Gamification enhanced motivational aspects of an e-learning system

Ján Lang, Michal Beliansky, Maroš Urbančok

Abstract: *The paper presents short analysis of e-learning systems and their impact on motivation of their users. Based on the analysis we offer certain specification of the system enhanced by gamification as a motivational aspect. This assumption we have verified over implemented prototype of an e-learning system for object-oriented programming subject. We have tested the direct and indirect applying of the gamification enhanced motivational aspects. Measured data were compared to the real term test results. Recommendations were discussed for future e-learning system implementation.*

Key words: *Motivation, Motivational Aspects, E-learning System, Gamification, Educational Content Creation.*

INTRODUCTION

In each case behavior of an individual may be conscious or unconscious. The behavior is focused on achieving a specific goal that is characterized by a certain degree of strength and duration in time. These characteristics define relatively well the degree of motivation. Motivation is a necessary and very important factor also in the educational process. Learning outcomes depend on the size and the degree of the learner motivation [3]. Motivation is a phenomenon that changes the behavior of a man in time through various internal and external factors. It addresses internal motive of the individual and controls its behavior so that it leads to the desired objectives [5]. In simple we can say that under the internal motives of an individual we see the factors that increase the intensity of performance and behavior. Internal motives are as follows: different social needs, interests, values, ideas and goals that are important to the individual. Motivating by some external factors is successful if at least one from the internal motives of the individual is being influenced. Game elements as the external factors application in an e-learning system for motivation support seems to be interesting.

RELATED WORKS

There are many research activities, articles related to experiments over extending game thinking to non-game contexts. For example [2] which is mostly oriented on video lecturing systems application or [4] which focuses on classroom lectures motivation improvement or [1] which is based on the use of web 2.0 technology options. Still we haven't found the research results of some kind of gamification enhanced motivational aspects of e-learning systems. There are also many applications for mobile devices and personal computers. Some of them are just simple games without connection to any educational content. Memory games are thematically focused mostly on just one topic that can not be changed.

MOTIVATIONAL ASPECTS OF AN E-LEARNING SYSTEM

In our schools, despite the opportunities arising from technological progress traditional education aspects still dominates. Its conventional form is (sparingly but quite interestingly) enriched by computer-aided methods of education management. E-learning is an alternative method of teaching. It's also because it does not only offer information in the form of rigorous text but allows the use of available support for multimedia (video, audio, interactions, games, etc.). The use of an e-learning system allows the teacher to open the content for students, to open solved and unsolved problems in the field or to prepare test questions and use them to test and evaluate students' results.

Game elements implemented in environments designed for learning are those external motivational factors. In this context, we have analyzed the selected e-learning systems. Analysis results and availability of observed properties of the systems are shown in Table 1. Submitted assessment is carried out from a user's perspective. We focused on parts that supported or should support the motivation of students. Among the surveyed systems were identified both advantages and disadvantages.

Table 1. Observed characteristics of selected e-learning systems

	eFront	MOODLE	ALEF
Description and conditions graduation courses/subjects	yes	yes	yes
Explicit identification of objectives	no	yes/no	no
Socialization support among students	yes	no	yes
Position control in charts	no	no	yes/no
Collective/individual statistics, history and activities	no	no	no
Tagging and commenting on materials	no	no	yes
Testing directly in the system	yes	no	no

Based on the analysis we have found a lack of motivation support for students. In two of the three systems we met elements of social groups which provide the student with partial but insufficient information about his current state its position in the learning social group.

SPECIFICATION OF THE GAMIFICATION SUPPORTED EDUCATIONA SYSTEM

For experiment purposes we have designed and implemented a prototype. The prototype logged student's activity in the information system, it evaluated it, and saved the information into a database. Requirements' specification of the prototype was extended by the gamification attribute - success chart of students in comparison to the existing e-learning systems specification. We assumed that watching position in the list of students (in charts) would well motivate students to use the system. We assumed that it would support certain form of curiosity, jealousy or acceptable fear. In principle similarly as in the real life where players are motivated to reach better results than their rival players.

