Classroom Gamification: Merging Game Design Theory and Behavior Analysis for Increased Engagement

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Abstract. Many instructors have added gamification to the classroom with the intention of increasing student engagement to promote student achievement. Gamification is a process by which non-game activities are designed to be more like a game. Thus far, the implemented designs of classroom gamification are influenced by methods used in video games such as earning points, badges, and advancing to new levels. These techniques have demonstrated some success in increasing student engagement at various age levels; we believe there is more to explore in order to maximize classroom participation and retention of academic information. This is an introductory paper that explores video game design theory through the lens of behavior analysis with the intention of utilizing game design to increase student engagement in the college classroom. We designed a gamified classroom by implementing video game design theory, then had the model critiqued by a professional behavior analyst using a behavior analytic framework. With the inclusion of behavior analytic research and video game design theory, our goal with this paper is to analyze classroom engagement of college age neurotypical students who are attending a gamified classroom. Additionally, we will provide suggestions for modifying existing instructional strategies to support the creation of gamified classrooms.

Keywords: Classroom gamification · Game design · Behavior analysis
Engagement

1 Introduction

Utilizing different teaching methods and the use of incentives to increase student engagement is not a new concept. Gabriela Kiryakova, professor of Economics at Trakia University states, "Teachers have to use different teaching methods and approaches that allow students to be active participants with strong motivation and engagement to their own learning" [1]. The key is engagement; interest in being an active participant in an educational setting varies greatly from student to student.

P. Zaphiris and A. Ioannou (Eds.): LCT 2018, LNCS 10925, pp. 150–163, 2018.
https://doi.org/10.1007/978-3-319-91152-6_12

Implementing different techniques to motivate students to take an active part in their learning can be a struggle. Typically, the sorts of incentives employed to motivate students are reward-based incentives. Common examples of reward-based incentives for younger students include honor roles, gold stars, and pizza for reading [2]. We intend to expand on the concept of reward-based systems by utilizing game design to increase student engagement in the college classroom. The designs will be critiqued by a professional behavior analyst using a behavior analytic framework. By combining game design and behavior modification principles we hope to improve on the current understanding of a gamified classroom and design better versions of gamification currently being used in school systems.

As a case study, the designs will be applied to a college level course at Purdue University Fort Wayne. Even though our test case is a college classroom we believe the principles will work for all levels of education. Our hypothesis is that student intrinsic motivation will increase by engaging students to actively participate in their education. Down the line, with habit and reinforcement, the students will have inspiration for learning rather than an apathetic response noticed by middle school and high school teachers. The outcome of our classroom case study will not be mentioned in this paper. The semester is currently ongoing and we have several weeks before our data can be collected. Once our targeted class is completed, we will compare student achievement data from our gamified Information Systems class to a non-gamified Information Systems class with similar demographics.

2 What is Gamification?

The definition of gamification has many variations; one of the most common explanations is from KM Kapp in 2012. Kapp defines gamification as, "using game-based mechanics, aesthetics and game thinking to engage people, motivate action, promote learning, and solve problems" [3]. Another variation for the definition of gamification comes from Marczewki, "Gamification is the use of game metaphors, game elements and ideas in a context different from that of the games in order to increase motivation and commitment, and to influence user behavior" [4]. Both definitions have similar meaning and focus on the same concepts: game mechanics, increasing motivation, and influencing behavior. Although similar, an important distinction is the acknowledgment of a context that differs from games.

Gamification occupies areas outside of actual gameplay in non-game contexts [5]. Common areas where gamification is employed are business, marketing, education, and even the military. Andreas Lieberoth, from Aarhus University states, "Gamification techniques are intended to leverage people's natural desires for socializing, learning, mastery, competition, achievement, status, self-expression, altruism, or closure, or simply their response to the framing of a situation as game or play" [7]. An important distinction, especially for unconvinced observers, is that adding gamification to something does not condense everything down into a game, reduce the importance, or eliminate any work associated. Kevin Werback, founder of Supernova Group and professor of Legal Studies and Business Ethics at the University of Pennsylvania, sums up the sentiment perfectly, "Gamification does not mean turning all business into a

game, any more than innovation turns it into an R&D lab or Six Sigma turns it into a factory production line" [5]. The intention of implementing gamification is to supplement rather than detract. Developing full-on games is not the intent, using the attributes that drive engagement, behavior changes, and inspiring skill development is the intent [9].

