# Personalized Rooms Based Recommendation as a Mean for Increasing Students' Activity

Veronika Gondova, Martin Labaj, and Maria Bielikova

Slovak University of Technology in Bratislava
Faculty of Informatics and Information Technologies
Ilkovicova 2, 842 16 Bratislava, Slovakia
{name.surname}@stuba.sk

**Abstract.** In this paper we present a novel method of navigation in an educational system based on game mechanics levels. We propose a concept called rooms. More precisely, we introduce a navigation based on personalized rooms as a part of gameplay design. The room is represented by a set of items (learning objects) selected adaptively. Its main purpose is a presentation of the recommended items in a series of small sets, which supports activity of the students. In gameplay design we focus on supporting of students' motivation what is the key to increase students' activity. We evaluate our approach using mobile version of an adaptive learning system ALEF in software engineering domain.

**Keywords:** personalized navigation; gamification; motivation; support of activity; personalized recommendation; levels; gameplay design

## 1 Introduction and related work

Important problem in domain of education is a low motivation of students associated with a low activity of students. In accordance with the fact that motivation is the source of any human activity [2], it is necessary to supporting it. Gamification by Zichermann and Cunningham can increase students' motivation until to 40% [11]. The concept of gamification is not new [11]. Many systems use different mechanisms such as leaderboards, points, levels or badges to support a motivation of users [3].

The idea of levels is used in several educational systems. Even though with different forms such as status of student or a level of a game [8], its main idea is always the same – a progress of the student [3], [11]. Level, as a status of the student, expresses the position of the student in the system [8]. This type of the level is used also by an educational system Moodle [6]. The second form of the levels represents typical levels in the games. In this case the content of system is organized into smaller units called levels. One of the systems that use both types of levels is a system Memrise.

Another way how to increase the activity of the students is personalization. Personalization can cause an increase in students' satisfaction [5], what is associated with an increase in students' activity. One of the most popular ways of personalization is personalized recommendation. The recommendation aims to simplify and streamline

users' activity in the system [10], [7]. Currently there are several methods of the recommendation including collaborative filtering, content-based filtering or hybrid recommendation [9]. Educational systems using this types of the recommendation are Wayang Outpost, ALEF, Coursera or Moodle [4].

## 2 Navigation based on personalized rooms

Existing approaches use the levels as a mean to express the progress. However, there is also the potential for use the levels as a tool for navigation while the original concept is exactly used for the motivation. In order to support the activity of students in the system we propose a method of navigation in personalized items. Our method is based on dynamic personalized distribution of items (learning objects) into smaller groups called rooms and navigation between these groups.

The main difference of rooms and typical levels is in distribution of items into the rooms that is based on personalized recommendation of items. The items are selected adaptively based on the configuration of two recommenders. The first recommender hids already solved items. The personalization of rooms is fully realized in the second recommender (realized as IRT recommender) that recommends items from simpler to more complex ones for each student separately. The probability of correct answer of a student to a question is computed through two-parametrical model of an item response theory (2P IRT) that provides information about this probability.

The navigation between the rooms is a basis for the gameplay principle. At the beginning of the week each student has available only one room. Achieving of the necessary activity in the current room is a condition for the opening of next room. Every room can be used to open a new one no more than once. If is the student active enough in current room he/she can open a new room, otherwise he has to work again with the items in the current room (Fig. 1.).

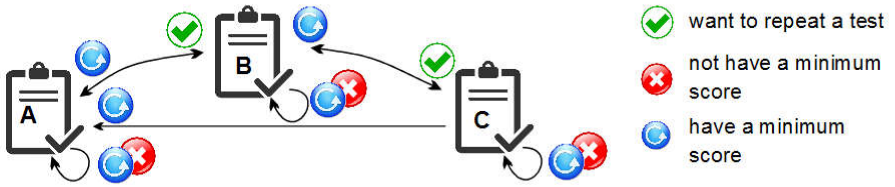


**Fig. 1.** Principle of personalized navigation between the rooms. After completing the test in the room A, a score of A is compared with a threshold score, what can cause the creation of a new room or repetition of current test.

Success of the student's try is determined by comparing two types of scores – threshold score and score of a current try. Threshold score reflects minimal activity that the student has to demonstrate to open a new room. This score represents the score obtained for M average correctly answered items. Score of the current try is a sum of two types of score, score for commenting and score for answering. Every type of the score is regularly calculated and it is dependent on the actual difficulty and importance of items in the current room.

## 3 Evaluation

We integrated our method of navigation in the recommended items into the mobile version of Adaptive Learning Framework ALEF [1] (aleftng.fiit.stuba.sk). ALEF is used by students during the semester as their preparation for entry tests in the course of Software Engineering. It contains a set of questions for every week selected manually by a teacher based on the identification of concepts that are taught that week.

We realized a three-week experiment with 250 students. We divided students into two groups based on the activity of students in the system before the experiment and on their study results aimed to make the groups equivalent. Students in the control group worked with the original version of ALEF and students in the experimental group worked with a new version of ALEF with implemented personalized rooms. We monitored students' activity expressed by the interactions of students in ALEF.

