed prominently (Dickey, 2005; Young, 2010). Some games imply progress through the collection of tokens or badges, relying on people's natural inclination to collect and hoard. Such badges should be displayed in a global, highly visible spot.

Badges and progress bars ultimately point to visible rewards. Game designer Rick Raymer (2011) identified two categories of rewards: momentary and persistent. Persistent awards are the progress bar or badge list. Momentary awards may be flashed across the screen only at the moment of success, such as a quick pop-up to congratulate the player on a victory. Rewards can come not only for success but also to acknowledge effort, the better to provide encouragement to players that the game itself is fun to play (Raymer, 2011; Salter, 2011). Finally, rewards can come at regular intervals (after finishing a level, for instance, or collecting five tokens), but can also come randomly so as to keep the gameplay just unpredictable enough that it provides the right level of challenge.

Maximize Competition

Humans may be hard-wired to compete with each other to varying degrees (Smith-Robbins, 2011), and many games rely on that as the bedrock principle. Single-player games certainly exist, but sales figures alone demonstrate that video games with an active multiplayer (or, better yet, online multiplayer) option perform better than single-player games

(Douglas, 2012). If competition is the key to a game's appeal, then players must know how they stack up against other players. Thus, the progress bars and badge lists need to be displayed publicly so that other players can see the progress. In an advanced (automated) system, this is sometimes accomplished with a progress bar that displays a single bar chart graphic. When multiple players compete at the same game, the progress bar concept can be exchanged for a leaderboard that displays names and summary (cumulative) scores.

Calibrate Difficulty Carefully

All games must maintain a delicate balance when it comes to level of complexity and difficulty. A game that is too simple quickly becomes boring. A game that is too difficult leads to player frustration; only the perfect balance, akin to a Goldilocks zone (Gee, 2003; Raymer, 2011), that is, "not too cold and not too hot," will be perceived as rewarding and fun for players.

Difficulty needs to be added in stages. Successful games begin with easy wins and add expectations of developing player skill sets incrementally (Raymer, 2011). The major principle undergirding this gradual ratcheting up of challenges is that of cognitive load. A typical video game might ask players to move three-dimensionally through a particular room, switching armaments and defenses while jumping to avoid enemy fire. The newest task in the list (say, switching to a different sword) becomes reasonable to demand of players only if the other requirements have been previously practiced and honed over time and now can be performed by muscle memory—an application of scaffolding from Vygotsky's (1978) well-known zone of proximal development, which stipulates that each new challenge has to be within reach based on the skills already mastered.

Good games also make use of spaced repetition, a well-understood educational practice in which concepts are introduced early and retested at several intervals over time, each instance deepening the learning and increasing the likelihood of student recall (Allen, Mahler, & Estes, 1969). For example, spaced repetition is the fundamental principle behind the use of flash cards to memorize foreign language terms. Often the employment of incremental increases in difficulty and spaced repetition together manifests itself in the form of "boss levels" that add extra challenge, make use of the most recently added skill, and provide a measure of closure to a chapter in the longer story of the game. Seen in that light, the overall narrative should rightfully be understood as a series of climaxes rather than one large arc with a single crescendo.

Provide Diversions

Popular video games such as the Legend of Zelda series or any Super Mario Brothers title have long understood that players prefer to switch their attention every so often away from the main goal or quest, the same human tendency that leads educational theorists to urge that teachers chunk lectures into smaller segments and provide breaks between them, perhaps to test student comprehension using interactive techniques (Sousa, 2011). In games, this is realized in secondary games (often called mini-games) that have nothing to do with the larger purpose at that moment but may require learning a minor new skill (Sanchez, 2009). Players in a Zelda game, for example, may be asked to master throwing items at targets akin to a carnival midway game, even though the larger Zelda game never again asks the players to repeat that skill. The mini-game provides a break in the action and resets player attention, allowing better focus on the main task. Many companies, including Cisco Systems and Miller Brewing Company (Aldrich, 2007), have started to use mini-games for training purposes.

A similar desire for diversion can make the discovery of hidden items fun. These hidden items (commonly called Easter eggs) are sometimes intentionally planted for players to locate, but usually in out-of-the way places. Knowing to expect Easter eggs, some players venture further afield than strictly required by the normal gameplay, and are rewarded when they discover the hidden items. In this fashion, Easter eggs can be used to reward exploration. Chris Taylor (2000) notes that Easter eggs extend the life of a product, since players want to explore everything. Taken to its furthest extreme, exploration can mean creating multiple pathways to successful completion of the tasks, or even nonlinear elements, which allow players to complete tasks in any order or skip some altogether.

