Abstract

Gamification is an incentive system that is under-studied and not truly understood. In this study, an online interface is used to measure the effects of gamification on the engagement and collaboration efforts of high school physics students, in preparation for a final exam. The ideas of engagement and collaboration are quantified for the purposes of measurement. The results show that gamification is a highly complex incentive that has contrasting consequences on long and short-term objectives.

Introduction

Incentive schemes increase motivation and engagement in an organization by relating compensation to productivity. They may also reduce turnover among good performers and are cost-effective due to savings that result from productivity improvements. Management usually assumes that money is the best motivating force, but oftentimes, it is the intangible and non-financial motivator that has the greatest impact (Uke and Coker, 2012).

Incentive systems are classified into three types: monetary, or cash, non-monetary tangible, such as restaurant coupons or vacation trips, and non-monetary intangible, like "employee of the week" recognition or positive performance reviews (Condly, 2003). In workplace history, the first two categories of incentives, monetary and non-monetary tangible, have been widely used by management. Non-monetary intangible systems, on the other hand, have been recently researched and tested by organizations. An example of a non-monetary intangible system, employee recognition, is arguably the most effective of all the available incentive systems because it offers a relatively low-cost but high-impact means to reward employees. This recognition could be done by holding annual dinners at which high-achievers or performers are celebrated, or by distributing certificates and gold nameplates for those who have earned them (Ude and Coker, 2012).

Uke and Coker (2012) define motivation, the human force that incentive systems appeal to, as a cognitive decision making process through which goal-directed behavior is initiated, energized, directed, and maintained (Ude and Coker, 2012). Motivation begins with the realization that individuals have needs or expectations that they want to meet, which results in a driving force or behavior to accomplish the desired goals. Motives are usually classified as intrinsic or extrinsic, and create desires that are manifested in goal-oriented behavior, physiological responses, and self-reported feelings. Individuals moved to do something for the sake of the activity itself are said to be intrinsically motivated, while extrinsic motivation manifests in the form of prodding, pressure, rewards, or threats of punishment. Four types of

extrinsic motivation are defined along a control/autonomy continuum: external regulation, introjected regulation, identified regulation, and integrated regulation. External regulation classifies a motive for external rewards or threats of punishment, while introjected regulation classifies a motive driven by internalized feelings of guilt, goodness, or pride that affected self-esteem and internalized by societal norms. Identified regulation classifies a motive based upon the importance of something to the individual, and integrated regulation coincides with a person's internal values and needs (Coleman, 2011).

Gamification is the use of game-play mechanics for non-game applications, and its main goal is to improve the engagement of users by using game-like techniques such as scoreboards and personalized fast feedback to make people feel more ownership and purpose when engaging with tasks. This mode of creating incentives desires to combine intrinsic with extrinsic motivation in order to raise motivation and engagement. Common gamification elements are levels, points, virtual goods, leaderboards and badges, which are all indications of progression (Muntean, 2011).

Gamification and its elements have backing in several psychological lenses. Gamification as a whole is supported by the self-determination perspective, which advocates that controlling and mastering a situation fulfills the key psychological needs for competence, autonomy, and relatedness, because any type of gamer seeks to control and master the game or gamified platform at hand. The specific impacts of badges and levels in a gamification platform can be explained by either the trait perspective, which sees the need for self-fulfillment, recognition, and affiliation as stable sources of motivation, or the cognitive perspective, which states that motivation depends on clear goals and a high value of consequences. Badges and levels achieve all of these needs, working as virtual status symbols, a means of group identification, and a means of setting and achieving short-term goals. Point systems, on the other hand, are based on the behaviorist learning psychological lense, which is centered on the belief that learning and motivation are based on reinforcement and punishment. Gaining or losing points is a form of reinforcement and punishment and is therefore an effective means to motivate, according to behaviorists (Hense).