Concerning an educational setting, gamification is designed to incentivize active student participation in the learning process, sustaining engagement through the students' increasing sense of accomplishment [6]. The focus is not about playing games; more importantly, it is making sure students have a feeling of success and accomplishment when faced with challenges [8]. The feeling of success will lead to the motivation to continue completing assigned tasks.

3 Designing Classroom Gamification

Our design for the gamified classroom is built from game design principles with the intent to increase student engagement. Not all gamified classrooms are designed the same. Differences will be based on the age of students and type of desired goals. In *A Practioner's Guide to Gamification of Education*, Wendy Hsin-Yuan Huang mentions that there are six common pain points in education. The pain points are, "Focus; Motivation; Skills; Pride; Physical, Mental, and Emotional Factors; and Learning Environment & Nature of the Course" [12]. Our gamification designs have the intention to ease these common pain points. Admittedly, gamification will not alleviate all of the pain points simply and elegantly, but we can take what we know about game design and motivate students to be more engaged in the classroom.

With the multitude of student personality types, gamification cannot hope to be a one size fits all solution. For example, some students may feel like gamification detracts from learning. In addition to students who may not see the benefit of gamification, other factors could lead to reduced performance within a gamified classroom. Micheal Hanus talks about students with performance anxiety by stating, "students with performance anxiety may be overly pressured by some gamification methods" [13]. Hanus' point is valid; students with anxiety could experience additional stress within a gamified classroom. However, Hanus continues by stating, "or they may benefit from the distraction" [13].

In order to determine the features of our gamified classroom, we must consider the course topic and student makeup of the targeted class. Our understanding of the class content and demographic drives the specific gaming elements of our gamified classroom. The topic of our targeted course is Information Systems; the classroom contains neurotypical college students within their freshman or sophomore year. A mix of on-campus and online students make up the class.

3.1 Our Design Overview

Students enrolled in an Information Systems college-level course have been given the opportunity to participate in our gamified classroom. The class is made up of 14 students; 10 of the students will attend class on-campus, while four students attend the

class online. Students earn experience points, spendable points, and achievements based on activities in the class. Turning in assignments, grades earned on the midterm and final exams, and participating in honor assignments are examples of the events that will award students within the gamified setting.

We intend to increase the students' intrinsic and extrinsic motivations for classroom work. Self-motivated learners have intrinsic motivation, and they find interest and satisfaction in what they learn [15]. Intrinsic motivation is related to the work of Jean Piaget, "when individuals experience discrepancy between their experienced knowledge of the world and their private, internally held knowledge, they are driven to eliminate this discrepancy" [16].

Learners who engage because it is a means to an end have extrinsic motivation [15]. Students only motivated by extrinsic motivation may not care what they are learning, and they may not commit new learning to long-term memory. Extrinsic motivation relates to the work of B.F. Skinner, who stressed, "the provision of rewards to direct and control learning behavior" [17].

Our goal is to inspire students to increase engagement through extrinsic motivation. Through habit and reinforcement, extrinsic motivation may transform into intrinsic motivation for the students, positively influencing their educational experiences and outcomes. Listed below is an overview of the elements that we deemed essential to inform our gamification design. Implementing these elements should help increase the motivation of students and increase engagement. In the Design Specifics section, we will go into more detail regarding how we applied these elements.

- Student Agency
- Leveling Systems
- Earning Experience Points
- Loss of Experience Points
- Earning Spendable Points
- Spendable Point Uses
- Performance Feedback

3.2 Design Specifics

In this section, we will give more specific detail on how the classroom gamification is implemented and how it applies to the students.

Student Agency. Agency is an essential element of game design; players should be able to make meaningful decisions about their actions [10]. In this case of a gamified classroom, we needed to ensure that students were given choices to mirror the experiences found in gameplay. A standard classroom curriculum experience is a linear path. Students are typically given tasks in a particular order and graded on performance. In the book, *The Art of Game Design: A Book of Lenses*, Jesse Schell uses the comparison, "The author of a book or screenplay is designing a linear experience" [11]. Moving down a predetermined path can be immersive; reading a book or watching a movie pulls the user into the experience. However, when given choices, the user has ownership of his or her actions and places a higher value on the experience. Shaun Gallagher writes, "In the normal experience of voluntary or willed action, the sense of

agency and the sense of ownership coincide and are indistinguishable" [18]. Within a classroom setting, students told what tasks to perform will not have the same levels of engagement or enthusiasm as a student who has optional paths to learn the same material.

