The effects of gamification on student learning through the use of reputation and rewards within community moderated discussion boards

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Structured abstract

CONTEXT
Gamification, the processes of including competitive elements to an otherwise non-competitive environment, has been shown to improve engagement and user experience in a number of fields (Kapp, 2012) (Deterdin et al. 2011) (Reevs, Read 2009). Engaging students in technical discussion is an important part of the learning experience in highly technical fields such as engineering.
This engagement is arguably most important in the early stages of an engineering degree program when students need to become part of the community of practice and to transition to owning their learning process. ENGG1100 and ENGG1200, two compulsory first year courses at The University of Queensland, have been purposefully designed to support both these objectives and thus offer the perfect platform for gamification. Previously the discussion board on the institutional learning management system was used to provide technical discussion but it was found to be clunky and usage low; Facebook has also been used but whilst usage was high, the content was poor and the news stream effect meant that questions were often repeated. Therefore a discussion board tool, based on those that have found success on the Internet such as Stack Exchange and Reddit, was developed and employed in first year.
An online discussion tool (Casper) has been developed which allows students to post and answer questions related to course content. Actions within the tool reward users for "positive" interactions such as asking questions and providing answers which receive positive votes, and also for marks from teaching staff indicating a question is useful or an answer as correct or helpful. Similarly students lose points for negative actions such as posting spam and non-constructive content. The points are cumulative and "achievement badges" are awarded at specific milestones; these are visible to the entire cohort which facilitates increased participation.

PURPOSE OR GOAL
To investigate the effect of gamification using a reputation system and badge rewards on the participation and quality of online discussion within technical courses taught in engineering.

APPROACH
Casper will be compared with the discussion boards from both the institutional learning management system and Facebook. The number of users, the number of posts per user, and the total number of posts will be evaluated along with the technical content of the boards.
In addition, students and academics/ tutors will be asked their opinion of the various systems on a number of key criteria such as user friendliness, and the quality of information.

ACTUAL OR ANTICIPATED OUTCOMES
Based on the data from the courses trialled over a six week period from July to November 2013 it is hoped that there will be a positive increase in discussion content and cohort engagement compared to previous years. It is expected that the reputation system will help to keep the discussions constructive by incentivising positive interaction.

CONCLUSIONS/RECOMMENDATIONS/SUMMARY
Gamification, whereby badges of achievement were awarded for engagement with technical discussion boards, improved the cohort engagement: more students participated and there were more posts made overall by each student. In addition, information was of higher quality and easier to find. Several improvements will be made to the software in order to increase its usefulness next year.

KEYWORDS
Gamification, eLearning, discussion

Introduction

Online discussion as a means of collaborative learning within a course is a key aspect of education as it promotes deeper thinking. Providing effective tools that support student discussions in the virtual space is an important area of investigation and development for student learning Most Learning Management Systems (LMSs), (the applications that underpin e-learning), have some type of discussion forum integrated into the software. These programs range from traditional forums such as newsgroups to real time chat programs. Over the past few years it has become apparent, based on the results seen in anonymous student course evaluations that traditional discussion forums are proving to be ineffective for question and answer style discussion. Important information is often lost in the chronological ordering of content, there is no reward for active participation and students seem to be frustrated with the format and the lack of prevalent 'experts' and rewards for participation.

Kelly and Cernerud (2002) showed that students' impressions of online learning systems are strongly influenced by their implementation and consequently this poor implementation can lead to an overall negative opinion of the course. Student participation has been shown to decrease, as class sizes grow (Jones et al., 2004) and as classes grow the amount of interaction time between staff members and students decreases. Therefore it is important to develop new and innovative means to provide improved participation that includes some element of reward to students regardless of class size.

To explore the relationship between rewards given to users and participation levels, a new independent discussion tool 'Casper' was developed to provide a forum for student questions and answers. The tool was designed to provide merit points and badges as a form of rewarding students and encouraging participation and in-depth discussion.

