Gamification in Education

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Abstract: Gamification in education is an up and coming idea. This paper will look at what gamification is and the effects of gamification on student motivation, homework, and assessment. Intrinsic and extrinsic motivation is discussed and the effects gamification has on both types. Learners use intrinsic motivation when first completing a gamified lesson, however, some learners turned their motivation to extrinsic motivation after a period of time. The future of gamification in e-learning is also, although brief, discussed.

What is Gamification?

Gamification is when game design elements (e.g. points, leader boards, and badges) are used in non-game contexts to promote user engagement (Attali & Arieli-Attali, 2015).   According to engagement alliance (2015), gamification leverages game design, loyalty program design, and behavioral economics to create the optimal context for behavior change and successful outcomes. Gamification can also be used for the purpose of improving user engagement and instruction (Kim, 2015).

In gamification, instructors usually don't give out experience points (points students can earn as they play) and decide that's all you're going to do. There are rules to follow when you want to gamify a lesson, project, or idea. For instance, rewards can be delivered through leader boards, badges, and loyalty programs that encourage students to have fun and perform a learning activity (Villagrasa, Fonseca, Redondo, & Duran, 2014). Gamification isn't just about playing games; it's also about making sure the students are motivated to complete the tasks. Students need the feeling of accomplishment and success of striving against a challenge (Villagrasa, Fonseca, Redondo, & Duran, 2014).

To create a gamification system that increases student motivation, it is necessary to focus on fundamental elements that make videogames appealing to their players (Dominguez, et al., 2013). Gamification applies characteristics of video games, such as game mechanics and game dynamics to non-game applications (Buckley & Doyle, 2014). Game mechanics are tools, techniques, and widgets that are used as building blocks of gamifying a website or application (Game Mechanics, 2010). There are many different types of game mechanics that can be added to help increase student engagement during game-based learning. According to the Gamification Wiki (2010), some of the game mechanics that can be used are achievements, bonuses, community collaboration, infinite game play, and levels. Achievements are ways players can bring attention to what they have accomplished. Bonuses are rewards after completing a challenge. Community collaboration is when the entire playing community works together to solve a problem. Infinite game play is when the game the player is playing doesn't have an end to it. Levels are when   players, after completing certain requirements, 'level up' in the game and unlock new challenges and achievements.

Effects of Gamification in the Classroom

Gamification in the classroom is still a trending topic of discussion. When people hear 'gamification', they're thinking that students are playing video games in the classroom. However, it's just the opposite. Gamification is applying game elements to non-game contexts (Hanus & Fox, 2015) and most companies (50%) predict that they will gamify at least one aspect of their workplace by 2015 (Hanus & Fox, 2015). Even though gamification is a trending topic, there are definite effects on different aspects of the classroom. Game playing is

associated with trial, error, failure and eventual success through practice, experience, reflection and learning (Buckley & Doyle, 2014).

Student Motivation and Engagement

Student motivation is always something to keep in mind when planning your lessons, as a teacher. If students aren't motivated, then they won't learn the content. By applying gamification to the classroom, students could be motivated to learn in new ways or enjoy otherwise tedious tasks (Hanus & Fox, 2015). Two main categories of motivation are intrinsic and extrinsic. Intrinsic motivation is when learners are interested in what they learn and in the learning process itself (Buckley & Doyle, 2014). Extrinsic motivation is learners engage in learning because it is a means to an end, relatively disassociated from the content and subject of learning (Buckley & Doyle, 2014). Depending on how gamification is used, it can either increase or decrease motivation. The ultimate goal when gamifying is to increase intrinsic motivation. Buckley and Doyle (2014) identify three types of intrinsic motivation (p. 4) which include intrinsic motivation to know (the desire to perform a learning activity for the pleasure one experiences while learning), intrinsic motivation towards accomplishment (desire to engage in an activity for the pleasure and satisfaction experienced when accomplishing a difficult feat), and intrinsic motivation to experience simulation (engages in an activity to be stimulated).