Earning Experience Points. Experience point values are intentionally set at a fraction of the letter grade point values. Student letter grades are based on a 1000 points. The gamified experience point rank value has a max of 66 points. The main reason we chose a small value for the rank points is to ensure that students could not confuse the rank points earned for gamification with their actual letter grade. Additionally, the number of experience points are valued higher because there are few to earn.

At the end of each week, the amount of experience points earned by the student indicates which rank the student has reached. Benefits are granted based on the rank achieved. For more detail on the ranking system, see the Leveling System section.

Opportunities to Earn Experience Points. Students earn experience points in a variety of different ways. The majority of the points are earned by completing assignments and performance on exams. The experience point value system is determined by the assignments assigned each week within the course syllabus. Aside from assignments, attendance is another way to gain experience points. Below are descriptions and experience point breakdowns for each way to earn experience points.

- **Chapter Connections** - An online discussion board assignment is based on the chapter assigned from the textbook. Chapter Connections are one of the assignments that give the student the ability to earn extra experience points. Three experience points are earned with a post to the discussion board and a meaningful response to another students post. Thirty total points can be earned if the student completes all Chapter Connections assigned during the semester. The student can earn one additional experience point by posting other meaningful peer responses. A maximum of two additional experience points can be earned each week from Chapter Connections.
- **Daily Attendance** - Each week the student will earn 0.5 experience points for attending the on-campus class or logging on to the website Blackboard if the student is taking this class online. Sixteen total experience points can be earned.
- **Midterm Exam/Final Exam** - The experience points earned from exams are designed differently than the other assignments. The experience points earned are based on the letter grade students earn on the exams. Ten experience points are given for the letter grade A. Eight experience points are earned for the letter grade B. Six experience points are earned for the letter grade C. No experience points will be awarded for earning the letter grade D or lower on the exams. A total of 20 experience points can be earned from the exams.
- **Honor Labs** - A more challenging lab assignment is an option for the students to earn extra experience points. Honor Labs are only offered three times over the semester. Five experience points are earned if the students decide to complete each of these assignments, for a total possible 15 experience points from Honor Labs.

- **Honor IS Paper** – This is a challenging report option for students to earn extra experience points. The Honor IS Paper is worth five experience points if the student decides to complete this optional assignment.

Honor Labs and Honor IS Paper are challenging assignments that students can choose to complete. Honor assignments are offered four times over the course of the semester. Weeks 3, 11, 12, and 15 contain these optional assignments. Students could choose to complete the normal Lab or IS Paper instead of the Honor assignments, but no gamification points will be applied. When selecting to complete these optional tasks, students are aware that the points earned only count toward the experience level within the classroom gamification data; extra credit is not awarded for the letter grade (Fig. 1).

	Attendance	Chapter Connection	Honor Lab	IS Paper	Exam	Weekly Point Total
Week 1	1					1
Week 2	1	3				4
Week 3	1	3	5			9
Week 4	1	3				4
Week 5	1	3				4
Week 6	1	3				4
Week 7	1	3				4
Week 8	1				10	11
Week 9	1	3				4
Week 10	1	3				4
Week 11	1	3	5			9
Week 12	1			5		6
Week 13	1					1
Week 14	1	3				4
Week 15	1		5			6
Week 16	1				10	11

Fig. 1. A chart for the possible Experience points broken down by week.

Loss of Experience Points: Along with earning experience points, students can lose experience points. The loss of experience points is intended to be a deterrent and inspire students to turn in assignments within the deadline. When looking at the number of experience points that can be earned over the whole semester, the number of points is relatively low. Losing even a small of amount of experience points from the 66 experience points that can be earned will have a strong effect on the rank that can be achieved.