After the first week of the experiment we provide a questionnaire for students to determine if personalized rooms did not cause some problems. This questionnaire was answered by 64 students (44 from experimental group and 20 from control group). Depending on the results of the questionnaire we can state that our method reduces the number of students for which number of items in the system was causing frustration by 21% what is a significant result ($H_0$: The percentage of students which said that the number of items in the system caused frustration is same for both groups; Mann-Whitneyho U test; $p = 0,03412$; $p < 0,05$ - $H_0$ is rejected). The second interesting result of the questionnaire is that up to 86% of students with personalized rooms said that this version of ALEF is better than original version of ALEF.

After three weeks of the experiment we observed 124 active students (61 in control group and 63 in experimental group), 21 674 of students' logs in the system (including 8580 interactions with learning objects) and 37 comments. Our results show that our method increased activity of students (activity = number of interactions with learning objects). The number of interactions in the experimental group was higher by 8% compared to control group. However, this result was not significant.

Despite this our method was able to significantly increase the proportion of interactions to the logs ($H_0$: The proportion interactions / logs is same for both groups; Mann-Whitneyho U test; $p = 0,00548$; $p < 0,05$ - $H_0$ is rejected). It means that our method increased the percentage of the activity that consists of answering to items to total activity of student in the system. Total activity is equivalent to logs and includes interactions with the questions and also the display of a question or correct answer to a question. Another interesting result was a significant increase of comments in the system, while students in the control group added the 7 comments, students in the experimental group added 30 comments ($H_0$: The amount of added comments is same for both groups; Mann-Whitneyho U test; $p = 0,0463$; $p < 0,05$ - $H_0$ is rejected).

The last result is a significant reduction of the interactions of type "I do not know" by 67,81% ($H_0$: The number of interactions of type "I do not know" is same for both groups; Mann-Whitneyho U test; $p = 0,03412$; $p < 0,05$ - $H_0$ is rejected). This type of interaction is recorded as explicit feedback from the students by clicking on the button "I do not know". This result means that our method motivates students to solve questions and not only click on some button to see the result. This difference is due to

calculating the actual score in room. Students get higher score for answering question (correct or incorrect) than clicking the button “I do not know”.

## 4 Conclusions

The goal of our work is to support activity of students. For this purpose we proposed a method of navigation within items (learning objects) based on a distribution of recommended items into the rooms. We evaluate our method through an experiment with two groups of students (experimental condition = mobile ALEF + adaptive rooms and control condition = mobile ALEF without rooms). The results show that our method increase activity by 8%. Our method also significantly decrease number of students, who said that the number of learning objects in the system caused frustration. Another significant result is increase in proportion logs / interactions and number of comments in the system. The last significant result is reduction of the interactions of type "I do not know" by 67,81%.

**Acknowledgement.** This work was partially supported by grants APVV-15-0508, KEGA 009STU-4/2014 and it is the partial result of the collaboration within the SCOPES JRP/IP, No. 160480/2015.

## References

1. Bieliková, M. et. al: ALEF: from Application to Platform for Adaptive Collaborative Learning. In Recommender Systems for Technology Enhanced Learning. Springer Science+Business Media New York, pp. 195-225 (2014)
2. Deci, E. L., Ryan, R. M.: Intrinsic motivation. John Wiley & Sons, Inc (1975)
3. Deterding, S., Sicart, M., Nacke, L., O’Hara, K., Dixon, D.: Gamification. using game-design elements in non-gaming contexts. In: CHI'11 Extended Abstracts on Human Factors in Computing Systems. ACM, pp. 2425-2428 (2011)
4. Drachsler, H., et al.: Recommendation strategies for e-learning: preliminary effects of a personal recommender system for lifelong learners, (2007)
5. Ferrer, F.: Personalisation of Education. In: Personalisation of Education in Contexts, SensePublishers, pp. 109-127 (2012)
6. Kiryakova, G., Angelova, N., Yordanova, L.: Gamification in education. In: Proceedings of 9th International Balkan Education and Science Conference, pp. 32-39 (2014)
7. Michlik, P., Bielikova, M.: Exercises Recommending for Limited Time Learning. Procedia Computer Science. Vol. 1, Issue 2, Elsevier, 2821-2828 (2010)
8. Mullins, W. L.: Game with multiple incentives and multiple levels of game play and combined lottery game with time of purchase win progressive jackpot. U.S. Patent No 6,210,276 (2001)
9. Pazzani, M. J.: A framework for collaborative, content-based and demographic filtering. Artificial Intelligence Review, 13.5-6: 393-408 (1999)
10. Tintarev, N., Masthoff, J.: Designing and evaluating explanations for recommender systems. In: Recommender Systems Handbook. Springer US, pp. 479-510 (2011)
11. Zichermann, G., Cunningham, C.: Gamification by design : implementing game mechanics in web and mobile apps. Sebastopol, Calif: O'Reilly Media, pp. 35-66 (2011)