Buckley and Doyle (2014) also identified three types of extrinsic motivation which include external regulation (behaviors performed to satisfy an external demand), introjected regulation (activities are performed to attain ego enhancements or avoid guilt), and regulation through identification (identity is linked with an externally proscribed behavior and he/she performs an action to instantiate that identity).

The study consisted of using a decision-making system for groups called a PM (Buckley & Doyle, 2014). A PM, according to Buckley & Doyle (2012), *is "designed and run for the primary purpose of mining and aggregating information scattered among traders and subsequently using this information in the form of market values in order to make predictions about specific future events [Tziralis & Tatsiopoulos, 2007, p.75]. Conceptually, PM's create group forecasts by allowing participants to buy and sell contracts in uncertain, future events. In the simplest form of a PM, a contract is created whose value depends on a future uncertain event (pg 6)."*

Students are to buy or sell contracts depending on whether they feel the contract will be completed on time. Students receive €100 **(virtual currency)** if the contract is fulfilled on time, and €0 if it's not completed on time. The more the contract is bought, the higher the contract price goes. The value of the contract is based on future uncertain events (Buckley & Doyle, 2014). If students believe the contract will be fulfilled on time, they will buy the contract. However, if students think the contract won't be fulfilled, they will sell the contract.

Students buy and sell contracts based on whether they think it will be completed. They use the PM as their main source of information and provide students with a variety of gamification design pieces. The PM, according to Buckley and Doyle (2014), provides continuous feedback; leader board/rankings based on the value of their portfolios, and have objective rules (p. 6). The students are learning about taxation and a PM is utilized. Students started with €5000 virtual cash and they used this to invest in outcome they considered most likely for each research question (Buckley & Doyle, 2014).

Buckley and Doyle (2012), in their summary of their study, that their research demonstrates a number of important points which guide the deployment of online gamified learning interventions and suggest further research in the area (pg. 11). They go on to say that,

> First, online gamified learning interventions have a positive impact on learning outcomes. While this is coveted by the acknowledged limitations of this study and the fact that positive results require careful design to ensure that the learning activities prompted a gamification are tied to learning outcomes, this study nevertheless presents a positive picture of the utility of gamification. This study positions gamification as a powerful tool for educators teaching at all levels within the education system.

Hanus and Fox (2015) also conducted a study about student motivation and engagement. They state that the increased social comparison, competition, and reward systems might have detrimental effects over the long term for students' motivation, satisfaction, enjoyment, and engagement with class material (Hanus & Fox, 2015). Their

study is meant to address the effects of educational gamification in a real world setting over time (Hanus & Fox, 2015). Hanus and Fox (2015) recruited 80 students in two separate classes of the same course taught by one of the authors and gathered data at four separate times (Time 0, Time 1, Time 2, and Time 3) over the course of a 16 week semester (p 155). The classes were broken up into a gamified course that required participation, badge completion, and engagement with an online leader board, and a non-gamified course (Hanus & Fox, 2015). Both courses featured the same material, assignments, exams and lectures and they measured motivational and psychological variables as well as behavioral variables (Hanus & Fox, 2015). They conducted their study as a longitudinal study to assess how these gamification elements affected student satisfaction, motivation, enjoyment, empowerment to learn and grades over time (Hanus & Fox, 2015).

What Hanus and Fox (2015) found was that students from each course started out at the same levels of intrinsic motivation, satisfaction, effort, social comparison, and empowerment, over time students in the gamified course tended to decrease in motivation, satisfaction, and empowerment relative to the non-gamified course (p 159). They also found that the effect of course type on students' final exam scores was mediated by their levels of intrinsic motivation where students in the gamified class tended to be less intrinsically motivated at Time 3, which caused lower final exam scores (Hanus & Fox, 2015).