Our goal was to find out the impact of certain form of gamification implemented in the e-learning environment on students' motivation to use this study environment.

We let ourselves also inspired by the Latin proverb panem et circenses (bread and circuses). This proverb describes the approach of the Roman emperors, who for food and games gained the favor of the common people for their goals achievement. Through a game respectively game adaptations of the prototype we wanted to achieve better motivation in using the system and consequently better tests results. To verify eligibility, we used a statistical evaluation of monitored indicators in confrontation with the results of term test in object-oriented programming subject and the questionnaire for students. Functional system requirements were recorded by detailed use cases description and important parts of the model were depicted by the appropriate diagram in Unified Modelling Language UML.

The wide functionality provided by today's computing devices offer comfort in communication, work and entertainment. Availability of communication interfaces and alternative communication networks allows the use of these facilities in areas for which they weren't primarily intended (especially mobile devices). One of them may be the area of education as an inseparable part of human life. The implemented prototype consists of the following parts:

1. Presentation layer (client-side) - HTML, CSS, Javascript, mobile application - game adjusted for education support

2. Application layer (server-side) - PHP, framework Yii
3. Database layer - MySQL

The architecture of the system is shown in Figure 1. Computing devices as clients used by learners could connect to the server side part through the internet. Learning materials and all necessary data (including observable data) were stored in the database. The prototype of the e-learning system we have created on the basis of the available material for the Object-Oriented Programming subject. Content includes textbooks and test questions database. Students were monitored until a term test, which took place in the sixth week of the term. For the analysis we used only the data collected during this period.

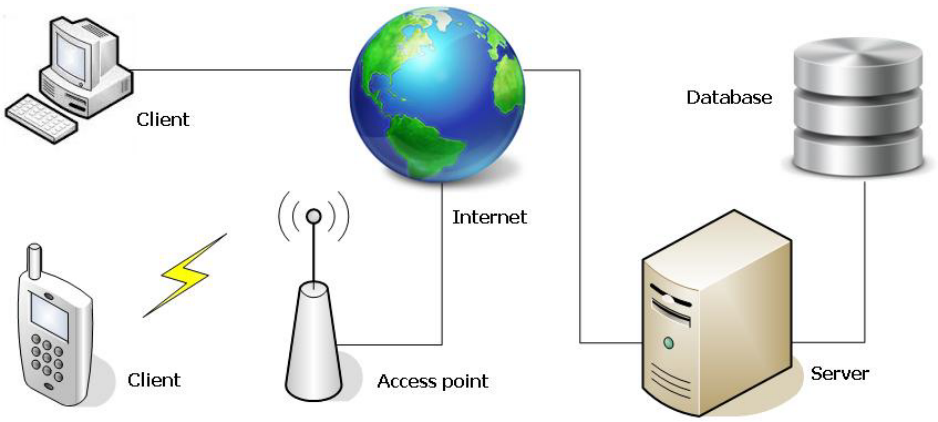

Figure 1. System architecture

Students' activities were the main pursued criterion. They were in some way (anonymously) available to other students in the group. This was the major motivating factor. Among the observed activities were: testing, study of the available materials, reaching the objectives, problem solving etc.

COMPETITIVENESS SUPPORT BY STUDENT INDEX PROMOTION

To establish a rank of competitors is difficult differently in various domains. In our domain student index (rank in the chart) depended on several factors. The index showed the current position of the student in the lists. The lists were created by the system itself based on the student's activity. These lists were intended to give the students up to date information about their status and position in the group. Information about the overall progress of the student had to be expressed simply and clearly by one number. Detailed method of the index calculation is shown in [6].

COMPETITIVENESS SUPPORT BY MOBILE APPLICATION

Students could interact with the content also indirectly by a mobile application implemented for Nokia N8. The application was memory game - pexeso. Education was just a side effect of playing the game. The essence of the game consisted in finding pairs of cards. Unlike traditional pairs they were formed by a question and answer to it. Questions and answers were synchronized from the database of our e-learning system. Within the analysis we found that there are many of similar applications for mobile devices. Although many, but not primarily intended to educate its users even doesn't support education or training.

