Evaluation of Achievement Badges as a Gamification Method for Increasing Motivation in e-Learning

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Abstract. In this article we discuss achievement badges as a way to motivate students' learning process. We present an experiment that includes two groups of students, enrolled in an online mathematics course for a one-month period. The article illustrates the results and effects of using badges in e-learning.

Keywords: Achievements Badges, Learning Motivation, e-Learning, Gamification.

1 Introduction

Lifelong learning is a contemporary concept around the idea that people gain knowledge and skills throughout their while life. In the context of modern knowledge society, lifelong learning is considered a critical factor for developing a successful career. Formal education is an important but still a small part of what people learn throughout their lives. On of the key qualities a lifelong learner should possess is motivation.

Students, who are not motivated enough to learn, have difficulties extending their current and gaining new knowledge and skills. Learning motivation is important because it affects the way students learn as well as the outcome. Those who are more motivated aim to solve harder and more challenging problems, while those with lower motivation will have lower interest and lower knowledge retention. Motivation theory proposes two main drivers for encouraging the increase in one's satisfaction and avoiding dissatisfaction – intrinsic and extrinsic. Motivation is an intrinsic factor, which includes everything that can push someone to reach their own success. The motivational factor can be a job, an achievement, a chance of growing up, a career progression, or just being recognized by others (Ly at al., 2016).

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2 Achievement Badges in Gamification

Badges usually are graphical icons that are given as a reward to the user after reaching a certain achievement or completing an action (Badges/faqs., n.d.; Hakulinen at al., 2015). The information included in the badge and the accompanying meta data helps to communicate the value of the digital reward and encourage users to earn the badge for their own professional development goals. That metadata includes:

- Badge name
- Badge description
- Recipient details
- Badge earning criteria
- Issue and expiration (where applicable) dates
- Skill tags
- Badging pathway details (where applicable)

Achievement badges are a form of gamification that is used to increase user engagement and motivation in various learning environments. Game experience can be understood as a psychological state resulting from the interaction of a perceived as achievable and a non-trivial goal, leading to high levels of engagement (Landers, 2014; Landers et all., 2019). Gamification strategies used in education, also known as gamified learning experiences, aim to foster a playful state in students that can be facilitated by introducing playful elements into the learning environment. When implemented effectively, gamification enhances motivation and can thus encourage students to engage more actively with their school tasks. Figure 1 shows the relationship between a learning environment, badges, and learning motivation.

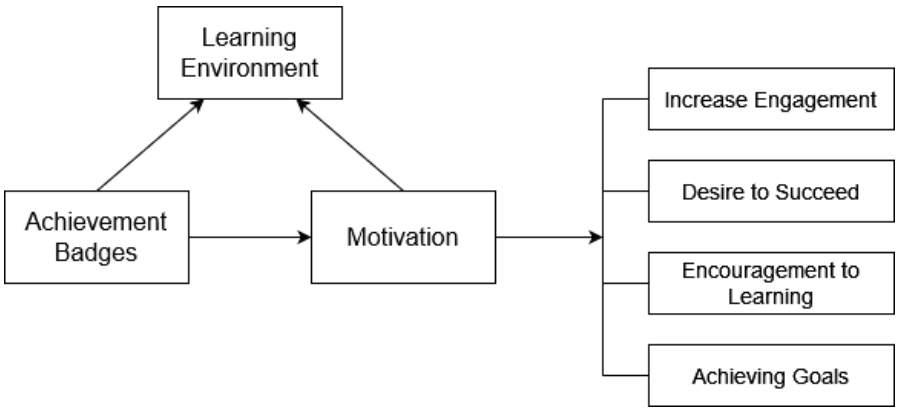

Fig. 1. Gamification and motivation in learning environments.

Achievement badges have some multiple advantages, and the main ones are (Mozilla-Wiki, 2024):

- Signal for an achievement - indicate achievement of new knowledge and skills.
- Support greater specialization and innovation - move faster to support and recognize new skills than traditional degree or certificate programs.
- Allow greater diversity - with specific recognition of "soft skills", social habits, ability to collaborate, etc., badges can measure and recognize skills that are valuable in many contexts but that traditional educational models don't even attempt to quantify.
- Motivate participation and learning outcomes - badges provide feedback and rewards during a course or training, encouraging engagement and retention as well as reinforcing a sense of progress.
- Capture the learning path and history - help trace the path a learner has taken to acquire their skills.
- Provide a more complete picture of the learner - badges show the learning history in detail and create a more representative overview of peer groups, for potential schools, etc.

3 Testing Badges as a Method for Improving Motivation

In this experiment, we added various Achievement badges to an online learning environment for kids' education. The aim of the experiment is to investigate the overall effects of badges and how much they influence motivation to learn.

Table 1. Groups of badges used in the experiment.