Issues impacting game-based learning

Ulicsak, Facer, and Sandford (2007) also conducted a study of game-based learning in secondary education. In their study, teachers chose one of the three pre-selected COTS computer games and were then responsible for determining exactly how, when, and which students would use the games, for planning schemes of work and assessment criteria and for managing all classroom activities (Ulicsak, Facer, & Sandford, 2007). Teachers were free to change or stop using the game at any time if they felt it was inappropriate for their teaching (Ulicsak, Facer, & Sandford, 2007). The games the teachers were to select from were Sims 2, Roller Coaster Tycoon 3, and Knights of Honor.

Ulicsak, Facer, and Sandford (2007) also state that all three games were often referred to as 'god games' because the players control the entire environment (p 2). According to Ulicsak, Facer, & Sandford (2007), 4 secondary schools participated in the study which had the diversity of both rural and urban settings, and were part of both private and state sectors. Three teachers from each school volunteered to participate in the study. The curriculum consisted of competency, French, English, Physics, Design & Technology, and Math. Data collected included semi-structured interviews conducted at the start and end, All emails between teachers and with researchers and all contributions to the wiki, all lesson plans, schemes of work and supporting material generated, teachers' final reports on activity, and Field notes from researchers and 2 student research groups.

What the researchers found was that teachers working with a 'competency based' curriculum were confident that they could use the games relatively easy within their teaching practice (Ulicsak, Facer, & Sandford, 2007). Teachers that focused on 'soft skills' tended to work with the game in a way that demonstrated a high degree of fidelity to the original games narrative and played the whole game (Ulicsak, Facer, & Sandford, 2007). The teachers working in a content-based curriculum environment tended to disaggregate elements of the game, using only parts of it for their teaching activity (Ulicsak, Facer, & Sandford, 2007). In their study, Ulicsak, Facer, and Sandford (2007) saw that teachers were required to extract elements of games to meet their educational needs, or reconfigure their educational objectives in order to enable games fidelity (p 7). This raises the question of whether, in our current educational climate and curricular and assessment contexts, the incorporation of COTS games for learning (rather than the design of bespoke and appropriate games) makes either economic or educational sense for the majority of teachers (Ulicsak, Facer, & Sandford, 2007).

Gamification and homework

Gamification can be implemented, not only in the classroom, but into homework as well. One of the key facets of video game design is player engagement (Goehle, 2013). Goehle (2013) also states that there is a relationship between good game design and creating a good learning environment (p. 234). Goehle's study is how to integrate ideas from video game design into an online homework program (p. 235).

According to Goehle (2013), details of the study consist of adding 2 gamification mechanics to online homework, it was implemented into 2 sections of a standard 16-week Calculus I course which has 60 students. The ultimate goal was to increase the amount of positive reinforcement in their homework system and increase the students' sense of growth and progression throughout the course as well as to increase students' engagement with their homework (Goehle, 2013). The primary activity will be solving mathematics problems with video game elements playing a secondary role in the activity (Goehle, 2013). Levels, Experience points and achievements will be used throughout the course. WeBWorK will be used to access the homework and to provide a notification system to keep students up to date on when they level up, gain an achievement (positive reinforcement), and scores on the homework submitted. Students get 5 XP for every homework problem they get correct; every level earns students extra credit on their homework scores, and after a student gains a level, the number of correct answers needed to achieve the next level increases (Goehle, 2013).

Within WebWork, a separate page was implemented which gave the students all of the information needed to see their current level, their achievements, as well as their progression towards growth (Goehle, 2013). While students gain achievements through work completion, some achievements require the students to do something extra i.e. Challenger and Persistence is Not Futile achievements (Goehle, 2013).

Some of the examples of achievements students can earn are Perfect 10: Earn 100% on 10 homework problems; The Long Road: Get 100% on 30 homework sets; Challenger: Complete all 10 challenge problems; On One Hand: Finish a homework set with less than 5 incorrect submissions; Persistence is Not Futile: Solve a problem after 10 incorrect submissions; and Night Owl: Finish a homework set between 12pm and 2am. Students were given a survey at the end of the course asking whether they found the achievement system engaging.