The Casper system included a points or 'reputation' system in order to reward positive contribution (i.e. a well written question or answer) and highlight to users who within the community, may be considered an expert. Voting on content was the main form of reputation change with additional points awarded when the author of a question or any staff member marked an answer as the best answer. Badges were also added to give clear feedback on user participation. Both reputation and badges were visible by the entire community as a means of identifying which users could be considered knowledgeable. This design was based on the concept of Gamification which is the process of adding game-style elements such as points and badges to otherwise ordinary tasks. This process has been shown to improve engagement in many contexts (Kapp, 2012; Reeves & Reed 2009). Kapp (2012) has extensively researched the effects of gamification in learning and has shown that proper implementation can positively affect the learning outcomes of students.

Many successful online forums use elements of gamification to enhance discussion; these include the popular sites "stackoverflow.com" and "reddit.com". Both sites provide users with a points system to indicate positive interaction within the community. Pal et al. (2012) have shown that in such situations a group of users may develop who are considered 'experts' by their peers and these expert users often nurture and help shape the community in a positive way. These users are identified by a publicised display of their reputation using points and badges. This was mimicked in Casper to help discover whether the same development of expert users occurred and helped to build the community and learning environment.

Casper was evaluated through the collection of usage data and user statistics. Usage of the site was monitored in order to identify how students utilized the tool and how the elements of gamification influenced this interaction. The distribution of user reputation was studied to identify whether expert users appeared in the community. Additionally a survey was conducted across all users of the system to determine how the tool was received amongst the users and whether the points and badges provided a real incentive to users.

Method

Casper was used in six courses at The University of Queensland. These courses were all within the Faculty of Engineering Architecture and Information Technology and several of these courses featured group based projects as core learning activities. The course title, a description and class size are outlined in Table 1. The first digit of the course code indicates the course year level. The courses chosen were based on both teaching staff interest and the desire to test the system on a range of courses with varying sizes and levels of technical content.

Table 1: Casper Student Test Groups

Course Title	Description	Students
INFS1300	Introduction to the web	308
ENGG1200	Introduction to engineering problem solving	1069
ENGG2800	Electrical group project	153
METR2800	Mechatronics group project	36
COMP3301	Operating systems design	34
METR4202	Advanced Control & Robotics	76

Each course had varying numbers of teaching staff but the ratio of staff to students remained similar within all courses at around 30:1.

The Casper system was built to be LTI (Learning Tools Interoperability) compliant so that it was accessible to students through the existing LMS. This removed the burden of students needing to sign up and provided a learning analytics capability in linking the student generated content on Casper with existing student demographic information.

All users were able to create questions and answers which could subsequently be voted upon by other users. A summary of all actions which affected user reputation is outlined in Table 2. To restrict users from voting down content maliciously two steps were taken: users were required to have a reputation score above 10 before being able to vote down content and voting down any content cost the voting user one reputation point. Answers could be marked as accepted by the content creator or any staff member as a means of indicating the best answer to the original question; in some situations there was no clear answer and acceptance was given to the best available answer, this could be changed as new answers became available that provided a better solution to the original question.

Table 2: Summary of reputation changing actions

Action	Reputation Change	Other Effects
Question or answer voted up	2 reputation points added to content creator	Question/answers are ordered by votes so content may move higher in these lists
Question or answer voted down	3 reputation points taken from content creator, 1 point taken from voter	Question/answers are ordered by votes so content may move lower in these lists
Answer accepted	15 reputation points given to content creator	Acceptance indicator shown next to answer and question displayed as answered on the question list
Answer unaccepted	15 reputation points removed from content creator	Acceptance indicator removed from next to answer and moved to new accepted answer

Badges were awarded when users completed predefined actions. The badges were awarded as bronze, silver or gold and when viewed in detail each badge was shown with a

title and description of the action awarding them. A summary of the available badges and how they were obtained is described in Table 3. Many badges come in a set of bronze silver and gold for completing the same action numerous times. The number of times the action must be performed before the badge is awarded is shown as a cut off in Table 3.