Name	Images	Criteria
A+ Student		This badge is unlocked by correctly solving all problems throughout the course
Learning Star		This group of badges is unlocked by correctly solving the problems of the course - respectively the first one for solving 10 problems, yours - 50, and the third - for all 100
Explorer		This group of badges is unlocked after completing modules that include 5 tasks. The first is unlocked after completing 1 module with 5 tasks, the second - with 10 modules, and the third - with 20

The experiment was conducted in a mathematics course that included 100 problems divided into 20 modules of 5 problems each, with a time limit of one month to solve the problems. Thirty students participated and were randomly divided into two groups – a test group with visible badges and a control group with no visible badges. Each solved problem was automatically checked by the system and the student immediately received feedback and a certain number of points. The system allows repeated solving of the same problem to practice and reach a correct answer.

For the purpose of the experiment, three different badges were developed and separated into groups. They are described in Table 1.

Students in the control group did not see any badges as part of their user interface and were not aware of their existence. Students who were in the test group could see the badges and their descriptions, so they knew how to earn them (the view is shown in Figure 2). This view is greyed out to clearly see which badges are about to be unlocked. Once a student has met the criterion to unlock a badge, it is coloured and the system counts down how many more problems remain to be solved before the next badge in the same group is unlocked.

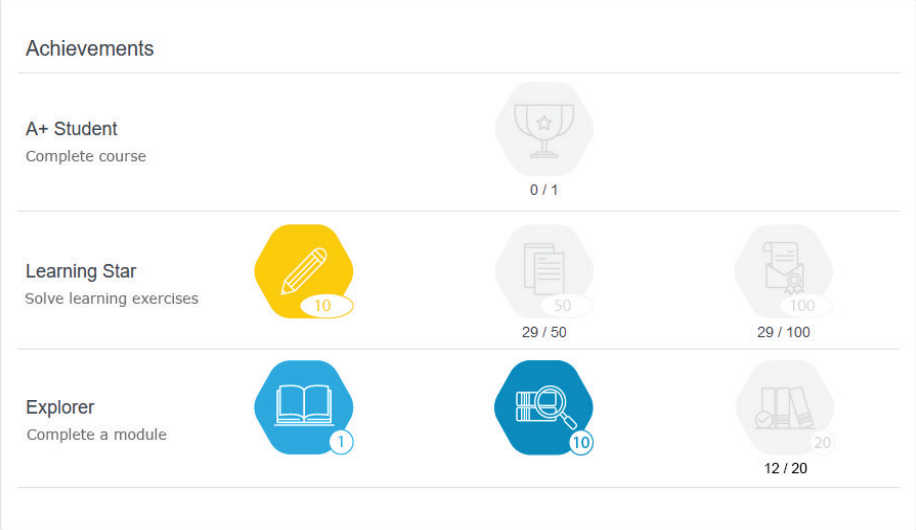

Fig. 2. Badges screen.

In order to analyse the experiment and understand to what extent badges contribute to an increase in motivation, after the end of the course we evaluated the number of problems solved, the number of modules completed, and the learning time in both the test and control groups.

4 Results

All students who solved at least one problem were included in the benchmarking. Out of 30 students, all have completed at least 3 modules with 5 problems each. Figures 4 and 5 below show the graphs of the total number of problems solved by each student. The first graph shows all 15 students in the control group (CU1 to CU15) and the second one shows those in the test group (TU1 to TU15).

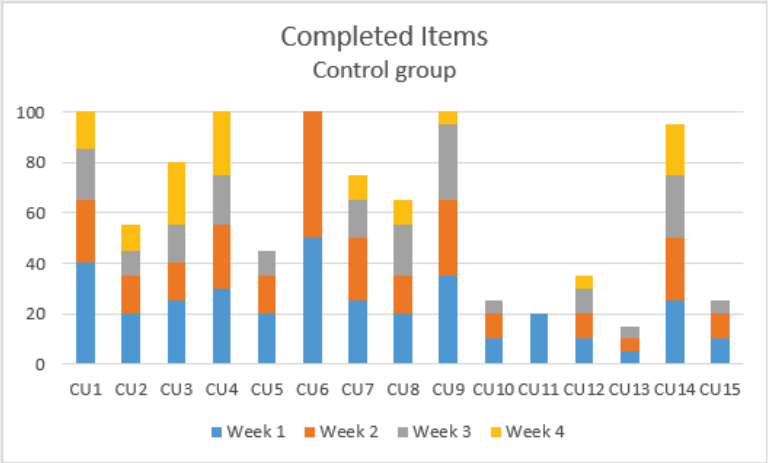

Fig. 3. Completed resources by students in the control group (no badges).