Out of those students who responded (29 students), 93% said they kept track of their level and achievements, 89% said they actively tried to earn achievements, more students earned a 90% or above on homework than any other percentage, and students were allowed unlimited number of attempts (Goehle, 2013). The WebWork system is designed so that simply completing 90% of the homework and only earning achievements which require no extra effort will get you approximately 1200 points, or partway through Level 9 (Goehle, 2013). Out of the participants, approximately half the number of students who scored above 90% earned Level 10 and we can also infer that at least half of the students who earned above 90% on their homework were also actively trying to earn achievements (Goehle, 2013). Students felt the system was rewarding them for doing their homework and appreciated the extra acknowledgment (Goehle, 2013).

Gamification and assessment

Do points affect test performance? That is what Attali and Arielli-Attali (2015) wants to find out. They conducted 2 different studies using the same material in both studies. The first study consisted of adults and the second study consisting of middle school students. Participants were encouraged to answer the questions on the assessment as quickly and accurately as possible (Attali & Arieli-Attali, 2015).

Study 1

Participants were recruited from Amazon.com's Mechanical Turk (MTurk) crowd sourcing marketplace, which allows researchers to post experiments to be completed by Amazon.com users in return for monetary compensation (Attali & Arieli-Attali, 2015). According to Attali & Arieli-Attali (2015), the study consisted of 1218 participants, ages range from 18-74, who were paid $2 to complete the assignments given and assignments were completed in about 25 minutes on average. Participants were US residents and whose first language was English and were randomly assigned to one of tests as well as one of three points feedback conditions (Attali & Arieli-Attali, 2015). The test items used were based on 'models' which are schemas of problems with parameters that can be instantiated with specific values (Attali & Arieli-Attali, 2015). The assessment used 50 item models with 8 instances from each model which totaled 400 items on the assessment (Attali & Arieli-Attali, 2015). The 400 item assessment was divided into 4 nonoverlapping tests with each assessment having 4 instances from 25 item models (Attali & Arieli-Attali, 2015).

On the assessment, immediate feedback on the correctness of the response together with the correct response was displayed and participants were required to click a button to continue to the next item (Attali & Arieli-Attali, 2015). After each section of the test, a message appeared letting the participants know that they were allowed to take a break if needed and at the end of the test, participants were asked identifying questions i.e. age, sex, and level of education (Attali & Arieli-Attali, 2015). The results were that, overall, items were easy and answered quickly, average percent correct was 77% and the average response time was 7.8 seconds, items in test 1 were less difficult than test 2, and the points manipulation had no effect on accuracy scores and a small effect on the speed of responses (Attali & Arieli-Attali, 2015).

Study 2

Study 2 consisted of middle school students from New Jersey in grades 6-8th grade (Attali & Arieli-Attali, 2015). The assessment items that were used in the first study were also used for this study. Similar to the first study, participants were randomly assigned to their respective groups for the first and second test sessions as well as randomly assigned to one of two points feedback conditions (Attali & Arieli-Attali, 2015). The participants test sessions lasted one class period and were conducted in the computer lab (Attali & Arieli-Attali, 2015).

After the completion of each testing session, students were asked to indicate how much they liked the test compared to other math tests, how much effort did they put into answering the questions, and for students in the points condition whether they liked getting points for their answers (Attali & Arieli-Attali, 2015). The overall results of the assessment were that the point manipulation had no effect on the main performance outcome and response accuracy in both populations (Attali & Arieli-Attali, 2015). However, point manipulation had a significant effect in the second performance outcome and response speed in both populations (Attali & Arieli-Attali, 2015).

Implementation

Gamification can be implemented in many ways. Some ways include Problem-based learning (PBL), Quest-based learning (QBL), and the "Learning by doing" methodology (Villagrasa, Fonseca, Redondo, & Duran, 2014). Problem-based learning begins with a problem or situation and students work collaboratively to solve the problem (Villagrasa, Fonseca, Redondo, & Duran, 2014). Quest-Based Learning, which is a new concept for me, is an instructional design theory that leverages game mechanics and gamer-like learning communities to support students. (Villagrasa, Fonseca, Redondo, & Duran, 2014). Quest-Based learning incorporates game mechanics and game-like learning communities into the lesson (Villagrasa, Fonseca, Redondo, & Duran, 2014). Learning by doing is applied in which students pursue a goal by practicing target skills and using relevant content knowledge to help them achieve their goal (Villagrasa, Fonseca, Redondo, & Duran, 2014). Complete this paragraph with synthesizing comments about implementation. What do readers need to understand from these teaching methods?