Table 3: Badge conditions

Action	Bronze Cut-off	Silver Cut-off	Gold Cut-off
Post a Question	1	5	20
Vote on content	1	25	50
Write an answer	1	5	20
Have your question receive n up votes	5	20	50
Have your answer receive n up votes	5	20	50
Be one of the first n students to post a question	N/A	10	1

Reputation and badges (in the order: gold, silver, bronze) were displayed next to user's names on all content they created as shown in Figure 1. The staff members did not show reputation next to their name but it was available on profile pages, in both images names have been intentionally blurred. A section of a profile page showing reputation and a list of achieved badges is shown in Figure 2. Each user had a personal profile page visible to others within the course. The page gave an explanation of reputation and badges and how each was awarded.

Figure 1: Public display of reputation for a general user and staff member

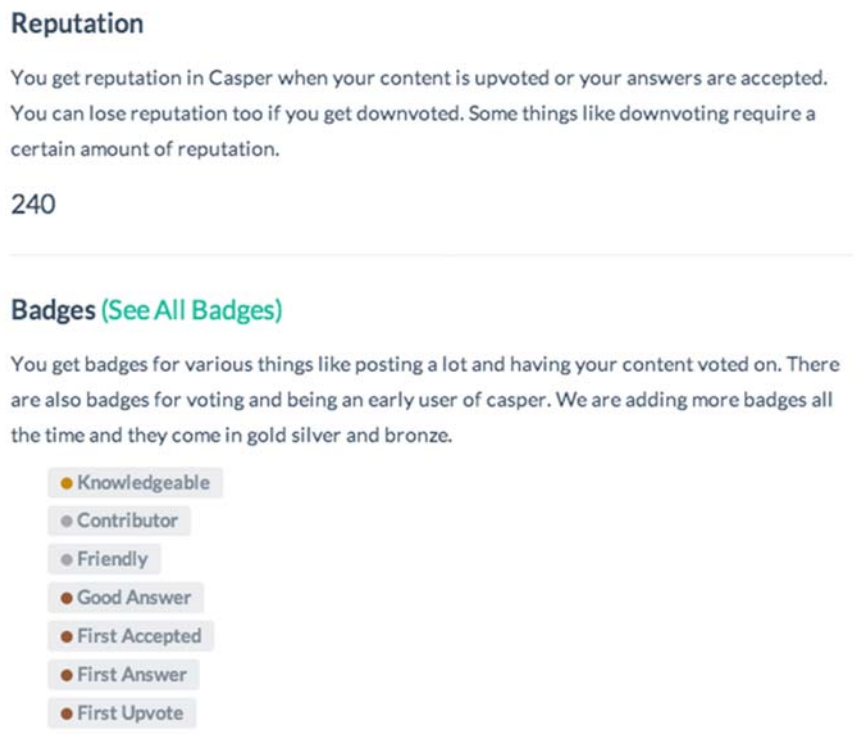

Figure 2: User profile page

Data from Casper was collected over a period of 5 weeks from the beginning of the teaching semester. Data included user's interaction with the site as well as a full log of created and revised content. Each change of user reputation was stored to monitor the variation in reputation over time and all badges, as well as their time of creation, were stored in the database.

In order to monitor the development of experts within the forum, a distribution of user reputation was created and users with a reputation score in the top 19% (above one standard deviation) were identified. For the purposes of this study these users will be considered 'expert' users.

A survey was distributed to all users of the system asking them how they found the system and whether gamification played any role in their use or enjoyment of the system. Results of this survey were collected across a period of two weeks from any willing participants. All responses were anonymous to allow students to provide honest feedback; this made it difficult to correlate opinions with user behaviour but allowed a clear indication of the tool's performance and where it may be extended for future research.