Lengthy design discussion was had regarding how substantial the loss of experience points should be when an assignment is late. We wanted to make sure we had a fair consequence for late assignments. If a consequence is too lenient, students will not be concerned about turning in late assignments, but too harsh of a consequence could increase student stress levels and the quality of work could suffer.

- **Late policy design for gamification points** - Late assignments will reduce the Experience Points gained for that week. The design is based on the late policy stated in the syllabus. A two weekday limit is enforced for turning in late work. One point will be lost for the first 24 h. An additional point will be lost for the second 24 h period. No points will be awarded if an assignment is turned in after the second day.

The Leveling System. A leveling system is in place to give students extrinsic motivation. At the end of each week, the experience points earned will be calculated and the student will receive a rank. The leveling system is based on an organizational business chart. Ranks that can be obtained by the students are listed by order of importance: CEO, General Manager, Manager, and Assistant Manager.

The experience points will be calculated from Week 1, but the students will not start to get updates until Week 4. The Honor Lab and the Honor IS Paper will not be part of the calculation of the Leveling system. This is done so that it gives the students a choice to work on the harder assignments for experience points. These Honor assignments could provide an extra point boost, primarily if there were a dip in experience points.

The points shown each week are the culmination of the previous week's assignments. At the end of the semester, after the final exam, the students should be given an End of Semester total once the final exam is graded (Fig. 2).

Earning Spendable Points: Each week the students will earn spendable points based on the Rank received from the previous week. Almost like a salary in the workforce the students are given points that can be spent.

- **CEO** earns 5 points
- **General Manager** earns 4 points
- **Manager** earns 3 points
- **Assistant Manager** earns 2 points

Spendable Point Uses. In order to maintain the student's motivation for earning spendable points, we wanted to offer compelling options on which to spend the points.

- **Bragging rights –** Students should feel a sense of accomplishment knowing that they've earned enough points to purchase an item. There is also an opportunity for a sense of goodwill when gifting spendable points to another student.

	Assistant Manager	Manager	General Manager	CEO
Week 4	5	6	7	8 - 9
Week 5	8	9	10 - 11	12 - 13
Week 6	11	12 - 13	14 - 15	16 - 17
Week 7	13 - 14	15 - 16	17 - 18	19 -21
Week 8	16 - 17	18 - 20	21 - 22	23 - 25
Week 9	23 - 26	27 - 30	31 - 33	34 - 36
Week 10	26 - 29	30 - 33	34 - 37	38 - 40
Week 11	28 - 31	33 - 36	37 - 41	42 - 44
Week 12	31 - 35	36 - 41	41 - 45	46 - 48
Week 13	32 - 36	37 - 41	42 - 46	47 - 49
Week 14	33 - 37	38 - 42	43 - 47	48 - 50
Week 15	35 - 40	41 - 45	46 - 50	51 - 54
Week 16	35 - 40	41 - 46	47 - 51	52 - 54
End of Semester	43 - 49	50 - 55	56 - 62	63 - 66

Fig. 2. A chart for the Ranking levels a student could achieve based on the experience points earned each week.

- **Eliminate a question of your choice on the Midterm and or Exam** - A student can elect to spend 20 points to remove a question from the midterm or final exam. This is a high-cost item, and due to the limited amount of spendable points that can be earned, only a few questions can be removed.
- **Choose the song at the beginning of the class –** This is a low-cost, playful way to spend points; a student could spend two points to choose a song to be played at the beginning of class.
- **Remove a Chapter Connection for full credit -** A student can choose to spend 10 points on removing a Chapter Connection assignment. The assignment will be marked as complete, and the student will receive three experience points for completing the Chapter Connection assignment.
- **Gift points to other students** - Students are given the option to be altruistic and donate spendable points to other students.

Achievements. Giving the students something to work toward, aside from the ranks within the leveling system, can be motivating. Acquiring an achievement should feel like an award, something that enhances the student's experience [20]. Achievements are excellent feedback for students because they are little boosts of excitement and recognition. Achievements do not award any additional point values; they are just collectible items. Below is a list of the achievements that can be earned by students.