DISCCUSSION OF RESULTS

Based on the monitored activities of the students in the e-learning system and recorded data, we built graphs showing statistics that say about the overall distribution of a student work time. Reality that the students have used the system is evident from the graph in Figure 2. Following the instructions they should start working from the second week. However, some out of curiosity had activity in the first week.

The principle of learning by imitation is typical for the early period of human life. By aging it loses its dominance but it doesn't disappear completely that's why students' behavior can be explained in this context. In the 2nd and 3rd week of the term students watched rankings especially to control its position in the crowd. Even in the third week more frequently than in the second week. Apparently the same degree of psychological tension resulting from the ratio of expended effort and the elapsed time (the test was scheduled at 6th week of the term, time passed and effort at that time was minimal). The real tempo of the students' work in the first weeks of that measurement is very important information. Given that the students in this period still did not know how much they checked whether their classmates are in the same situation.

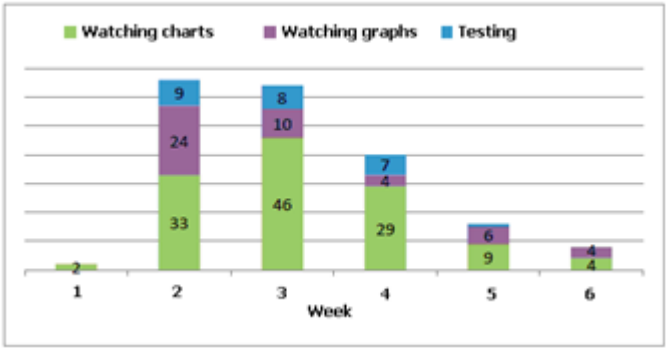

Figure 2. Watching charts, watching graphs and testing

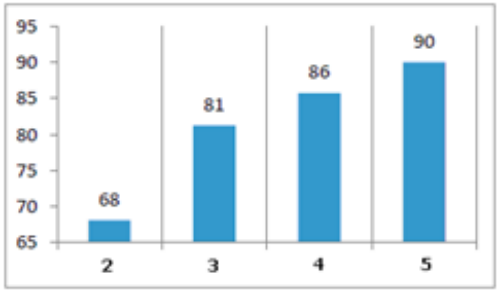

Figure 3. Percentage of tests in %

The interest in watching charts began to decline in the 4th and 5th week. This can be explained by the fact that fears from the failure disappeared or minimized in principle as we see in Figure 3. The success of students in tests from third week is quite high above the 56% which could somehow saturate their need for further education. In the fourth week percentage peaked at mark B (very good). This may be due to the fact that learning replaced testing as shown on the graph in Figure 4.

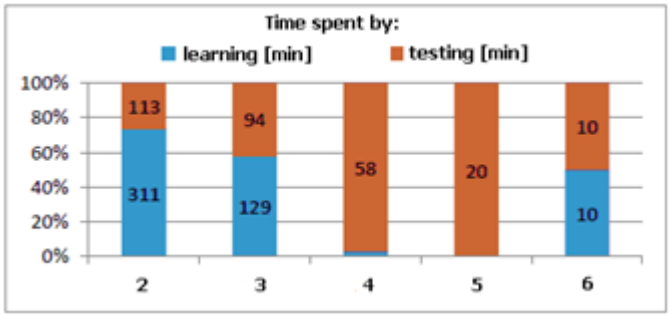

Figure 4. The ratio of time spent by studying and by testing in minutes per week

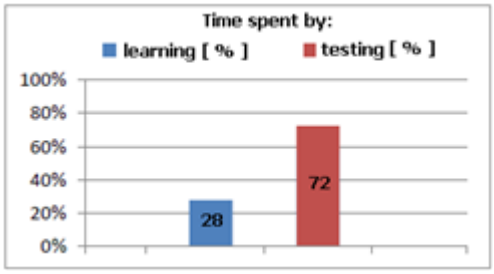

Figure 5. Ratio of time spent by studying and testing for the observed period

Most of the students recognized the more appropriate procedure interactive learning respectively learning by doing. Another interesting finding is that students no longer detect its position in the social group based on its index which reached the average grade of C respectively B as is shown in Figure 4. This again can be explained

