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RAPID PROTOTYPING OF MOBILE LEARNING GAMES

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ABSTRACT

This position paper presents the first results of an on-going project, in which we explore rapid prototyping method to efficiently produce digital learning solutions that are commercially viable. In this first phase, rapid game prototyping and an iterative approach was tested as a quick and efficient way to create learning games and to evaluate them by a group of experts. The experiences of the process were positive, as the first prototypes produced were very useful as concrete presentations of the ideas for evaluation. In the next phase, the game prototypes will be tested by teachers and pupils.

KEYWORDS

Augmented reality, education, game design, iterative development, learning games, mobile learning, rapid prototyping, video games

1. INTRODUCTION

Use of both mobile devices and games in education are gradually gaining wider acceptance. Additionally, the recent active discussions of the Bring Your Own Device programs in schools indicates that students using their own mobile devices as learning tools may soon be reality, especially in cases where the schools can't afford to introduce one-to-one programs (Lai et al. 2013). As a first step, elementary schools are likely to adopt small "drill and practice"-types of tasks, in parallel with the traditional educational materials. However, a challenge is how to produce large amounts of games for different kinds of learners, various subjects and age groups, and how to develop pedagogical mobile games cost-efficiently. In general, the mobile games are usually suitable for short term use for a certain student group (drilling). There should be a wide variety of games in order to be able to enrich the traditional learning material and to support differentiated learning (Paavilainen et al., 2010).

This position paper provides the mobile learning community with insights to methods and collaboration networks that can be necessary when aiming to progress from mobile learning game pilot projects into sustainable commercialized applications. In pilot projects the applications can be developed for short-term use by a selected group of people only, and reproduction of the prototype and support of different devices are necessarily not taken into account. However, these usually are the very first challenges that the developers are posed with when working with producers of commercial educational services. In this study, we aim to decrease the gap from the ideas and prototypes to commercial services by a rapid procedure for presenting and evaluating games and by utilizing methods for collaborative development. With the procedure we aim to support the renewal of production processes of existing companies to enable more efficient development of engaging learning experiences provided by mobile technologies. This position paper presents experiences from the first phase of our study, where we have explored rapid prototyping method (Chua et al., 2010) as a tool for young programmers and as a way to quickly produce simple prototypes for evaluation by the stakeholders. In the next phase of the research emphasis will be put on creating processes for the companies for collaborative rapid development of commercially viable learning games.

2. METHODS

2.1 Rapid Game Prototyping

The rapid game prototyping method was utilized in student projects carried out at the Nokia Student Innovation Lab. The Student Innovation Lab is a unit of Nokia Corporation where high school students of Päivölä Mathematics School are offered two year traineeship which they attend in parallel to their upper secondary school studies. Eight students participated in this project during the spring term in 2013. The trainees had some initial programming experience but very little formal training. The platforms used in the implementation have been Windows Phone and web environments.

The challenges of software development projects can be divided into four categories: communication, collaboration, technical, cognition (Begel & Simon, 2008). The rapid prototyping approach takes a stand on each of these challenges. Communication and collaboration are forced by the tight schedule, and under the time pressure, students naturally increase the amount of communication and improve their organization. Having a new technology in use and as the focus of the project helps them to fix simple enough goals. The cognitive challenge is the biggest problem with inexperienced software developers. Young students often fail to identify when to seek help early enough and this has a high cost in motivation.

Rapid game prototyping has been inspired by the Global Game Jam[1] culture. The weekend long game building competitions that online communities started to host about 10 years ago showed the world that a small team can build a working prototype of their game idea within a very limited amount of time. On the other hand, the game design research community also presented highly positive results from testing various methods of iterative paper prototyping.

The target in the rapid game prototyping method utilized in this project is twofold. First, the idea is to use the method to create and initially test game ideas. Working prototypes of the game ideas help in communicating the idea as well as in evaluating the idea. Second target has been a learning process for the students involved in the prototyping. Through the use rapid prototyping method, the students learn to concentrate on the essential aspects of their idea, they learn programming, how to reuse code, get feelings of success and do not have the possibility of falling to the trap of endless polishing of their game.

The rapid prototyping method used at the Student Innovation Lab has been as follows. The work is done in six day cycles. Within the six days the trainees create a game idea, design the initial game and implement a working prototype of the game.

2.2 Iterative Procedure for Developing Learning Games

The steps of the iterative procedure (see Ollila, 2009) used for developing the concepts from the first rough idea or specifications to a refined prototype or even a product are presented in Figure 1. Two essential aspects in the procedure need to be emphasized: evaluation and decision making based on that, and speed of each iteration round.

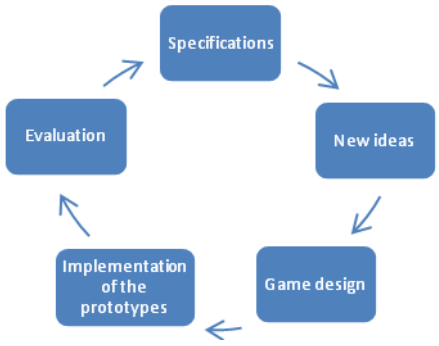

Figure 1. Iterative procedure for developing learning games.