This purpose of this study was to investigate the effects of gamification on collaboration efforts and engagement of high school students. The experiment sought to answer the following questions: 1) Does the implementation of gamification elements in an online class forum promote student collaboration? 2) Does the implementation of gamification elements in an online

class forum improve the quality of student responses? The hypothesis was that if gamification was used as an incentive, engagement and collaboration levels would increase.

Materials/Methods

In this study, two classes of the same level and with the same teacher were used as test subjects. One class was the experimental group and the other was the control group. The subjects were assigned anonymous user accounts, distinguished only by a code number to maintain anonymity. Each subject was also paired with another subject as a "partner."

Using the iPipal website, the experimenter posted review questions for the New York State physics Regents to all subjects two times a week for 3 weeks. As an incentive to continue visiting the website, the teacher told both groups that if they showed a consistent, decent effort throughout the 3 weeks, 5 points would be added to their lowest test grade. This consistent, decent effort was defined as an average of at least 3 points a week.

In response to the online review question, the students filled in their "Give Help" on iPipal and shared it only with the experimenter, their teacher, and their assigned "partner" (See Figure 1). In the same time period, each student could "review" their partner's post by commenting, with the intention of helping the student improve their response on the next assigned question.

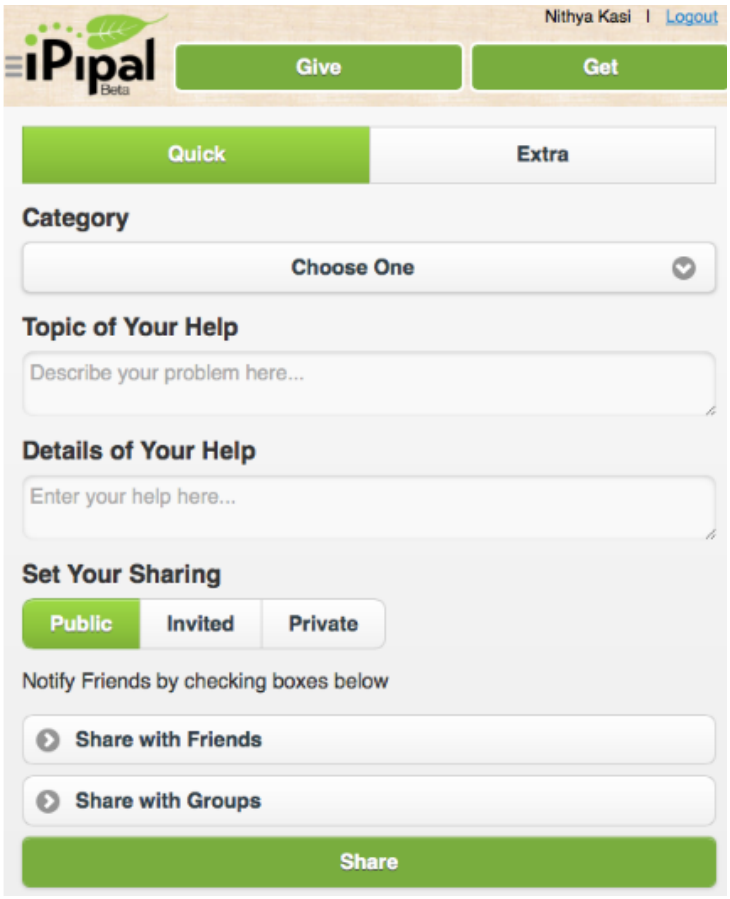

Figure 1: *This image shows the "Give Help" screen.*

The only distinction between the two groups was that the experimental group had gamification elements implemented. Each of the experimental group participants were shown individual point totals on a scoreboard, along with different achievement levels. The student also received private feedback from the experimenter on how they were performing. The control group had no gamification feedback. Engagement was measured as as the number of points the students receive, based on a set of rubrics (See Tables 1-3).