Conclusion

Gamification in education and e-learning is still considered an emerging technology. Studies have shown that when you look at intrinsic and extrinsic motivation using gamification, that learners mostly participate in gamification because of intrinsic motivation. However, some learners transitioned from using intrinsic motivation to extrinsic motivation due to the types of game mechanics used in the gamified environment.

Future of Gamification in E-learning

What is the future of gamification in e-learning? According to John Laskaris (2014), at Fortune 500 firms, 73.6 percent of technology-delivered training comes through networked, online methods, corporations can save up to 70% by replacing traditional training with eLearning (IOMA 2002), over 18,000,000 college students are taking at least one of their classes online and by 2019 half of all classes will be done online. He also goes onto state that, "*eLearning is a $56.2 billion industry. By 2015, this will grow into a $107 billion market which makes it the fastest growing market in the education industry.*"

So how can gamification improve learning for corporations? Learners remember 10% of what they read and 20% of what they hear (Laskaris, 2014). If there are visuals accompanying an oral presentation, then the number rises to 30% (Laskaris, 2014). If learners observe someone carrying out an action while explaining it, then

the learners remember 50% (Laskaris, 2014). However, if learners do the job themselves, even if only a simulation, then they remember 90% of what they learned (Laskaris, 2014).

Incorporating gamification into e-learning would be helpful especially when it could help learners remember 90% of what they have learned. Even though gamification is still an emerging technology, corporations can use simulations to help relate skills learned to the real world.

References

Attali, Y., & Arieli-Attali, M. (2015). Gamification in assessment: Do points affect test performance? *Computers & Education, 83*(April 2015), 57-63.

Buckley, P., & Doyle, E. (2014). Gamification and student motivation. *Interactive Learning Environments*, 1-14. doi:10.1080/10494820.2014.964263

Dominguez, A., Saenz-de-Nacarrete, J., de-Marcos, L., Fernandez-Sanz, L., Pages, C., & Martinez-Herraiz, J.-J. (2013). Gamifying learning experiences: Practical implications and outcomes. *Computers & Education, 63*(April 2013), 380-392.

Game Mechanics. (2010). Retrieved March 29, 2015, from Gamification.org: https://badgeville.com/wiki/Game_Mechanics

Goehle, G. (2013). Gamification and Web-based Homework. *PRIMUS: Problems, Resources, and Issues in Mathematics Undergraduate Studies, 23*(3), 234-246. doi:10.1080/10511970.2012.736451

Hanus, M. D., & Fox, J. (2015). Assessing the effects of gamification in the classroom: A longitudinal study on instrinsic motivation, social comparison, satisfaction, effort, and academic performance. *Computers & Education, 80*(Jan 2015), 152-161.

Kim, B. (2015, Feb/Mar). Designing Gamification in the Right Way. *Library Technology Reports, 51*(2), 29-35.

Laskaris, J. (2014, July 30). *30 facts about gamification in elearning*. Retrieved April 29, 2015, from eLearning Industry: http://elearningindustry.com/30-facts-gamification-in-elearning

Ulicsak, M., Facer, K., & Sandford, R. (2007). Issues impacting games-based learning in formal secondary education. *Advanced Technology for Learning, 4*(4), 212-217.

Villagrasa, S., Fonseca, D., Redondo, E., & Duran, J. (2014, October-December). Teaching case of gamification and visual technologies for education. *Journal of Cases on Information Technology, 16*(4), 38-57.

What is gamification. (2015). Retrieved April 29, 2015, from engagement alliance: http://engagementalliance.org/what-is-gamification/