[1] http://globalgamejam.org/

During the spring term 2013, The Student Innovation Lab trainees worked on the project for 15 weeks, two days a week which made it possible to carry out five iteration cycles. Two teams continued to further develop two of the game prototypes during the summer break when the trainees worked full time for a period of six weeks. They implemented altogether 19 game prototypes. Most of the prototypes were implemented for the Windows Phone 8 mobile operating system. Additionally some prototypes were also implemented for running on web browsers on any device running a modern browser. The prototypes were reviewed by the project team consisting of game and user centric design experts and two prototypes were selected to be further developed by the student teams during their summer internship period. Originally the game ideas and prototypes where implemented for mobile phones as basic on-screen games, but at this stage it was decided to test applicability of augmented reality elements with these particular games. VTT's ALVAR library for implementing augmented reality was used and the implementation platform was changed from mobile to PC.

3. RESULTS

The number of prototypes produced during the iteration rounds in this project are presented in Table 1.

Table 1. The number of prototypes produced and evaluated during each development phase.

Development phases	Nbr of prototypes	Evaluators
First ideas by the students	19	Project team (& provider of educational services)
AR game concepts	2	Project team
Refined concepts (company partner)	2	Project team, teachers

During the spring the developed prototypes were evaluated and commented by the project team of experts and some of the prototypes also by an educational services provider. From these evaluations the students received feedback on their ideas and implementations and were given further advice to take into account in the forthcoming prototypes. In the next phase two prototypes were selected to be further developed as the summer projects of the trainees. The selected games were called Laser Game (Figure 2) and Molecule Builder. These two games were selected as they were considered, by the review team, to have interesting potential to be intriguing learning games. Also these two ideas were considered to potentially benefit from adding AR elements into them.

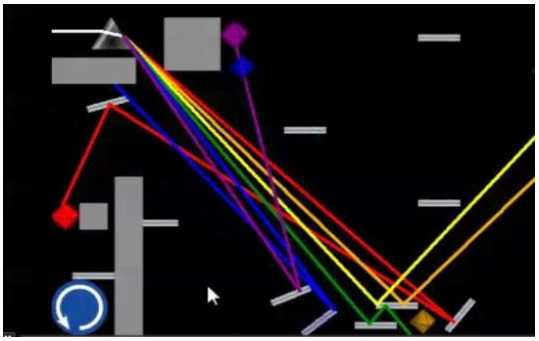

Figure 2. Laser game (the first prototype, no AR-elements)

Laser Game is a game where the player learns some basics of optical physics by directing laser beams to a given goal with the use of optical elements such as mirrors and prisms. Molecule builder is a game for learning organic chemistry. The aim is to repair broken molecules by first collecting needed molecules, then breaking the molecules into elements and finally placing the correct missing elements to the molecule under repair. Augmented reality with 3D-models is used to help the player to understand the 3D-nature of the molecules.

In the next iteration cycle, the prototypes were further refined and taken to user testing by teachers and pupils.

4. DISCUSSION

When starting our project, we identified a clear need for collaborative agile procedures where expertise from various disciplines could be efficiently combined. Creation of partner networks is a central part of the development of work processes. In order to support the adoption of new digital solutions in schools it is feasible to link them with the existing solutions or learning materials, and to build on the learning entities that are familiar for the teachers. We believe that this is a feasible approach for establishing sustainable and extensive mobile learning solutions, instead of small scale applications and pilots.

The first prototypes produced by the Student Innovation Lab were promising and extremely useful as concrete presentations of the ideas for the evaluation by experts. The rapidness of the development was impressive. In the next phase we need to develop the processes for more focused application development, both with regard to pedagogical content and game design. However, even though the process itself was very successful and the trainees were very good at bringing their ideas to prototype level, it seemed that by narrowing the scope of prototyping to a specific area resulted in a decrease in creativity of the development teams. Earlier project, which did not have a similar specified target, ended up with much more creative ideas. So, the question is, did the goal of creating learning games limit the creativity of the teams?

The concepts that were developed in this first phase based mainly on use of the mobile device as a technical tool that is easily available for the learners, in the classroom or elsewhere. However, none of the concepts made use of the mobility of the learners and/or the special features of a smartphone, like e.g. camera, location information or communication features. In the future, these are also features that the students could be guided to utilize in their concepts.

5. CONCLUSIONS AND FUTURE WORK

The rapid game prototyping method proved to be very suitable for quick and efficient prototyping and evaluation of game ideas. Also, for evaluation of game ideas, the different viewpoints coming from provider of educational services, researchers and game designers made it possible to thoroughly discuss the strengths and weaknesses of each idea and how to improve the ideas. When creating new ways for producing learning solutions, procedures that help to create mutual understanding and to visualize the goals are extremely useful. The collaboration between companies and educational institutes, and combining simultaneously students' learning objectives and involving them in a (pre-commercial) co-development project were also regarded as promising initiatives that should be further explored.

Questions that remain for future research are whether the quality of the prototypes or the originality of the ideas improves in the process, as well as how the creativity and motivation of the young trainees will be maintained as more strict specifications are given. In the next phase of the project, the goal will also be to develop more refined prototypes with commercial potential and to determine a more structured process for collaboration between the partners. As more partners will be involved and more specifications will be needed, special attention needs to be paid on efficiency and rapidness of the process, to reach to cost-effectiveness goals.

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