For answer post:

Points	Possible Characteristics
-1	- Inappropriate or irrelevant response
0	- No response
1	- A very minimal response (ex: one word)
2	- Just a link - A very short response (ex: one sentence) - Nothing in the "Extra Help" tab
3	- Just answers the "what" - Simply copied and pasted (word for word) - No analysis or connections - Nothing in the "Extra Help" tab
4	- Detailed - Mostly copied and pasted (word for word), but there is some analysis - Copied and pasted, but not word for word; student attempted to make the answer his/her own - "Extra Help" tab is utilized - Not exemplary (a 5)
5	- Exemplary - Very detailed and analytical - Draws connections to other topics - Includes information from outside sources, but the majority is the student's own thinking - Can include links - Every field is completed, including "Extra Help"

Table 1: *This table is the rubric for the answer post.*

For peer-to-peer feedback:

Points Earned	Possible Characteristics
-1	- Irrelevant or inappropriate feedback
0	- No feedback
1	- Minimal feedback, such as "Good job" or "Ok"
2	- Good feedback, but it is not very detailed - Doesn't highlight both the positives and the negatives
3	- Very helpful, detailed feedback - Highlights the positives and negatives - Constructive criticism

Table 2: *This table shows the rubric for the peer-to-peer feedback.*

For consistent participation:

Participation 2 questions in a row	2 points added to point total
Participation 3 questions in a row	3 points added to point total
Participation 4 questions in a row	4 points added to point total
Participation 5 questions in a row	5 points added to point total
Participation 6 questions in a row	6 points added to point total

Table 3: *This table shows the rubric for consistent participation.*

Data

The mean total number of points (counting 0 points) was slightly higher for the gamification group (3.9 vs. 3.2), but the mean total number of points (not counting 0 points) was higher for the control group (13.8 vs. 9.7),. The median total number of

points (not counting 0 points) was higher for the control group as well (11 vs. 5). However, none of these differences are statistically significant (See Figure 2).