Employ Narrative Elements

While board games usually do not rely on a highly evolved storyline, most video games do (Jensen, 2012), in recognition that human beings react well to narratives, possibly as an evolved trait learned from generations of communication that was necessarily oral in nature. Whatever the origin, research demonstrates that listeners—including college students—recall material better when it is packaged as part of a story (Heath & Heath, 2007).

Any story added to a gamified experience will likely be helpful, but not all stories are equally interesting. Drama is driven primarily by conflict,

so a narrative with a clearly defined central conflict stands the best chance of being perceived as organically interesting to an audience. It may also be worthwhile to think less about a plot than about a mystery—when there are gaps in knowledge and a puzzle to unravel, players become more emotionally engaged. It can be useful to imagine as many details as possible for characters, back stories, and settings before laying out the specifics of the plot.

Caveat to the Five Principles

Note that it is not required to use elements from every category in order to gamify a process or to build a successful game. For instance, there are no narrative elements in older video games such as Pac-Man or newer gamified apps such as Foursquare. Conversely, some successful games eschew competition entirely in favor almost exclusively of narrative, such as the best-selling computer game hit of 1993, Myst, which allowed players to explore a deserted tropical island to uncover a mystery—one presented to the players with no ticking clock and no other players to compete against. The five principles of gamification can be favorably compared to ingredients for cooking that might be assembled in various combinations, in one attempt stressing a single element over all others, and other times omitting one or more ingredients completely. There is no single recipe for successful gamification.

Gamification in Classroom Instruction

There is little agreement about what successful gamification looks like inside a college classroom, and in any event success is likely to be varied by discipline, context, and individual faculty member. To some extent, games have always been an instructional option available to professors. Low-stakes activities that are short term rather than those that persist throughout the term are especially popular choices for serving as ice-breakers for new material or when reviewing before a test (Angelo & Cross, 1993). Television game show formats such as *Jeopardy* and *Super-Password* seem to lend themselves particularly well to this format. Yet the principles of gamification outlined above seem likely to offer the greatest benefit with a sustained game or simulation that extends across several weeks or perhaps the entire term.

Although the principles of gamification have become better understood, technology has not yet advanced far enough for simple digital games to be built by amateurs for "short" purposes such as a course

(Raymer, 2011; Smith-Robbins, 2011). Constructing even a rudimentary game as an app or a browser-based activity, such as a Flash game, requires many hours of programming in advanced computer languages and remains an expensive proposition not commonly undertaken for individual courses. Nor do learning management software (LMS) solutions like Blackboard or Desire2Learn come with built-in functionality to construct games. A more recent LMS, Canvas by Instructure, does promise easier integration with outside companies, applications, and websites using Learning Tool Integration (allowing one-click linking of courses with external games). While such integrations may make it easier to create and link to diversions such as mini-games, there is no comprehensive solution to contextualize whole modules or an entire course under a single game structure.

The lack of easy gamification solutions does not have to translate to abandoning the idea until technology catches up. Many attempts at gamification of college instruction can make use of workarounds and low-tech solutions to provide a game-based framework. It is feasible to include game elements on a purely face-to-face basis inside the physical classroom and to record progress with low-tech methods such as paper and pencil, but to realize maximum gains from a semester-long game simulation, instructors are likely to harness the tools of an LMS to serve as the repository of game elements, including both the activities and the long-term tracking of student progress. A gamified class might look like a regular LMS presence plus a few external garnishes such as lists of badges or a leaderboard on the home page. Many of the game elements would be integrated into the fabric of the assignments and readings themselves. In other words, many tasks might remain the same, but the contexts around them, as well as the students' motivation for completing them, would be altered. It is perhaps most accurate to conceptualize pedagogical gamification as a process rather than a product. It provides a means of thinking about organizing the various activities and rewards of the class (many of them already present in the curriculum) into a coherent schema of rewards first promised and then delivered.

The first principle of gamification, the need to track progress, offers an example of how gamification leverages existing tools and functionality to new purposes. Progress is acknowledged in ways both momentary and persistent. Momentary rewards are an easy match for the LMS in the form of self-grading quizzes, perhaps set so that students can retake the assessment as often as necessary until they obtain a perfect score. Similarly, embedded games (such as Flash games created locally, online, or using third-party software) promise autonomous feedback to students

immediately. Persistent tracking of progress is much harder to automate. It is here that tech-savvy instructors with knowledge of programming sometimes attempt to craft applications that will automatically record, tally, and display progress such as badges earned by individual students. For everyone else, the lack of automation seems daunting and all but insurmountable. Would most professors want to add to their workloads by attempting to track badges manually and spend time placing each one individually on a digital leaderboard? Yet employing a few tried-and-true pedagogical methods brings the workload to a more manageable level. Just as representative student work can sometimes replace the need to read and grade every last student submission, so too can badges by individual students stand in for a wider group. If students are organized into groups, only one of them needs to perform the task to earn the badge for the entire group, and the instructor's workload is reduced significantly.

