Engaging Students With a Mobile Game-Based Learning System in University Education

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Abstract — In this contribution we present a game-based learning concept which is based on mobile devices. It focuses a joyful stabilization of knowledge and the engagement of students using the Gamification approach and its game mechanics. Previous findings how to promote students’ motivation are adapted in the mobile context and discussed. Steps for the realization of the concept in a university are described.

Keywords — Game-Based Learning; Gamification; Mobile Learning; Motivation; University Education

I. INTRODUCTION

Due to the mobile diffusion, learning is not a matter of a specific time of occurrence or a particular location any more [1]. This fact offers possibilities to revolutionize the way education is by now. To use these possibilities successfully for teaching, combining mobile learning and game-based learning approaches with Gamification seems a proper chance. This is what Extended Mobile Gaming Education (eMgage) is about. As a quiz-based mobile learning application it is extended with game mechanics to increase students’ motivation and engagement, possibly some of the most important prerequisites for learning [2].

II. CONCEPT

We had the vision to build a system which motivates students to stabilize and extend their knowledge in a sustainable and joyful way with the use of recent mobile technology. After tailoring an agile software engineering process to break down and operationalize these thoughts into appropriate aims as well as to prioritizing them, we came to the following system architecture as a result of the requirements analyses.

The system consists of three parts, which interact together using the internet or a local intranet (see fig. 1.). The mobile server is responsible for providing data to the clients and channeling the communication and interaction between them. The supervising client, a standalone Java client, controls the server, its data and provides instant feedback on mobile clients connected to the mobile server and their actions. The learning application eMgage is a mobile application, based on Android, which is used by students during university lectures or in non-university contexts (e.g. at home). The application provides the following main features:

- Learnsessions capulate different types of questions as a learning unit to a specific topic which can be edited by students.
- Personal profile to inform students about the recent achievements and knowledge state.
- Leaderboard to compare and compete with other participants.
- News area to inform students about upcoming events and learnsessions.
- Question builder to send in new suggestions for questions from students to the lecturer.

A. Supporting the individual learning process

In order to create sustainability in learning, student performances and related benchmarks have to be integrated in a broader process. As a temporal limitation of the process, the beginning and the end of a university course can be applied. The learning application eMgage offers the possibility to support this process by providing volunteer benchmarks on knowledge units as milestones of the process, which – not depending on the grade of success – gives students feedback on their knowledge. Each milestone is connected with the processing of a learnsession by each student, either during lecture or in non-university contexts. learnsessions deal with a defined topic, for example nonfunctional requirements in the context of software engineering.

They contain different types of questions (single choice, multiple choice and textual input) as well as their related answers. Each question is rated with a score and can be supported with different types of media (pictures, video streams, and podcasts).
Students have different types of feedback tools when using eMgage. They derive from the Gamification approach and are summarized under the term “game mechanics” [3].

B. The use of game mechanics in eMgage

Gamification is defined as the concept of applying game-design thinking into none-game applications to make them more fun, engaging and change user’s behavior. Game mechanics are “the mechanics of a gamified system which are made up of a series of tools, that when used correctly, promise to yield a meaningful response from the players” [3, p. 36]. Each feature of eMgage is connected to at least one game mechanic. The learning application integrates the following game mechanics: point systems, leaderboards and badges.

Point systems are described as an “absolute requirement for all gamified systems” [3, pp. 36]. According to the classification in [3] the applied point system in eMgage is based on experience points. This type provides the possibility to observe a learner, benchmark and lead him out of the view of a lecturer. Lecturers could observe the understanding of topics due to the average scores achieved in the related learnsessions. They can react respectively this average score for example by revisiting a topic with a different learning method. A comparable way of instant feedback is already successfully implemented in other learning scenarios like JiTT (Just-in-Time Teaching) [4, 5].

Experience points are expressed and compared in leaderboards. The type of leaderboard implemented in eMgage is described as local (limited to a university course) and non-infinite (limited to the users who participate in that course) [3]. It is used to increase the peer-group pressure in order to let students compete with each other. Due to the fact that every student is rated with the same metric system, performances are comparable. In case a participant recognizes a deficit in a topic he is able to appeal to another participant with a higher score, referring to the leaderboard. That is why leaderboards are often combined with a known and social environment [6].

Badges can be found in everyday life: sticky on the back of a car, as an award on clothes or as a virtual rating on e-commerce platforms like eBay. Besides the aim to signal status and social standing, badges are often used to control or guide a progress [3]. In eMgage there are two different types of badges: performance badges and fun badges. As the term indicates, performance badges are related to student performances hence to a specific metric. In order to achieve both seriousness and fun, special fun badges are implemented. They also use a metric for awarding but are primarily focused on non-performance achievements. An example for an awarding of a fun badge is the submitting of a suggestion for a question.

Fig. 2 summarizes the use of game mechanics in eMgage in a meta model using a UML class diagram. It indicates, that defining a particular metric each game mechanic is an important part of the design [6].

Additionally to the features the learning application offers, there are some more areas of impact which can positively influence students’ interest in a topic and their learning motivation.

III. MOTIVATIONAL AREAS OF IMPACT

Learning motivation itself is hard to foster and describes the willingness of students to address sensory, cognitive and motoric capacities in a predefined learning situation and to coordinate in a way suitable for achieving a clearly defined objective [2]. However, we found four areas to be very effective in increasing students’ motivation and their interest in a topic: arouse curiosity, promote independence, adapt difficulty and create incentives [2]. These can be adapted in the mobile context.

