Using Common Gamification Elements to Enhance Knowledge Sharing: The Effect of Score Keeping Function on Player Performance

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Abstract
Gamification, the use of game design elements in non-game contexts to encourage a desired type of behavior, have become increasingly popular over the last few years. Gamification attempts to harness the motivational power of games, however existing motivational models for video game play focus on how a game as a whole creates experiences of fun and they are not linked to the more granular level of single game pattern [7, 34]. A closer examination of game elements and their role in creating the underlying mechanisms of gamification may provide more insights regarding encouraging of desired type of behavior and participation.

We examine the effects of points and the score keeping function, a commonly elements of gamification, on player's motivation and behavior in an online serious game for crowds. Based on our initial findings we discuss implications and continuance research.

Keywords
Gamification; points; score keeping; motivation; behavior; serious games.

Introduction

“Gamification” is the use of game elements in non-gaming systems to improve user experience and user engagement, loyalty and fun [5, 6, 6, 17, 25]. In recent years gamification systems were applied in marketing [25, 33] as well as non-business contexts such as politics, health [17], or interactive systems [11] and education [17, 28-30]. This rapid development has caught the interest of researchers as a potential to create engaging workplaces [31]; facilitate mass-collaboration [21] or encourage knowledge contribution [16, 33, 39].

Gamification attempts to harness the motivational power of games in order to promote participation, persistence and achievements. Although the motivational appeal of full games has already been discussed [26, 27], it is hard to isolate which game elements may actually affect player motivation, thereby extending only limited carry-over to gamification [24]. This leads to questions about the relationship between game behavior and distinct game design elements. One approach to handle this gap is by examining the effects of separable game design elements [7].

The idea of using game mechanics and dynamics to drive participation and engagement mostly by using extrinsic motivation is worth examination because research suggests that using an extrinsic reward may have a significant negative effect on motivation by undermining free-choice and self-reported interest in the given task [2, 3]. In contrast, a recent study of badge systems suggests that negative aspects are mostly attributable to poor design [1, 2]. Hence ,it is still not clear what effect these mostly extrinsic game mechanics have on intrinsic motivation and how exactly they affect motivation and game behavior, both positively and negatively [2].

Using a serious game for a large user base (crowd), which was developed by IBM, we aim to address the issue of feedback mechanisms with a focus on the relationship between game behavior and accumulated game scores (points).

Related work

Underlying the concept of gamification is motivation. Motivation is demonstrated by an individual’s choice to engage in an activity and the intensity of effort or persistence in that activity [13]. Current approaches concern two dominant clusters that play a role in determining player’s motivation: extrinsic and intrinsic motivation [4, 32]. Gamification combines these two motivations; on one hand using extrinsic rewards such as levels, points, badges to improve engagement while striving to raise feelings of achieving mastery, autonomy, sense of belonging [25].

Games contain elements designed to deliver information to the player as part of an ongoing motivational process. One of the most commonly used patterns of feedback in games is accumulation of points. Points play a role in making games motivational, challenging and engaging [15, 41]. By earning points the player gets information about his/her performance, and incremental success in the game is thus encouraged to continue playing [20, 40]. Points are used as a scoring system, a progression indicator, a scale of rank, a goal setting tool or even as a currency [12, 13, 22, 36, 37]. Points encourage mastery of the game [10]. Comparing players along quantitative measurements provokes competition which eventually results in a change of players' status [12, 18, 19] and increasing replay value [11, 23]. Current rank and the number of points remaining for the next rank drive the player to earn more points in order to reach the next level [37]. Thom, Millen and DiMicco [35] show that removal of a points-based incentive system made a significant negative impact on players' activity, and led to reduced overall participation.

Hacker and Von Ahn [15] create an additional motivation for the present research outlining the role of scoring function in making games more enjoyable as this can add excitement by creating an artificial ladder from which players can fall if they make a mistake. A closer examination on implementation of points and different score keeping functions to enhance user performance may provide insights regarding desired type of behavior and participation. This issue is highly relevant to gamification designers, as these elements are applied to a broad spectrum of non-game contexts [24].

In line with previous works on the effects of points and score functions on user behavior [8, 9, 24, 35, 37-39] we frame the following hypotheses:
H1: *Points significantly increase performance compared to the control condition (no points)*
H2: Different score keeping functions (linear vs. exponential) yield different patterns of performance.

Experiment

In order to investigate the effect of score keeping function on player motivation and behavior we implemented an online experiment. A total of 16 students (7 male, 7 female, 2 not specified) were asked to play 3 games containing 3-4 questions each. Players were asked to enter as many relevant responses regarding the specific question within one minute before the question changed. The independent variable was points. All students participated in a control condition with no points and then proceeded to participate in two conditions with points based on linear and exponential functions, respectively. The dependent variables were: players' performance, number of items, and cheating behavior, i.e. writing down meaningless items in order to earn points.

In the control condition (no points) players got a feedback message without accumulating points. In the points conditions, players got feedback messages and earned points for each item they had entered. Points had no further meaning, other than describing how many items a player had entered. Players earned points based on either a linear function (3 points for each item) or an exponential function ($y=6e^x$). Players were presented their current score on the right-hand side of the screen (Figure 1), and on the leaderboard at the end of the game. Performance was measured by monitoring the number of items generated per game, per question and per player.

