Illusion of Progress is Moar Addictive than Cat Pictures

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Abstract
We conducted two studies on the effect of visual reward mechanisms for increasing engagement with an online learning material. In the first study, we studied the effect of showing cat pictures as a reward to correct and incorrect answers to multiple choice questions, and in the second study, we created an illusion of progress using a progress bar that showed step-wise increments as students answered to the questions. Our results show the use of cat pictures as a visual reward mechanism does not significantly increase students' engagement with learning materials. At the same time, students who were shown progress bars had a statistically significant increase in the quantity of answers – on average 88% more answers per day. However, our results also indicate that this effect declines over time, meaning that students catch up to the illusion.

Author Keywords
multiple choice questions, visual rewards, visual feedback, motivation, student engagement, gamification, pictures of cats, progress bar

Participant demographics

In the first study, 664 students answered more than three questions. Out of them, 314 were in the treatment group and 350 in the control group. In the second study, 411 students answered more than three questions, with 197 in the treatment group and 214 in the control group.

Introduction

Being active during a course leads to a significantly smaller risk of failing [5]. One way of increasing participation is to motivate students [2]. In any large enough course, not every student is intrinsically motivated to study [9]. Therefore, additional incentives can be helpful. A classical way is to offer partial course credit for assignments [7]. Another, more recent, way has been to employ *gamification* [3, 4], with the purpose of engaging and motivating the students.

In this study, we look at two possible ways of increasing student motivation via visual feedback for answering multiple choice questions (MCQs).

Research Design

Research Questions

The research questions for this study are as follows:

- **RQ1**: How does the use of cat pictures as a feedback mechanism for MCQs change students' behavior?
- **RQ2**: How does the use of progress bars as a feedback mechanism for MCQs change students' behavior?
- **RQ3**: If the students' activity increases or decreases due to the changed feedback mechanism, to what extent does the effect persist?

Context and Data

The study was conducted in an online programming course organized by the University of Helsinki during Spring 2015. The participants included students both affiliated and not affiliated with the university. See sidebar for demographics.

The students were expected to study a blended online material with programming assignments and embedded programming-related MCQs. The students did not receive course points for answering the questions, but they were told that the questions could be useful in rehearsal and as a way to test their understanding so far. Thus, studying the effect of visual rewards on the students' engagement with the questions was meaningful. The MCQs were designed so that the students could request new ones that would have some parts of the question altered. The system was inspired by the QuizPACK [10].

Methodology

Two subsequent 18-day randomized controlled trials were conducted. The students were randomly assigned into two groups that received different types of visual rewards after answering a question. In all studies, all groups received textual feedback in the form of a single word telling them whether the answer was correct, and in addition, the control group was always shown an icon indicating the correctness of their answer. Only users who answered at least 3 different questions were included in the studies.

In the first trial, the treatment group was shown a picture of a sad kitten for an incorrect answer, and a randomly chosen image of a cat with a positive or neutral expression for a correct answer. The cat pool used for the study contained over 1000 images. In the second trial, the treatment group was shown a progress bar that filled one third for every consequent correct answer, and emptied on a wrong answer. When the progress bar was filled completely after three consecutive correct answers, it changed color from blue to green.

Results

A statistical analysis performed on the differences between the groups of the first study ($p = 0.54$ and $df = 33.87$ for Student's T-Test) indicates that there is no statistically significant difference between the groups. The mean answers per day per student were 4.30 for the group that was shown pictures of cats and 4.10 for the control group.

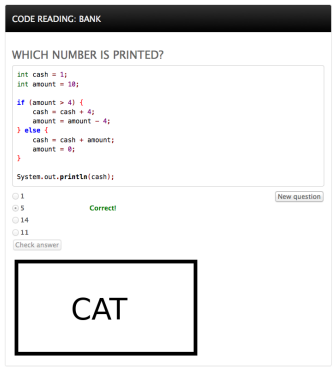

Figure 1: An embedded parameterized question in the course material.

For a correct answer, the shown cat was selected randomly from a database of over 1000 pictures, while an incorrect answer always led to the same picture of a sad cat.

The answer profiles of the student groups in the second study are different, confirmed by Student's T-Test ($p < 0.01$, $df = 26.57$). For the treatment group that was shown a progress bar, the mean answers per day per student was 9.32, while for the control group, the mean answers per day per student was 4.97. This means that the treatment group submitted around 88% more answers per day than those in the control group.

We also searched for statistical trends in all four groups. A Cox-Stuart test for trend showed that the treatment group from the second study — in which students were shown a progress bar — had a statistically significant ($p < 0.02$) decreasing trend. This indicates that the effectiveness of the progress bar diminishes over time. While the other groups also "lost" students over time, no statistically significant trends were found.

Discussion & conclusion

The lack of a statistical difference in student engagement between the groups in the first study suggests that a reward scheme based purely on pictures of cats does not significantly increase student engagement. It is possible that the pictures of cats ended up feeling cheesy or unnecessary in a fashion similar to the way some students perceived badges that were added to online exercises in the study conducted by Haaranen et al. [6]. While we did not study how the students perceived the images, negative perceptions that could be possible in our context have previously been observed by Berkling and Thomas [1]. Our data shows that a small amount of students did answer the questions with cat pictures extensively when they were first introduced, but this small population does not change the overall result. No observable trend was found that could tie the answering behavior to age, gender or previous programming experience.

Based on the above, the answer to our first research question is: "*pictures of cats as a feedback mechanism for MCQs does not increase student engagement with the material.*"

In the study with progress bars, we observed that the amount of students' answers in the treatment group was significantly higher than in the control group, with students answering up to 88% more questions. Therefore the answer to our second research question is: "*a progress bar as a feedback mechanism for MCQs significantly improves student engagement with the material.*"

This behavior with progress bars is interlinked with the *challenge*, an important part of gamification [8]. We postulate that the cat pictures did not present an interesting enough challenge for the student – in the case of the cat pictures, the challenge can be seen as "*can you find the right option for this question?*", whilst in the case of the progress bar the challenge can be seen as "*can you answer a question correctly three times in a row?*"

This result is consistent with the findings of Stott and Neustaedter [11]: overall, students answer more questions when the system has all four of *freedom to fail*, *rapid feedback*, *storytelling* and *progression*. In our case, only the study with the progress bars had a *progression* element.

However, our results also showed that there was a statistically significant decreasing trend in the number of answers in the treatment group with progress bars. Since only the progress bar group showed a statistically significant decreasing trend in the amount of answers, it seems that the other groups form a "baseline", towards which the progress bar group's activity declines. Based on this, our answer to the third research question is: "*the positive changes on student engagement decrease over time.*"

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