A. Arouse curiosity

A study of the University of Hampshire has shown that more than 70 percent of the students participating in a course use their smartphone more than three times during a course [7]. These findings might not be representative for every university but indicate a high significance of mobile devices for students and their interest in this technology. Hence, most students are familiarized with this medium. In addition human beings have got a natural and “objective interest for everything new” [8, p. 229]. The familiarization with this medium and our natural interest are used to arouse students’ curiosity. This is the reason why eMgage is based on mobile devices.
B. Promote independence

Learning processes are personalized and can differ in time (when to learn), place (where to learn) and context (under which circumstances) [9, pp. 18]. Due to the use of mobile devices these constraints are almost compensated and provide learners increasing independence to structure their personal learning process. In addition, the access to learning material and its sharing gets more comfortable and context specific information is provided just in time. The learning application eMgage profits from these aspects as it uses recent mobile technology.

C. Adapt difficulty

“Learners will only have a joyful learning and develop motivation when they consider themselves to be efficient” [2, p.1303]. An imperative prerequisite to achieve this state is to have a flexible level of learning. It is characterized by the parameters that transfer of learning and level of learning are adequate but still there is something new to discover for learners [2, p. 1304]. The three parameters cannot be ideal provided for each type of learner, but different forming can at least support plenty of different learner types. Therefore eMgage uses a simple but effective algorithm to rate each question on the basis of these parameters (lectures rate on their personal estimation):

- Evaluate each parameter with a value in the range from 1, which means low, to 3, what expresses high.
- Build the arithmetic mean of the three values.
- Ceil the whole arithmetic expression.
- Compute.

The result of this calculation is the score that can be achieved when the question is answered correctly by a student. Certainly there are additional parameters and aspects which have to be taken into account when constructing a learning exercise as described in [10]. In this case the main focus of attention should not be the overall competence-oriented construction of learning exercises, rather the learner-centric and structured sensitization what knowledge can be expected from learners.

D. Create incentives

Incentives like prices or rewards can be used to increase students’ short-term learning motivation [2]. Most of them are limited to the “action-reaction-principle” and are not embedded in a broader process. An example could be the evaluation of a student’s performance during semester by a lecturer where the action is the performance itself and the evaluation result is the reaction in an educational short-term context. A challenge here is to keep students learning motivation high in long-term situations beyond finished student performances. Therefore it is necessary to create sustainability which is not related to knowledge of students in the first place, rather addresses their learning motivation. That is related to the step before learning: promoting the interest in a topic by creating incentives when dealing with it.

IV. DISCUSSION

Game mechanics derived from the Gamification concept as well as our findings offer possibilities to promote the engagement of students. Actually there are some limitations which have to be taken into account when transferring these approaches into university education.

One of the biggest challenges is to combine these approaches in a way that the learning motivation of students does not only depend on the awards which can be achieved. This would imply that an existing intrinsic motivation shifts to a one-sided extrinsic motivation which is not driven by curiosity anymore [11]. In addition a reward approach can suffer under the circumstance that achieved awards do not satisfy students anymore when using them over a long period. Thus incentives have to be dynamic and steadily improved or changed, otherwise the learning motivation is in danger to decrease.

Another important aspect is the kind of person a university is dealing with. Students cannot be compared with each other across-the-board in their personalities. Each student personality is individual and the motivation to use and play with such an application can differ widely. Consequently competing with other students can work well or will just have no effect on some individuals [12]. Nonetheless many researcher support the thesis, that mobile learning can actually revolutionize learning issues: “Mobile devices really make a difference in education. Their possibilities allow defining new kinds of scenarios that improve motivation, increase retention, enhance creativity, facilitate more flexibility” [13, p. 5].

V. eMgage at the Kempten University of Applied Sciences

A. Basic situation

At the faculty of computer science at Kempten University of Applied Sciences the total number of students in our software engineering courses is about 50 – 100 each semester [14]. The software engineering education is placed in the bachelor programs in computer science and business informatics. We tested the application eMgage in some of our labs. As we expected the students liked to interact with eMgage.

B. Next steps

Actually we have all the prerequisites to integrate eMgage in our software engineering courses and examine the impact of using eMgage. Further steps ahead are:

1. Deploying the mobile server and installing the supervising client.
2. Roll out of the eMgage client on the smartphones offered by university or owned by our students.
3. Preparing learnsessions, related questions and answers for eMgage.
4. Preparing different badges and metrics for eMgage.
5. Practically integrating eMgage in our courses.
6. Examination of the answers of our students.
7. Increasing the intensity of subjects of the course which are supported through eMgage where students have problems.
8. Examination if the students have a better understanding of a subject.
9. Repeating steps 3 – 8 in order to get significant empirical data.
10. Evaluation with users (students and lectures) who were not involved in the development of eMgage.

After the completion of these examination tasks in 2014, there will be a result publication which summarizes our findings.

VI. SUMMARY

In this contribution we presented a concept for a mobile game-based learning system. We described the features of eMgage and their realization with game mechanics and furthermore the relation between them. Our previous findings in increasing the learning motivation of students were adopted in the mobile context. Possible areas of motivational impact and their limitations were shown and discussed. Furthermore we presented the current state and the next steps in order to integrate eMgage in our courses.

REFERENCES