- First "A" on an assignment
- You made it to the halfway point in the semester
- You earned Manager status
- You earned General Manager status
- You earned CEO status
- You helped a friend by donating points
- Perfect attendance every four weeks
- Perfect attendance all semester

Performance Feedback. Students will be notified of an update with the experience point value, spendable point values, rank, and achievements earned each Monday. The Teachers Assistant (TA) will send the student updates via email. This will give the students a consistent summary of their point progress and will address the out-of- sight out-of-mind problem sometimes associated with online classes. Rapid feedback is important for the students; the update allows students to see how their actions directly translate [19].

From a game design perspective, we would like to display a leaderboard that shows the progress of the students. However, due to the IRB and Purdue University Fort Wayne's policy, we will be unable to display a public leaderboard with anything that could indicate student classroom performance, even if the student names are coded.

Students will not get updates on ranks until week 4 in order to give them the ability to settle in to the classroom before adding potential pressures with ranks and where the student may fall on the organizational chart that week. We do not want the students to fail at the beginning [14]; it can discourage students and lead to a lack of engagement. Within the update emails sent by the TA starting on Week 4, the students will see the point values earned and be notified of which rank level they are currently positioned, and if there have been any achievements earned.

4 Critique of the Gamified Classroom Using a Behavior Analytic Framework

Applied behavior analysis is defined by the Behavior Analyst Certification Board as "a systematic approach for influencing socially important behavior through the identification of reliably related environmental variables and the production of behavior change techniques that make use of those findings" [21]. Applied behavior analysis (ABA) emerged from B.F. Skinner's experimental research and original discoveries of the effects of environmental consequences on operant behavior, and has continued to develop and expand into many facets of human behavior. Current areas of research and

applied behavior analytic work include gambling and addiction, gerontology, education, organizational management and currently most prolifically, autism treatment. Operant behavior, the impetus of behavior analysis, is the behavior of organisms that is controlled by its consequences. According to Staddon and Ceruitti, "The term (operant) was coined by B.F. Skinner in the context of reflex physiology to differentiate what he was interested in – behavior that affects the environment - from the reflex related subject matter of the Pavlovians" [22]. Skinner stated in his book *The behavior of organisms*, "In both operant conditioning and the evolutionary selection of behavior characteristics, consequences alter future probability. … Operants grow strong because they are followed by important consequences in the life of the individual" [23].

The relationship between gamification and ABA has only recently emerged, nonetheless, behavior scientists have found value in the systematic arrangements of video games for decades. In his 1984 article, "The Shame of the American Education", Skinner stated "The fascination of video games is adequate proof…that successful action is automatically reinforced. What would industrialists not give to see their workers as absorbed in their work as young people in a video arcade? What would teachers not give to see their students applying themselves with the same eagerness? But there is no mystery; it is all a matter of schedules of reinforcements" [24]. It is the goal of this author to assess the classroom gamification model presented within this paper and describe the components based on the principles defined within behavior analysis, as well as contribute to recommendations for the gamified classroom model in future applications.

4.1 Game Playing Versus the Game

Game Playing as a Dependent Variable. Murry Sidman stated, "A functional relationship is said to be established when changes in the dependent variable are due to systematic changes in the independent variable, rather than to changes in any uncontrolled extraneous variables" [25]. The goal of a gamified classroom is to arrange an environment that successfully produces desired learner behavior. Morford, Witts, Killingsworth and Alavosius stated "We distinguish game-playing (as a class of behavior) from a game. We define the latter as the environmental system with which a player interacts (i.e., the contingency arrangement) that serves to bring about game-playing" [26]. Game playing is considered a response class, as distinct from an individual response, because of the many unique behaviors that occur while playing a game, all of which achieve the same reinforcing outcome. According to Baer, "A response class consists of behaviors that are topographically different but functionally similar in that they are maintained by the same reinforcing consequences" [27]. Student participation and engagement within the gamified classroom are response classes, and serve as the dependent variable of interest within this model.

Behavioral responses defined, observed and measured within the gamified classroom include; attending class or logging in for online students, turning in individual assignments, providing a quality reply to a peer's post on a discussion board, and completing an honor assignment. Only one item described within the classroom arrangement, receiving a specific grade on a mid-term or final, does not meet the definition of the dependent variable. This item is an outcome, or consequence, for an

undefined and unmeasurable group of behavioral responses within the gamified classroom.