that they were used to such assessment from the previous study. Although they spent more time by testing than by studying as shown in Figure 4 from second to fifth week they spent less time for testing in absolute terms. This could be explained by the fact that students already knew more and, thus testing took less time.

After the reported period (from the term beginning to the term test) students completed a short questionnaire in electronic form. Students as the most important reason of using the system for learning and testing using identified curiosity, self-satisfaction and preparation for term test. They did not identify preparation for lectures and exercises. A large part of students did not know to assess whether they were motivated by created events (questions and tasks) or not. Nevertheless they admitted that they were motivated by their classmates results, even they didn't envy them. This argument only confirms the fact that students first monitored the activity of their classmates and acted as a crowd.

Students already in the second week reached results exceeding the limit of 56%. Mutual index tracking of classmates enabled thanks to better results of skillful students to move the crowd - therefore, the rapid onset of knowledge. We understand on the basis of this finding, that by the absence of skillful students the process would start much later. By this finding due to the efforts in creating elite academic groups, we can point out the potential danger.

The system failed to motivate students as a group enough. We consider this from the time spent for learning and time distribution spent for testing and also of mobile application using. Students confirmed that fact in response to a question about the frequency of use of the system in the questionnaire. Most students indicated that they did not learn regularly. In another question, they stated that they were tested on the basis of the results achieved in the system. It follows that some degree of motivation can be attributed to the system.

For complexity we conducted a comparison with the results of the term test. Term test consisted of a similar test questions that were given to students in the prototype to verify their knowledge. 301 students did the test with the maximum of 15 points. The average result is close to 45%, which represents more than 6.5 points per student, which doesn't constitute 56% of the evaluation within the academic scale. Test questions were solved by 112 students from 168 individuals who expressed their interest in using the system. Students developed together almost 2,500 tests with an average success rate of 57.5%. Students had the opportunity to solve test questions generated from a finite set. Their testing was in the nature or repetition or learning to answers. The questions in the test were developed novel. The test was focused on a specific transfer under Niemierko taxonomy.

CONCLUSIONS AND FUTURE WORK

Interpretation of the content supported by elements of the game motivated to activity two weeks before the term test 40% and a week before the term test 15% of students involved in the experiment. In the sixth week 8% of students still used the system. They were students who watched continuously rankings and worked so that their index has always been high on the charts. Majority of the students stopped watching the rankings as they achieved percentage with which they agreed see Figure 2, 3.

When students discovered that events (questions and tasks) from the database mapped well the content for the subject they stopped to study materials and dedicated primarily to testing. Implemented part of the testing was more interactive nature from the student perspective. The ratio of time spent by studying and testing for the observed period is shown in Figure 5.

Element of competitiveness/game was also obvious from watching the placement of students in the generated charts. Motivation for competitiveness declined significantly

before the term test. At that time the students did not mind their position in the chart because they saved percentage in tests ranged above 83% which is the mark B (very good) with which the students were apparently satisfied. This finding is interesting because such acting group was quite significant. This finding correlates Gaussian distribution, which counts more than 90% (about 10% A, 25% B 30% C 25% D, about 10% E) of the total number of successful students.

Gamification introduction to the system was also supported by gaming applications for mobile devices, which has been linked to the data (events, charts etc.) managed by system. Reason why they would not want to use the mobile application for learning was mainly because of the small size graphic elements arising from mobile phone display. Overall, this possibility has not done enough to get the results significantly affected. Investigating the suitability of application deployment can represent our future work. Students identified as inappropriate in the questionnaire.

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The paper has been reviewed.