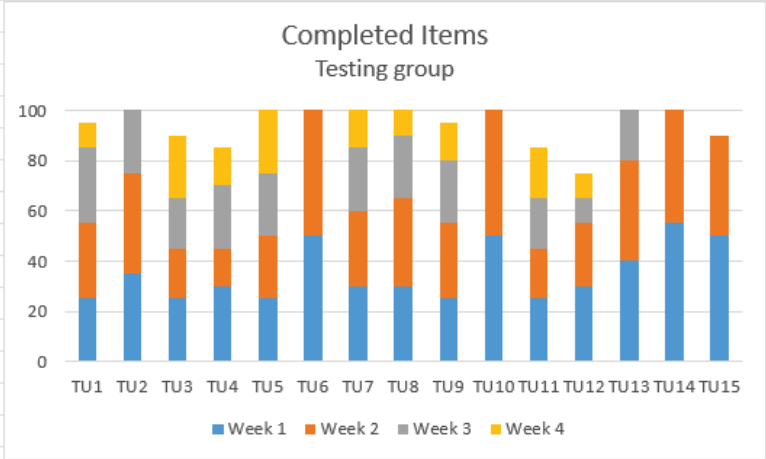

Fig. 4. Completed resources by students in the test group (badges visible).

The above two graphs clearly show the difference in the number of solved problems in the two groups. In the control group the number of solved problems varies between 15% and 100%, while in the test group the percentages are between 75% and 100%.

The number of students who solved all the problems in the control group was 4 out of 15, while in the test group it was twice as many - 8 out of 15.

In addition to the number of problems solved and modules completed, we calculated the weekly learning time for both groups for the purpose of the experiment. Figures 5 and 6 show that the test group, comprised of students who saw badges, solved the same number of problems faster and in a shorter period of time compared to the control group, which had no badges displayed.

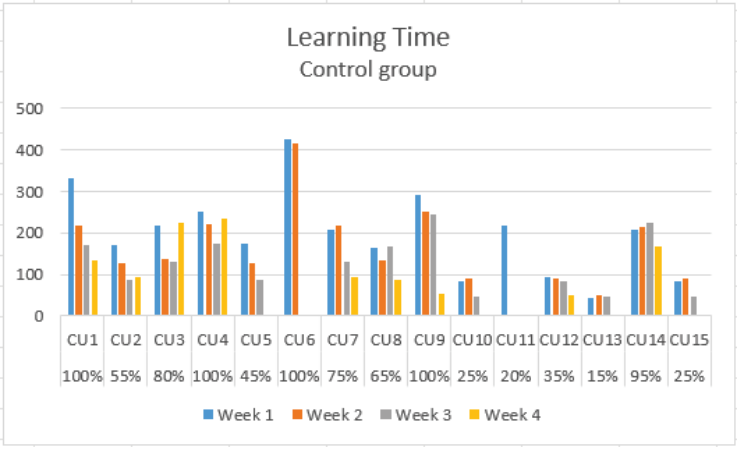

Fig. 5. Weekly learning time of students in the control group (no badges).

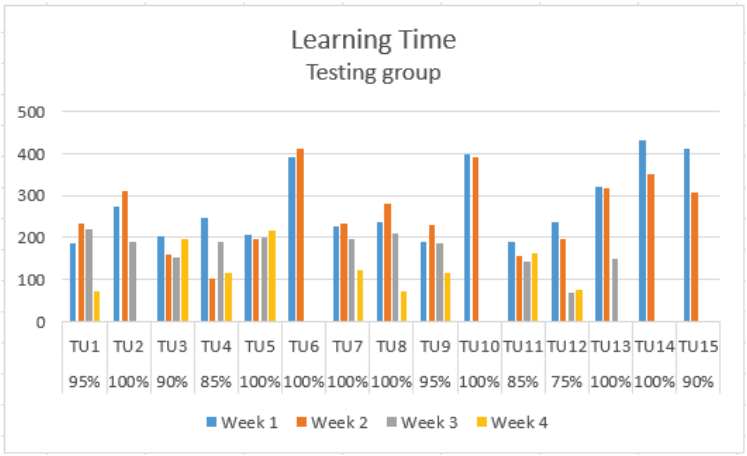

Fig. 6. Weekly learning time of students in the test group (badges visible).

The results of the experiment show that badges have an impact on students' attitudes towards tasks and learning material. After the experiment was completed, it was found (proved) that students in the test group who had seen the badges and knew how to unlock them were more motivated to solve more problems in less time. The badges had a

positive effect for the control group - they promoted the learning process and motivated students to complete their set objectives on time.

5 Conclusions

In this experiment, we added several Achievement Badges to our online learning environment and investigated their effect on students' problem-solving behavior for a specific number of problems. Based on our results, badges seem to be a promising way to motivate and encourage students. Badges should be both challenging and achievable, as well as adaptable, which is an interesting topic for further research.

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