Results

Survey responses

A three question survey was distributed to gauge student opinion on the use of Casper within their course. Responses are detailed in Table 4 the survey also allowed one free form response on the user's overall opinion of Casper. The results indicate a positive response in all questions and only a small percentage expressing a negative opinion. The strongest positive sign was from the first question gauging overall effectiveness of the tool. The survey had a total of 198 responses of which 95% were students and the remaining 5% staff. The system was used by a total of 1054 users which gave a user response rate of 18%. The questions used a 5 point Likert scales ranging from strongly disagree to strongly agree.

Table 4: Survey response summary (N = 198, 95% Student, 5% Staff)

Question	Disagree / Strongly Disagree (%)	Neutral (%)	Agree / Strongly Agree (%)
Casper is an effective tool for discussion amongst the student cohort	12	27	61
Reputation and badges add to the experience of using Casper	16	30	54
Finding questions and answers on Casper is easy	16	33	51

The second question, outlining the student's response to the added gamification was seen as the key indicator of success in this context however it is limited only to the conscious recognition of the gamification and its effects; further investigation into subconscious effects requires further investigation.

Identification of 'expert' users

Expert users have been found to shape similar online communities and in order to further study their effects on the learning environment it is required that expert users can be identified in some way. If it is possible to identify such user it is possible to, in the future, correlate these users to offline behavior and results to determine how these expert users behave. In order to identify expert users of the system, a distribution of user's reputations was generated. Only users who had experienced one change in reputation (see Table 2) were included in the distribution. There were an additional 854 users with zero reputation, these were users who had logged into the discussion board as a viewer but had not created any content. The mean of the reputation dataset (zeros included) was 3.88 and the standard deviation was 22.05. Excluding the users with zero reputation gave a mean of 21.32 and a standard deviation of 48.03. This information was used to determine expert users based on their reputation when compared to the mean. Defining users as 'expert' when they were more than one standard deviation from the mean gave 30 'expert' users when considering the users with zero reputation and 14 'expert' users when excluding them. The full distribution of user reputation scores for those with greater than zero reputation was graphed and has been displayed as Figure 3. Four students who achieved a reputation score greater than 150 have been removed from the distribution for clarity in the figure.

