Gamification: Implications for Curricular Design

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The search for an answer to the question of how to teach inexperienced physicians while protecting patient safety has led medical educators to become creative and innovative in designing curricula. One place where educators are looking for answers is video gaming.

In 2009, video games earned $10 billion with an estimated 1 out of 3 households nationally playing video games. More than half of all gamers are adults 18 to 49 years old.[1] Kevin Kruse, author of *We: How to Increase Performance and Profits through Full Engagement* writes, "Game design indeed has broad utility for learning and development . . . and for motivating at-work behaviors."[2] The process of adapting aspects of games to traditionally nongame-related activities is called *gamification*. Is gamification the answer? This article will explore the effect of gamification on curricular design.

In 1997, the US Department of Defense invested in gamification to solve parallel problems: how to train soldiers while protecting them and reducing injuries. The Advanced Distributed Learning Initiative for military training was developed. During the development process, the US Department of Defense studied more than 6400 military trainees, showing the effectiveness of the initiative in multiple areas, including a 20% higher confidence in trainees' ability to translate information to training-related tasks compared with traditional training methods, an 11% increase in knowledge recall, a 14% increase in procedural knowledge, and a 9% greater retention of knowledge.[2]

Gamification includes 3 main elements: abstraction, mechanics, and interfaces. First, gamification abstracts real world scenarios into a series of challenges. Abstraction simplifies those challenges, allowing learners/players to concentrate on learning specific tasks or skills sequentially. Learners/players can then build on each individual skill toward greater complexity, and learn to combine individually mastered skills into more complex series or sets of skills that can further be combined to create larger movements or patterns. This allows a learner/player to avoid learning complex skills or skills sets before mastery of any particular skill has occurred. As an example, we can think about abstracting the sport of basketball. A player needs to learn individual skills like dribbling a ball, shooting a ball, and passing a ball before putting those individual skills together to play a game.

Second, gamification involves designing mechanics. Games use a system of challenges that become progressively more difficult. Each challenge brings the learner/player closer to accomplishing an overall objective or goal. The design of mechanics includes development of an evaluation and assessment process to judge mastery of a skill before progressing to the next level; a mechanism to give the gamer positive and negative feedback, which enhances confidence in the skills acquired; and encouragement for learning new skills. The mechanics of a game are the sets of rules and feedback loops that govern a learner's/player's progression toward completion of the objective.

Third, game interfaces are designed to invite ongoing participation. The purpose is to promote engagement and to create a sense of fun. Without interfaces that create excitement and a sense of fun, a learner/player would not be compelled to continue playing a game despite hardships, obstacles, and frustration.

The 3 core elements can offer solutions to some of the challenges of competency-based medical education as outlined by the Next Accreditation System, which emphasizes the use of the educational Milestones and entrustable professional activities. First, medical education requires long hours of intense training, putting learners at risk for burnout. Learners may perceive those long hours as mandated service rather than productive educational time, which may impede their professional development. An interface that invites learners to voluntarily choose those long hours by making them fun could reduce learners' perception of the burden. Second, the move toward competency-based curricula requires a system of "game mechanics" to assess learners' abilities to perform various tasks, while progressing through higher levels of complex skills as learners achieve certain Milestones and perform certain entrustable professional activities. Third, the most important solution that gamification may provide is the abstraction of the highly complex task of "taking care of patients" into a series of digestible skills and core competencies.

To better understand the benefits and pitfalls of gamification in curricular design, it is helpful to analyze early attempts at gamification. Several studies have shown a

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strong link between video game use and improved technical skills for procedures.[2] Just as video games can simulate real life, simulation laboratories, or simlabs for short, seek to replicate real life to teach procedures. In their simplest incarnations, simlabs use mannequins instead of patients to allow learners to practice invasive skills while avoiding the patient safety concerns of practicing on real patients.

One example involves residents visiting the simlab for brief sessions to learn how to perform a thoracentesis. After the session, the residents are "checked off" as being able to perform the procedure and allowed to progress to real patients. In this incarnation, simlabs succeed in the abstraction of complex tasks. Simlabs simplify the evaluation and management of pleural effusion into a single task, thoracentesis, and further simplify this task into digestible sets of skills (eg, locating anatomic landmarks on a mannequin, inserting a needle). Unfortunately, procedure-based simlabs often limit the use of 2 crucial components of gamification: game mechanics that allow progressively more complex skills to be introduced based on a systematic feedback system that evaluates the competency of learners and a game interface that creates a continuously engaging environment (ie, that is "fun").

In another example, residents are introduced to mock codes where they demonstrate basic life support and advanced cardiovascular life support. A variation on mock codes introduces an interdisciplinary and interprofessional team, including respiratory therapists, pharmacists, and nurses, to teach team dynamics. Some programs may concentrate on purchasing advanced technology that includes high-fidelity mannequins that respond in physiologically appropriate ways to different interventions. Optimal application of these learning tools may call for added elements of gamification. Although high-fidelity mannequins enhance the interface, they do not directly address consistent game mechanics. As they engage in self-limited exercises, learners are not challenged to become progressively better at a task before progressing to a more difficult one. Moreover, mock codes can introduce concepts that are not simplified or abstracted enough to teach specific skills, on which a learner can subsequently build, leading to muddled learning objectives.