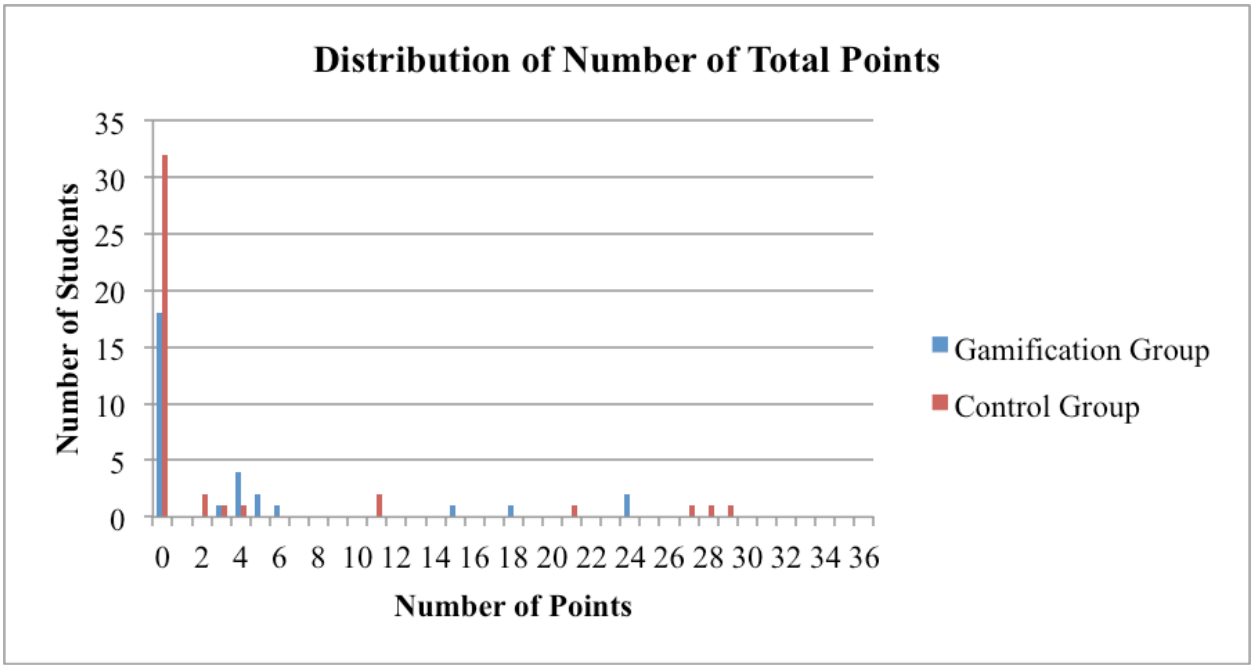

***Figure 2**: The distribution for the control group is wider than that of the gamification group. There is no statistically significant difference in total number of points for the two groups.*

More students responded to at least one question in the gamification group than the control group (40% vs. 24%). This difference was statistically significant (See Figure 3).

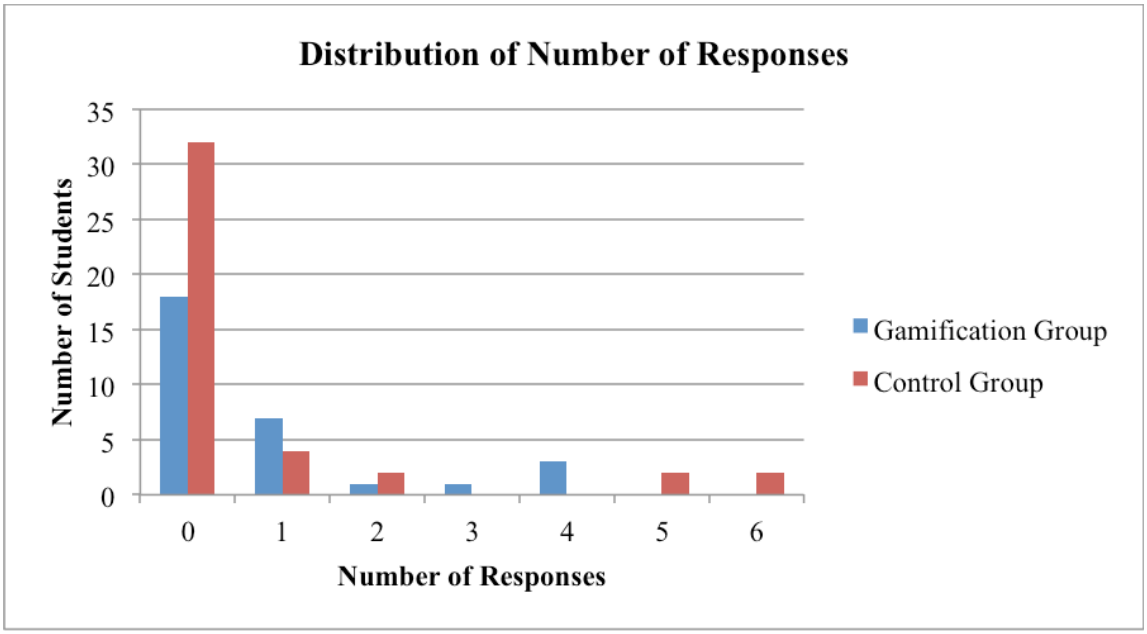

***Figure 3**: More students responded at least once in the gamification group than in the control group. Only in the control group did some students answer all of the questions. This difference is statistically significant.*

The differences in number of responses between groups was minimal and not significant. However, the number of responses in each group over time showed interesting patterns. For the gamification group, the percentage of students who responded to each question decreased steadily with each passing question. The control group also descended overall, but less rapidly and consistently than the gamification group (See Table 4 and Figure 4).