The second principle of gamification, competition, has been around in many educational contexts for decades. When college classes are small enough and the topic of discussion warrants it, many faculty reach for a competitive activity as an outgrowth of the regular curriculum (Angelo & Cross, 1993), which can be as simple as dividing the class in half and using the whiteboard for quick quizzes, drawing games, or practice solving problems. But a semester-long competition calls for a more robust tracking system than tally marks on the whiteboard. The heart of competition is public approbation and the reward or shame that accompanies one's performance displayed to the world (Young, 2010), so a leaderboard of some sort is normally indicated. However, many countries limit the release of student educational records, including grades. Due to these privacy laws (an example is the Family Educational Rights and Privacy Act in the United States), the leaderboard cannot display the results of material that was required of students and counts for a grade. That leaves optional assignments as the only source material for the publicly visible badges. In this case, the assignments to earn badges are likely to be value-added types of activities that deepen learning rather than provide the initial instruction. Examples could include discussion board posts about TED videos, performing online research about a related but ancillary topic, or creating a video using an online tool such as Animoto or Xtranormal.

An alternative method could be to keep the tracking of badges private and visible only to each student using an online grade book. While this has the advantage that regular (required) course content could then be included in the items that earn a badge, it has the disadvantage that

students lack the spark of competition. In fact, there is no functional difference between a privacy-enabled leaderboard and the existing LMS grade book in a course otherwise lacking gamification elements.

No matter the reporting mechanisms, it is crucial to have some visible reward structure in place because students are likely to react with maximal enthusiasm if there is something at stake beyond simple bragging rights in winning the competition (Gee, 2009). Due to privacy laws, awarding points toward the semester total seems contraindicated if the leaderboard is public, but a college instructor has other rewards available. Perhaps students in the winning group might be permitted to drop their lowest (individual) test grades or could be allowed to skip the final exam and use their chapter test average as a replacement.

Putting together these elements—badges for optional assignments, a nongrade reward for the winning group, and the need for a leaderboard—implies some manual processes that the faculty member will have to perform. Although strategies can be employed to minimize the number of badges awarded each week, absent an advanced program or app to automate the process, the instructor will have to manually update the leaderboard on the LMS with the newest scores or badges. Careful choices in the construction of groups and numbers of available badges can limit the additional workload on the faculty member.

The advice to ratchet up the difficulty in careful, measured ways corresponds with good pedagogical practice for any course, even without gamification (McClarty, Orr, Frey, Dolan, Vassileva, & McVay, 2012). Students always realize a psychological boost when they notch an early win that promotes positive associations with the course material and their potential mastery of it (Salter, 2011), but the logic in providing an early assessment designed to be easy, even rewarding, is more compelling still when the course has been gamified and students are expected to engage more than usual. Similarly, the directive to add skills only one at a time is well known to educational theory in the form of scaffolding, since learners require a context around new concepts and a foundation on which to build (Ambrose, Bridges, DiPietro, Lovett, & Norman, 2010). Yet it may not been enough to simply trust in the process of typical course design; more can be done to ensure success by mapping the skills and activities across the semester onto individual game elements and decisions, so that the rollout of skills and tests is more deliberate. In his discussion of brain-based learning, Sousa (2011) noted that educators should strive for an optimal level of anxiety in a classroom—neither so simple that it is boring nor so difficult that it induces anxiety, and the same is true of balance in game elements.