Another example of gamification is the development of an online game to teach medical knowledge. In 1 intervention, medical students were introduced to a series of progressively difficult questions, with the goal of having them complete all sets of questions,[3] repeating questions answered incorrectly before being able to progress to more difficult questions. Old questions are retired, and new ones are introduced until all questions are completed correctly. Each student's progress is displayed on a leader board to encourage competition. In this example, we see fairly well-developed game mechanics that have defined feedback systems to progress to more difficult levels, but we also see limited abstraction of tasks and limited attention to an interface that encourages "fun." Even with these limitations, this program was able to show improvement in educational outcomes, showing the potential for gamification in medical education.

These examples of early attempts have not been able to completely integrate all 3 elements of gamification. This may explain the mixed results encountered. In a systematic review by Randel et al,[4] which examined 68 studies that compared the effect of games on student performance compared with traditional classroom instruction, 32% showed that games improved performance, whereas 52% showed no difference. Research is needed to answer a number of critical questions. First, is the presence of all 3 core elements of gamification necessary for it to be consistently effective? Second, is 1 element of gamification more important than another? Third, is gamification more beneficial to learners of particular types or at particular levels? Finally, is gamification an effective model for medical education?

Gamification that includes the complete set of the core elements is used in other domains of education, becoming a popular and successful platform on the web. Lumosity.com is developed and marketed as a way to "challenge your brain" with "scientifically designed games." It combines an interface that is fun, game mechanics that allow learners/players to track progress, and abstraction of complex cognitive tasks into a series of simpler skills. It has proven very popular, with more than 50 million users, as well as effective with studies showing improvement in several cognitive functions among older users.[5] Another model of gamification is Khan Academy, developed by Salman Khan, with its mission to "provide a free, world-class education for anyone."[6] Khan Academy uses clearly defined game mechanics, abstraction of skills, and an interface that is fun and interactive. It has more than 10 million users and includes more than 5000 lessons covering subjects as diverse as math, science, economics, finance, history, and art, and it is available in 28 languages.

Gamification does not have to replace traditional methods of teaching: Traditional teaching methods can be improved by incorporating core ideas used in gamification. A lecture series that is based on progressively complex concepts can benefit from gamification's focus on abstraction of complex tasks and game mechanics that introduce progressively more difficult levels of "play." Small group exercises can benefit from a thoughtful approach to the interface to make learning more fun and engaging. Combining fun with competition can allow learners to tolerate failure rather than be discouraged by progressive challenges.

A curriculum designed using principles of gamification holds the promise of solving another great challenge of curricular design: How do you sustain a learner's interest to practice without becoming bored or burning out? Malcolm Gladwell popularized the theory that it takes 10 000 hours of practice to develop expertise in complex tasks.[7] The amount of practice required to develop expertise is well within reach with gamification. In a speech for Ted Talks, Jane McGonigal cited research that an average young person voluntarily spent 10 000 hours playing video games by the age of 21. Moreover, at least 5 million people in the United States spend an average of 40 hours a week voluntarily playing video games.[8]

This suggests gamification has great potential to serve as a curricular design template to meet the demands of patient safety in training, to limit burnout in learners, and to fulfill the promise of competency-based education.

References

1 Entertainment Software Rating Board. Video Game Industry Statistics. http://www.esrb.org/about/video-game-industry-statistics.jsp. Accessed October 26, 2013.
2 Kapp KM. *The Gamification of Learning and Instruction: Game-Based Methods and Strategies for Training and Education*. San Francisco, CA: Pfeiffer; 2012.
3 Kerfoot BP, Baker H, Pangaro L, Agarwal K, Taffet G, Mechaber AJ, et al. An online spaced-education game to teach and assess medical students: a multi-institutional prospective trial. *Acad Med*. 2012;87(10):1443–1449.
4 Randel JM, Morris BA, Wetzel CD, Whitehill BV. The effectiveness of games for educational purposes: a review of recent research. *Simulat Gaming*. 1992;23(3):261–276.
5 Luminosity. The human cognition project. http://www.lumosity.com/about and www.lumosity.com/hcp/research/bibliography. Accessed December 25, 2013.
6 Khan Academy. http://www.khanacademy.org. Accessed December 25, 2013.
7 Ericsson KA, Krampe RT, Clemens Tesch-Romer C. The role of deliberate practice in the acquisition of expert performance. *Psychol Rev*. 1993;100(3):363–406.
8 TED Conferences. We spend 3 billion hours a week as a planet playing videogames: is it worth it? how could it be more worth it? http://www.ted.com/conversations/44/we_spend_3_billion_hours_a_wee.html. Accessed November 5, 2013.