Game Playing as an Independent Variable. The independent variable presented within behavior analytic research is the intervention, or changes made to the environmental contingencies, that affect the dependent variable. Johnston and Pennypacker (1980) stated, "The independent variable must be represented by some environmental event, the physical parameters of which are known, specified and controlled to the extent required. Such a clear description of the independent variable is essential if any factually accurate statement is to issue from the experimental effort" [28]. The components of the independent variable within the gamified classroom system includes providing opportunities for choice making, defining and clarifying expectations, organizing a system for earning points and assigned rankings, arranging contingencies for earning spendable points and exchanging points, and scheduling and providing written feedback.

Reinforcement. According to Cooper, Heron and Heward, reinforcement is the presentation of a stimulus contingent upon a behavioral response which increases the future likelihood of that response [29]. An example of stimuli scheduled for delivery following a behavioral response within the classroom are experience points. Experience points lead to an assigned ranking, which in turn earn differing amounts of spendable points. The points are essentially tokens for exchange. According to Doll, McLaughlin, and Baretto, the token economy is a common behavioral intervention that has been demonstrated to be effective for increasing appropriate behavior and decreasing inappropriate behavior [30]. Spendable points are conditioned reinforcers, and have value because they can be exchanged for unconditioned reinforcers, which may have value in and of themselves. The unconditioned reinforcers include bragging rights, the potential to eliminate a question on mid-term or final, the ability to choose the song at the beginning of class, a chance to skip a chapter connection, and the option to gift points to another student.

Additional consequences identified that may increase desired behavior in the classroom include the Easter egg achievements, which are earned unexpectedly contingent on pre-determined responses or milestones. Also considered was the timing of the feedback delivery, or schedule of reinforcement. Feedback is arranged on a fixed-interval schedule of one week, delivered through email and with a weekly posting of rank each Monday.

4.2 Individual Versus Group Reinforcement Contingency

The gamified classroom is designed to improve each individual student's behavior within the class, and the behaviors selected for improvement, criteria and reinforcers remain the same across the entire group of students. Therefore, this design is identified as an independent group contingency. Independent group contingencies can be very effective in producing behavior change, however they also have some limitations. Examples of limitations include a limited pool of reinforcers and the potential to lead to a class system [31]. An additional limitation of the independent group contingency is that each student comes into a classroom with unique set of classroom experiences and behavioral repertoires, and therefore it is likely their behavior within the classroom will

be effected uniquely by the established and inflexible contingencies. Individual experiences, including any prior experiences within games, token economies, or achieving educational success or failure, could impact the outcome for the individual student. According to Freeman and Lattal from West Virginia University, variability in responding…sometimes results in part from historical variables; the expression "history effects" connotes sources of control over present behavior that have not been eliminated by refinements of…contingencies and thus confound the obtained functional relations between responding and proximal contingencies" [32]. Students can not be separated from their experiences, and therefore variability across student participation and engagement is expected.

5 Recommendations and Conclusion

Prior to the beginning of the class, it is recommended the teacher gather information from the students regarding what would motivate them within the classroom. Preference assessments can increase the likelihood there is a reinforcer available for each individual student, and eliminate some of the concerns associated with independent group contingencies. It is recommended that all consequences should be made contingent on defined behavior, and therefore an earned grade having an effect on points gained would be removed. Additionally, it would be worth exploring the influence of the teacher as a more active participant in the design execution, and if the teacher's involvement in a more direct and active way could improve student participation in the classroom.

The efficacy of the various elements in a gamified classroom can be debated. Experience points, ranks, spendable points, and achievements can be helpful or a detriment based on the students preference for learning. That being said, we firmly believe that student agency is the most important element to a gamified classroom, and, more importantly, to all of education. Creating optional assignments that teach the same content in different ways is a great challenge. Yet, it is worth rising to the challenge, especially when attempting to create and sustain student engagement. Luckily, not every assignment needs to have choice. We implemented student agency four times through the whole semester.

Many aspects of behavior analytic principles are present within the design of our gamified classroom, most notably, the application of reinforcement, which can have lasting effects and lead to an increase in engagement, participation and learning. Increased engagement should promote improved overall learning outcomes, as measured by academic achievement demonstrated through course grades. Students who participated in the gamified classroom should show higher achievement than similar students in a non-gamified Information Systems class.

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