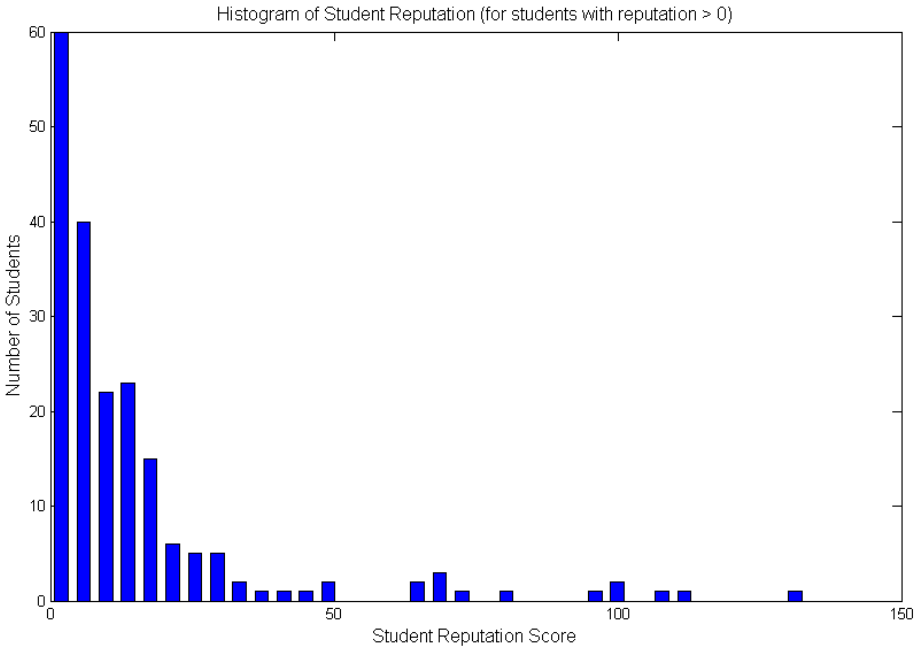

Figure 3: Distribution of user reputation

Discussion

The preliminary research into the effectiveness of Casper was directed towards determining the effect of gamification in student discussion; identifying whether expert users appeared in these communities and understanding how students reacted to gamification within the learning environment. Based on the responses to the survey shown in Table 4, it appears that the overall student reaction to Casper and its gamification was positive. Most students found the tool effective as a discussion forum and found it easy to discover content. This was an encouraging result considering the negative reaction of students towards the traditional message board style, as evaluated through anonymous course feedback. Gamification also had a positive result with a majority of the students attributing this to their continued engagement with Casper (Table 4 question 2). As students had previously stated that the traditional forum style had made content hard to find, this strong result is a very positive sign that question and answer style discussion boards are a useful learning tool for technical courses.

While gamification is a much broader concept than just the addition of points and badges implemented in the work discussed here, it suggests a strong basis for further study into how gamification may be utilised in improving student engagement in online discussions supporting their learning. Some aspects which appear to be worthy of further investigation include using completion of goals or tasks as well as temporal progression or story telling style elements. Such elements are common in many games and may have some application within the learning environment. While integrating these strategies may require significant modifications to the course and prove to be impractical, the positive results that we have seen suggest that students are open to the introduction of these game style elements in the learning environment.

When looking at the distribution of user reputation it was clear that some users participated significantly more than the majority of the cohort. These users, (‘experts’ in this context) were seen to be the driving force of many of the subject forums and had been rated as such by their peers. It was interesting to see ‘expert’ users develop in such a short timeframe and a continued study on the temporal change in this distribution may reveal a better

understanding of the effects of student and staff behavior within this environment. Identifying these users as experts is the first step in monitoring these users and their effect on the community both online and offline.

It is also apparent that while ‘expert’ users demonstrate a high level of technical understanding, it is also important to determine whether this knowledge is transferred to other users of the system. Analysing the distribution of these experts amongst the student and staff users may determine a more effective way of increasing students’ learning benefits from the tool. An important factor under investigation is how to account for the inhibition of some students to provide answers in the presence of these ‘expert’ users as seen by Pal et al. (2012) in the stack overflow community. To account for this, a period of anonymity could be implemented during which the author of content is not displayed until either a time or vote threshold is crossed.

Based on the distribution of reputation it was clear that there was a sizeable portion of students who did not receive any reputation. Whether this was due to a lack of participation or a general lack of voting on content by students should also be explored. Helping to remove barriers to engagement with the system will increase the involvement of all students leading to a deeper level of technical discussion.

A number of limitations of the study revolve around the limited timeframe and need to be acknowledged. The five week period limited the amount of data that was collected and due to the anonymous nature of the presented survey it is difficult to correlate the results to any particular user type. In further studies the link between users of the discussion tool and their performance in other aspects of the courses will be evaluated to discover if any links are present between the two. However the results obtained were relevant and provide a strong rationale for the continued use of gamification within student discussion. Further research along these lines is both needed and achievable using the tool.

Conclusion

The combined increases in university course sizes and active learning pedagogies suggests that in order to maintain communication and feedback to students new online tools will need to be developed and improved. These new tools pose challenges in the way information is identified and judged and if poorly implemented, can lead to frustration amongst users. In this paper, the evaluation of a new discussion tool was discussed.

The tool assisted in identifying expert users amongst student cohorts with the intention of monitoring these students and their effect on the conversation amongst the cohort utilising the tool. These students were able to be identified which allows further long term analysis to take place to monitor their learning performance over a longer time period utilising learning analytics techniques.

Gamification was used as a core design strategy to encourage student participation and to assist them in identifying quality feedback. Based on the survey results it was found that this was an effective means of incentivizing students and further implementation around this theme will be investigated.

The Casper tool appears to have been well received by students and further research and development will continue to assist in refining its use in improving the learning outcomes of the students involved.

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