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Analyzing Students' Intentionality towards Badges within a Case Study using Khan Academy

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ABSTRACT

One of the most common gamification techniques in education is the use of badges as a reward for making specific student actions. We propose two indicators to gain insight about students' intentionality towards earning badges and use them with data from 291 students interacting with Khan Academy courses. The intentionality to earn badges was greater for *repetitive badges*, and this can be related to the fact that these are easier to achieve. We provide the general distribution of students depending on these badge indicators, obtaining different profiles of students which can be used for adaptation purposes.

Categories and Subject Descriptors

J.1 [Computer Applications]: Administrative Data Processing – Education. K.3.2 [Computing Milieux]: Computers and Education – Computer and Information Science Education: Information systems education

General Terms

Algorithms, Measurement, Human Factors

Keywords

Badges, Learning Analytics, Khan Academy, Modelling Behavior

1. INTRODUCTION

Gamification techniques in education have been used broadly in the last years. The application of learning analytics for gamified environments in education can bring useful information for the learning process such as students' behavior through gamification (e.g. if they are motivated or not for gamification features). One of the most used gamification techniques in education is the provision of badges. Badges are awards that students can receive by doing specific actions on an educational platform (e.g. for watching videos during some time or for solving a set of exercises correctly). Gamification indicators are not frequently included in those platforms, e.g. the review of indicators reported by Dyckhoff *et al.* [1], does not include any. ALAS-KA [2], a plugin for the Khan Academy platform that provides a set of more than 21 new different indicators related to the learning process, include some general indicators related to badges but they do not describe the intention of students to get them.

In this work, we propose and implement indicators for analyzing students' intention for the achievement of badges, taking into

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account two different types of badges: *topic* and *repetitive* ones. There are other works [3, 4] which have also proposed models of the students' behavior towards badges in Stack Overflow and findings seem to indicate that indeed badges affect the normal behavior of students. The work of Grant & Betts [3], focuses in three types of specific badges of Stack Overflow to see how these badges influence the behavior of students – which is a similar approach to ours as it is very challenging to focus in all types of badges. They found that user activity increased before earning some badges and it would decrease immediately afterwards. However to the best of our knowledge no work has proposed similar models about the intentionality of students towards a badge system as we do in this proposal.

2. MODELLING STUDENTS' INTENTIONALITY TOWARDS BADGES IN KHAN ACADEMY

Students can receive badges as an award for their interaction with the platform. Students can also access detailed information about each badge and the requisites to get it and the student will receive a notification whenever they earn a badge. Our aim is to infer if a student is intentionally completing the badge conditions in order to acquire badges. Taking into account the diverse types of badges, there are some cases in which we cannot infer this information based on the events that the learning platform provide. We focus on two types of badge: *topic badges* and *repetitive badges*.

2.1 Intentionality on Topic Badges (ITB)

Topic badges have a set of exercises as requirement. The student must reach a proficient level in all of the required exercises to get the badge. In addition, in our experiment, the exercises required are not repeated in the requisites of the different *topic badges*. A specific topic badge can only be received once.

We calculate the number of badges the student has received, and compare it with the maximum number of badges the student might have received, taking into account the total number of proficient exercises the user has mastered. Therefore, we would be able to see if the student is trying to maximize the number of badges he/she is earning according to his/her actions.

The system first needs to retrieve the number of *topic badges* that the student has received. Next, we have designed an algorithm which obtains the maximum number of badges that the student could have received with the number of exercises that he/she has mastered. The last step is to divide the number of badges that the student has received with the maximum number of badges that the student could have received with those skills, which gives the ITB indicator.

2.2 Intentionality on Repetitive Badges (IRB)

This indicator is related to those badges that can be earned repetitively. Our goal is to be able to detect if the specific badge was earned as part of the natural learning process or not. Then, we

would be able to detect if the student is intentionally earning more and more of the same type.

Students should solve exercises until the system informs them that they have achieved a proficient level in that skill. Therefore, when a student keeps solving exercises after achieving proficiency in the skill and they earn a *repetitive badge*, we make the hypothesis that they keep solving exercises not to learn (they have already mastered the concept) but to earn more badges. At the end of the process we can calculate the percentage of *repetitive badges* that were intentionally earned (i.e. the level of repeated badges earned without being part of the learning process out of the total number of badges), which gives the IRB indicator.

3. RESULTS AND CONCLUSIONS

In this section we apply the two metrics from previous section in an experiment with 291 students using the Khan Academy platform at Universidad Carlos III de Madrid. These courses are taken by freshmen students in the topics of physics, chemistry and mathematics.

For this analysis we have set a threshold of at least 60 minutes in order to guarantee that the students made some interaction with the platform, discarding students who did not do enough activity. Figure 1 shows the density distribution of both intentionality indicators for all students. The 1st quartile of ITB and IRB indicators is 0, as well as the median of ITB. This means that there are a big percentage of people who despite spending at least 60 minutes, did not show much interest on earning badges, especially *topic badges*. On the other hand the median for IRB is 48.44%, which seems to indicate that students show more interest in *repetitive badges*. The mean value of IRB indicates that the average user earns 39.52% of *repetitive badges* intentionally, which we think is a high percentage. We must state too, that probably many of the students near the 0% of both indicators, probably did not interacted a lot with the platform, as a result, they might be end up classified as having no interest for badges.

A visual look at figure 1 can help understand how these two indicators are distributed among the students. We can see that for ITB, a higher amount of the population is accumulated in the low numbers of ITB, and there are not many users getting between 50-100% of ITB, however we can see a small peak at 100%, who are the set of students showing a lot of interest. In the case of IRB, we can see that there is a valley between 10-30% who are probably those students who interacted with the platform, but did not show interest for *repetitive badges*. Also we can see a moderate peak between 50-75% whom are students showing a moderate interest in *repetitive badges* and 75-100% whom are those showing a high interest. We should note out that to be able to acquire in IRB such high values, you must really put a lot of interest in these badges. Overall, it looks like students felt more motivated towards *repetitive badges* rather than *topic badges*, but we should also mention that as these badges are easier to earn, and that might be why students might feel more motivated towards them. We also found a moderate correlation ($r = 0.445$, $p < 0.00$) between IRB and ITB, which makes sense, because if one student is interested in earning one type of badge, probably the other type too.

Knowing which students are really motivated and challenged to earn more badges, might help in order to be able to adapt their learning process within virtual learning environments, and these indicators can be combined with others for making adaptation e.g. using approaches like [5]. Although these indicators have been

defined for the Khan Academy platform, they can be easily generalized to other platforms. In order to implement these badge indicators in a different context, the intentionality for obtaining topic badges should consider a set of badges for which each badge can be achieved by obtaining the proficiency in a set of predefined exercises. Each badge cannot repeat an exercise as requisite if it is part of another badge's requisites. The intentionality for achieving repetitive badges should consider badges that can be obtained several times for students.

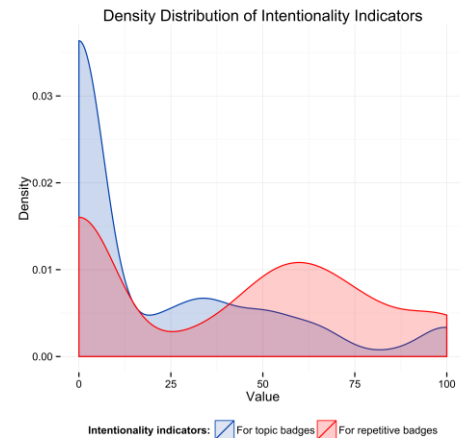


Figure 1. Density distribution of the intentionality indicators.

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