

Gamification – An Empirical Study

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ABSTRACT

Using game design elements in non-game contexts is an established concept. Gamification is all about improving actual user engagement with the system, making users contribute more time and resources than they have intended, by rewarding them with status, access, power and stuff (SAPS). In this paper we give an overview of gamification and user motivations for playing games. We focus on empirical studies on gamification in Education, not only in Computer Science but, education in general. We then discuss the impact of gamification in education and how it affects engagement. Finally, we discuss some studies or methodologies that could be adopted in Computer Science education.

ACM Classification and Keywords

H.5.2 [Information Interfaces and Presentation]: User Interfaces

General Terms

Human Factors, Design

Keywords

Achievements, rewards, Badges, motivation, gamification.

1. INTRODUCTION

Following the success of the location-based service *Foursquare*, the idea of using game design elements in non-game contexts to motivate and increase user activity and retention has rapidly gained traction in interaction design and digital marketing. Under “gamification,” this idea is spawning an intense public debate as well as numerous applications ranging across productivity, finance, health, education, sustainability, as well as news and entertainment media. Several vendors now offer “gamification” as a software service layer of reward and reputation systems with points, badges, levels, and leader boards. Reward-based systems are being used increasingly to drive user participation and engagement across a variety of platforms and contexts. Despite positive anecdotal

reports, there is currently little empirical evidence to support their efficacy in particular domains. With the recent rapid growth of tools for online learning, an interesting open question for educators is the extent to which rewards can positively impact student participation.

2. WHAT IS GAMIFICATION

Gamification can be defined as “the use of game design elements in non-game contexts” (Deterding et al., 2011, p. 10). This is accomplished through the use of designs and structures, incorporating game-based practices, to include game-elements, to embed some characteristics of games within non-game contexts (Deterding et al., 2011, p. 13). It is different to other concepts, such as ‘serious games’, which is concerned with the incorporation of non-entertainment elements into game-environments (Liu et al., 2011) where a task is incorporated into the game so that the task is accomplished (Oja and Riekki, 2012, p. 138). Thus, gamification is not a game for learning purposes, but application of “the motivational properties of games and layers them on top of other learning activities, integrating the human desire to communicate and share accomplishment with goal-setting to direct the attention of learners and motivate them to action” (Landers and Callan, 2011, p. 219).

The term ‘gamification’ was first used in 2008 but was not widely adopted until late in 2010 and is frequently confused with other terms such as ‘game layer’, ‘applied gaming’, ‘productivity games’, ‘funware’ ‘playful design’, or ‘behavioral games’ (Deterding et al., 2011). The concept is that a designer “takes the motivational properties of games and layers them on top of other learning activities, integrating the human desire to communicate and share accomplishment with goal-setting to direct the attention of learners and motivate” (Landers and Callan, 2011, p. 421). Small changes to existing educational elements can also be beneficial. Simply changing the wording of a question in a market research survey, to make it a ‘challenge’, may make respondents engaged and extract more useful information (De Ruyck and Veris, 2011). Some gamification elements have been incorporated into regular activities in ways that are now common place – such as the use of frequent flyer programs, where support is rewarded with points that can be redeemed (Han, 2012, p. 5)

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3. RELATED WORK

Current research into the impact of Rewards in non-game applications has focused on investigating user perceptions rather than measuring the effect on participation. An early example of this work was conducted by Montola et al. in which an achievement system was added to a location based photo sharing service. The 8 week field trial involved 20 participants using mobile phones to take pictures and record audio clips that were automatically uploaded by an application on the phone to the Nokia Image Space service. Individual achievements were awarded for uploading various numbers of photos, sound clips, and scenes. Participant interviews indicated that the achievements triggered some friendly competition; however a drawback of the application was that achievements were not visible within the mobile client. Participants did not receive explicit feedback or notification of earned achievements on the device, and were restricted to viewing this information on the web at a later time.

A more recent study by Fitz-Walter et al. investigated achievements within a mobile application designed to help University students learn about their campus during the orientation phase of the semester. The application leveraged the GPS and QR-code scanning functionality of Smartphone's, and achievements were awarded when students physically visited certain parts of their campus and answered questions relating to University services. Several of the achievements, such as those for attending a certain number of events on campus, served the "goal setting" role as described by Antin and Churchill. Goal setting is known to be an effective motivator, and achievements of this type set a target for users that they are challenged to meet.

Another study investigated the use of gamification to improve college student in-class participation and engagement. Game mechanics were applied to the construction of a reward based system that acted as an incentive for students to engage in class discussion. Students were provided with a virtual tree which grew and developed in response to points assigned for participation in class discussions. The majority of students reported increased participation in class as a direct result of the virtual tree system.