What qualifies as an appropriate diversion for a gamified class is subject to considerable debate (Taylor, 2000). At a simple level, strategies designed to encourage and reward exploration satisfy the basic definition of diversion toward gamification, such as links to optional content that support and deepen the main learning objectives (TED talks or other videos are common in this regard) or Easter eggs in the form of humorous floating captions (contained in the ALT text of the HTML code) for images embedded with the reading. Small, targeted activities, often Flash-based games and widgets, offer a close analogy to mini-games that are used to great effect in video games. Some large individual institutions keep a team of programmers on staff to create such games, either customized by course or easily populated with course-specific material by the instructor. Similar games can be found in off-the-shelf software developed for this purpose (Wondershare, Hot Potatoes), as well as many websites (Quizboxes.com, Quizlet.com, Purposegames.com). Experience suggests that students are less likely to engage in optional activities if they must click a link to access them, so whenever practical, it is better to embed mini-games directly amid the required content. At the high end of the range of diversions is the concept of nonlinear progress toward course goals, in which participants have a number of possible pathways toward the same outcome, or sometimes toward one of several possible outcomes, similar to Choose Your Own Adventure books (McDaniel, Fiore, & Nicholson, 2010). Configuring a nonlinear game scenario increases the complexity of the instructor's task considerably and may be best implemented when a custom game interface and automated tracking can be programmed for the course so that manual processes are kept to a minimum.

In the hands of an experienced storyteller, narrative-based instruction increases both listener attention and later ability to recall details (Heath & Heath, 2007; Sanchez, 2009). To some extent, all instruction can include narratives to draw learner interest, but the benefit is magnified when introduced in a course with other elements of gamification. Rather than separate narratives with no apparent connection to each other, a single narrative that spans a longer block of time, perhaps even the entire term, provides the greatest benefit to a gamified class. All other elements, from mini-games and badges, to leaderboards and Easter eggs, achieve integration only when placed in the larger frame narrative that provides both context and structure.

At the heart of a narrative is a central conflict, but instructors looking to introduce a central story to their classes might profitably think first about a high-concept description, as if provided in an elevator pitch.

A memorable hook will increase retention of the narrative (Heath & Heath, 2007). One effective way to craft the story line could be to explore alternate time lines, such as starting in the middle of the action to generate interest in both backstories and future outcomes. When inventing a narrative, faculty members might consider the basic Aristotelian structure of setup, buildup, and payoff. The individual diction choices within the course, such as introducing assignments and tasks, might also serve the narrative, such as referring to objectives as "quests" or whatever is appropriate to the chosen context.

Role of Faculty Development Centers

Faculty developers interested in introducing gamification to their faculty audiences might start with workshops explaining the principles of gamification and providing model courses that have been gamified. Faculty developers serve many roles (Lewis, 1996), but one of the most urgent functions they fulfill is to provide solutions to instructional problems, often by employing creative workarounds (Wager, 2006). Faculty members may well wish to cultivate strategies that convert high-tech game concepts into low-tech solutions.

Teaching centers may also play a part in helping faculty with improving the overall appearance and production values of the gamified course, so that students experience more than mere words in the game. The principles behind gamification could theoretically be applied to a purely text-based environment. Indeed, early computer games were strictly text based. However, there are no more text-only games for sale today, for the simple reason that consumers prefer a rich visual interface when that is an option. Accordingly, gamified college courses should do what is feasible to provide visual reinforcement. Games and game elements do not need to feature rich (and expensive) custom graphics, but neither should they be strictly text based. A simple shift to image-heavy presentation would help, and teaching centers can provide support for faculty needing to make such a shift, such as pointing faculty to royalty-free images from Creative-Commons websites and the means using HTML to embed images natively.

Next Steps

While gamification offers significant promise for enhancing the educational experience, it is not yet an experimentally proven strategy, and research is needed to ascertain its basic efficacy. In particular, it would be

useful to identify which specific variables separate success from failure. Are all five principles of gamification equally central to success, or are some indispensable, while others merely add to the richness of the experience without being fundamental to it? For instance, if narrative elements are not crucial to the success of gamification, do they nonetheless intensify the experience to a sufficient degree that students learn better, as measured by the class assessments, when compared to a class that contains the other gamified elements but lacks the narrative component?

It will also be necessary to expand the vision for possible gamified operations, such as developing alternate methods to deploy competition and leaderboard tracking within an LMS. As technology advances, it seems likely that software will someday soon make the granting and tracking of badges into a fully automated process. At that point the texture of the gameplay will change, possibly throwing into sharp relief which of the principles of gamification are most vital to success and lead to new questions about how best to structure them into a course design.

An approach that privileges technology, however, misses the point that the principles of gamification can be made more or less electronic, depending on instructor time and preference. Gaming theory appears to be optimized for digital delivery, and indeed this is how it is most commonly consumed by today's students, yet it actually comprises well-established best practices in teaching merely imported into a digital context. The degree to which those practices remain digital or are recaptured for an analog (face-to-face) delivery is subject to each instructor's design preferences, and certainly further study is warranted to determine if an optimal mixture can be ascertained.

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