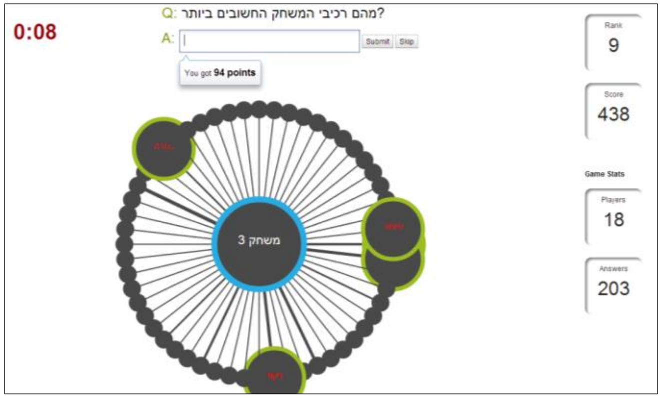

Figure 1: A screenshot from the game with the score displayed in the upper right corner.

Results

In order to test the hypotheses, Friedman's test (a nonparametric repeated measures ANOVA) was calculated unless otherwise stated.

Data preparation

For each player we count the number of items mentioned per question, number of questions answered, number of quality items contributed. We checked whether points had an effect on quality. We found that there was no cheating behavior, all the answers were relevant. We examine the results at the game, question and player levels.

The game produced 136 items in the no points condition, 271 items in the linear score function condition and 231 items in the exponential score function. Table 1 summarizes the descriptive statistics of the number of responses per question in each condition.

	Control (no points)	Linear score keeping function	Exponential score keeping function
Mean	45.33	67.75	77.00
Median	47.00	67.00	72.00
Mode	34[a]	53[a]	70[a]
SD	10.60	13.33	10.44
Skewness	-.69	.27	1.66

[a] Multiple modes exist. The smallest value is shown

Table1. Means and standard deviations of the number of responses per question for all conditions

A Friedman's test revealed a marginally significant effect of type of function on performance ($\chi^2(2) = 6.00$, $p = .05$).

Figure 2 illustrates performance per question over all experimental conditions

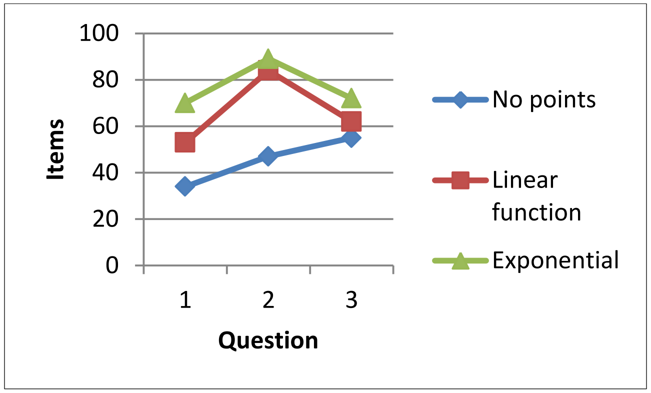

Figure2. Number of items (replies) per question over the course of a game (3 questions)

The distribution of the number of items per player showed some interesting differences. In the control (no points) condition only 1 player (6%) came up with more than 20 items in game, while in the points condition, linear and exponential functions, 6 (37.5%) or 4 (25%) players respectively came up with more than 20 items each. Moreover, Friedman's test results yield a statistically significant difference in players' performance depending on type of function condition($\chi^2(2) = 17.16$, $p < .001$). Wilcoxon signed-rank tests post hoc analysis showed a statistically significant difference in number of items per player in the no points condition vs. linear function condition (Z = -3.52, $p < .001$), and between the no points and the exponential function conditions (Z = -2.15, $p < .05$). Players earning points generated significantly more items than players in the control condition (no points) (M_{Linear}=16.38, SD_{Linear}=8.42, $M_{Exponential}$=13.25, $SD_{Exponential}$=9.96, M=8.13, SD=4.76) respectively. No statistically significant difference was found between linear and exponential score keeping functions (Z = -1.58, p = .115). In contrast to our expectations, no significant effect of score function on players' performance was found. Players in the exponential score keeping function condition generated items at the same level as players in the linear control condition. H2 could thus not be confirmed.

Conclusions and Future Work

In this study we address the issue of feedback mechanisms with a focus on the relationship between game behavior and accumulated game scores (points). While points did motivate participants to enter more items, the kind of score keeping function did not seem to be important. Points prompted more items from players probably due to their functioning as feedback. Using points increases motivation by providing a clear connection between effort in the game, performance and outcomes [39].

This pilot study indicates that the game rapidly collects large volumes of valid information using points as incentive for participation as was already tested in an early version of the game [14]. Moreover, in this study performance was measured by the amount of items entered per player. We plan to introduce a new dependent variable for the amount of time player spent on the task per item, as according to von Ahn and Dabbish, the amount (i.e., the number of items generated per human-hour) and the overall time spent on the task determine whether the gamification of a human computation task was successful [39]. Preliminary results from a second study will be presented in the conference.

Finally, by looking into the component of games and implementing them in different non-game contexts, we may gain a deeper understanding of how gamification works. Understanding game scores promises to offer interesting implications in various fields such as business, knowledge sharing, game design, collaborative design environments and education.

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