Game mechanic	Application
Achievement badges or levels	addition of leaves, background, ornaments etc.
Leader boards or a way of publicizing achievements	Each student could see the others tree so the high achievers were obvious
Progress bar or other visual meter	The addition of leaves backgrounds animals etc to their tree image as they accumulated points
System for rewarding	Points were given in class for answering questions thoughtfully, expressing opinions, adding resources or knowledge of the subject, associating the knowledge with other information presented etc.
Challenges or competition between users	As each student could see the other student's trees, competition to have the best tree was evident.

Table 1. Selected game mechanics and application in the case study.

Another such work was done in a Business class in Curtin University for Supply and Logistics Chain Management students. Game elements were incorporated into existing systems and tasks in a way that increases user engagement in the process. Current approaches in logistics and supply chain education are discussed in relation to active learning. A framework was developed that combined several gamification elements that can be relatively easily incorporated into existing approaches and learning management systems (LMSs) in ways that aims to increase engagement and extend active learning. This framework and the relationship between the elements provide fertile ground for further research. Active learning is a fundamental method to increase engagement with the classroom and is supported through the incorporation of structured in-class activities. While there are a range of activities such as quick quizzes or activities, the use of supply chain- or operations-focused games have been popular. These are often designed around specific learning outcomes and include examples such as:

- The beer game, or the beer distribution game, developed by MIT in the 1960s (Sterman, 2000); this is a simulation of limited complexity that is designed to demonstrate the 'bullwhip effect' (Lee et al., 1997) in a small, simple supply chain. The game can be run in a single class session.
- The Fresh Connection, a team-based simulation of a perishable fruit-juice manufacturing (Cotter et al., 2009); a relatively complex computer-based game that divides the players into focused roles with divergent lines of responsibility. Materials and data are all close at hand, allowing students to interact and determine the best response to changing conditions and how to best use new supply chain functions and options that are offered to them. The game can be run in a one-day session or with a turn every week over an entire semester.
- Supply Chain Game by Responsive.net (see also, Feng & Ma, 2008).
- Supply Chain Risk Management Game (Kuijpers, 2009).
- Port Simulator 2012-Hamburg is a computer game which allows competitive rivalry between players.
- Other L&SCM in-class activities can be sourced from books and may involve dice, coins, or even making paper airplanes in class (Wood and Reefke, 2010); immersive tasks also improve engagement (Gregory et al., 2011). Within an appropriate framework, these activities can improve students' understanding through a process of 'learning by doing'. An added benefit is that students find that such "practices empower them in class and create new opportunities for interaction outside class" (Maruyama et al., 2000, p. 78).

Similarly, the use of the Peer-Wise system among students also helped in learning of the subject. Peer-Wise is an online repository of student-generated multiple-choice questions (MCQs). MCQs consist of a question stem (the introductory text that presents the question) along with a set of alternative answers, only one of which is correct. The Peer-Wise tool supports students in the question authoring process, and enables an entire student cohort to create, share and moderate a repository of their own MCQs. When creating a question, a student must identify a topic or concept to be assessed and consider possible misconceptions when designing the set of alternative answers. In addition, they need to provide an explanation for the correct answer to their question in their own words. Prior to the introduction of the badge system, Peer-Wise did have some game factors and the involvement of the students of the POPLHLTH course was identifiable. As the Badges were introduced to the system the engagement and the contribution level of the students increased significantly.

Not only education but, Gamification was introduced in organizations as well to increase involvement and engagement of an individual to a task. One such study provided the use of point system in IBM by using a Social Networking site Beehive into their inter organizational network. Surprisingly, the use of the point system in the site significantly increased the number of users using the service and the number of contributions made by each of them, even though they had their other official work to do. Gamification also has its implementation in fields such as Geography where it is used in the Gamification of the Geographic data collection.

4. DISCUSSION

The quantitative results from these studies show that the users who saw the Rewards system actively increased their participation and engagement in the task assigned to them. In case of the Nokia Image Space Service more and more images, videos and sound clips were uploaded to stay on top of the charts. Similar cases of engagement were found in other studies such as achievements within a mobile application designed to help University students learn about their campus during the orientation phase of the semester. Students not only participated actively but, also got to know their campus. Same was the case with the class discussion activity, and for Supply and Logistics Chain Management students. The Peer-Wise system is no exception. These intrinsic rewards made them involve and engage in the activity as much as possible of course, with a feel of a friendly competition among them.

5. CONCLUSION AND FUTURE WORK

Our study results indicate that people are definitely motivated by the reward system within the test platform, especially by Badges, Points and Status levels. Also, evidence was found that the increase in contribution and

engagement levels inspired other users to put in their contributions to the same. There were some weaknesses in a few systems, such as, non diminishing point values. Also, some of the systems did not dynamically adjust to the user's behavior. An interesting area for future work will be exploring what if these achievements were publicized more openly. Allowing a student to display his achievements to the whole of his class or maybe, to a subset of students who approve or may introduce a competitive element that further impacts engagement. Future work could also be done on finding the facts as to why earning rewards encouraged students to participate in certain ways, but not in others. More work is needed to assess the impact of these rewards and achievements within a range of contexts, including Computer Science.

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