	Gamification	Control
% of Students Who Responded to Question 1	20.0	16.7
% of Students Who Responded to Question 2	16.7	11.9
% of Students Who Responded to Question 3	16.7	9.5
% of Students Who Responded to Question 4	13.3	11.9
% of Students Who Responded to Question 5	6.7	9.5
% of Students Who Responded to Question 6	6.7	11.9

***Table 4:** In the gamification group, the percentage of students who responded decreased steadily with each passing questions. This did not occur to such a noticeable extent in the control group.*

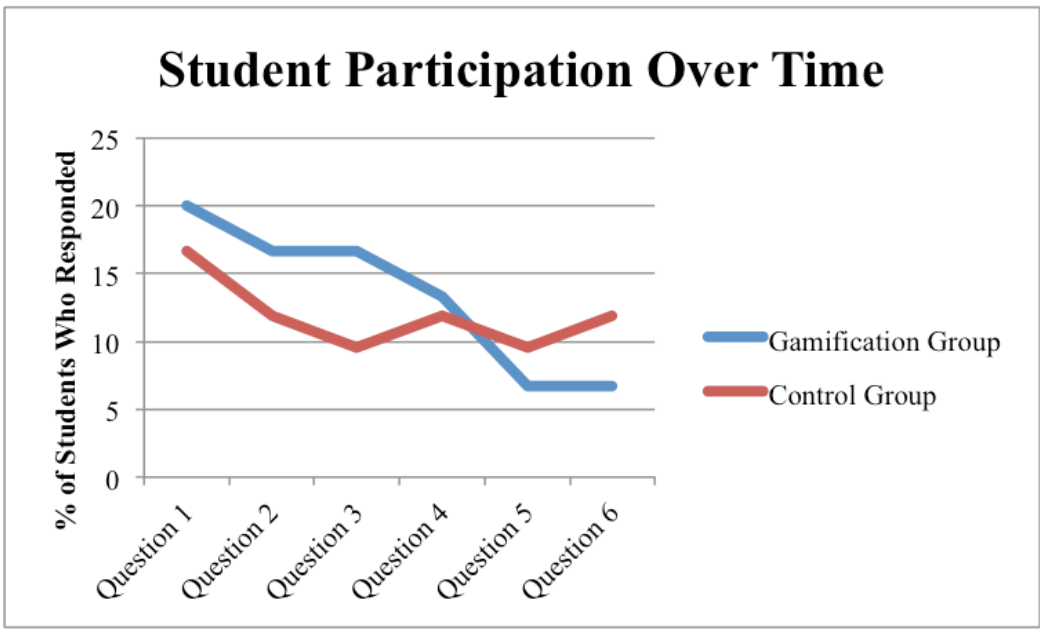

Figure 4: *The gamification group had a more pronounced decline in student participation over time.*

Discussion

The results indicate that gamification provides an initial burst of motivation. However, this motivation does not transfer to the long-term. As seen in Figure 2, a higher percentage of students responded at least once in the gamification group. However, as seen in Table 1, the percentage of students that responded to each question decreased greatly and consistently in the gamification group, with each passing question.

The trends show that the individuals in the gamification group that gave up after the first one or two questions were either at the top of the leaderboard or the bottom. The students at the top may have become overconfident in their ranking, while the students at the bottom may have lost their intrinsic motivation.

There were not as many fluctuations in the trends of the control group. The students in this group that answered the first question had *intrinsic* motivation, and naturally this motivation did not tend to decrease over time. Those who attempted the questions in the beginning had no reason to quit. Gamification, on the other hand, initially gave students a reason to participate, but it also gave them a reason to eventually quit, when their rankings and results were either highly favorable or unfavorable.

There were limitations to this study that could have biased the results, however. While the study was designed to also measure collaboration efforts, none of the participants in the study chose to collaborate with their partner, leaving no data to analyze for that dependent variable. In addition, several students, for the first few questions, answered the questions from a username other than their assigned code number. I could not record their data for this reason, and their responses were ignored. If these students had participated from the proper account, the data could have been slightly different.

Further research needs to be conducted about gamification, perhaps both in schools and in the workplace. There is still limited understanding as to how gamification truly affects the mind, and if scientists can begin to develop a deeper understanding of this, gamification incentives could be used strategically to increase engagement, productivity, and motivation in any context.

Works Cited

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