

## Students designing educational games

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### Abstract

When teachers try to implement game-based learning, they always have questions like: What kind of games should we use? How high is the educational value of the game? How much do the students like the game? One safe way to answer these questions is to let the students develop the educational games instead of playing the games - the focus can then be on the process of developing the game. This article describes a case-study in which 11 - 12 year old students designed educational games for learning English as a foreign language.

**Keywords:** game-based learning, digital game-based learning, project-based learning, game design, game development, serious games

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### 1. Introduction

Digital game based learning is a growing trend in education. This is an approach by which educational objectives are integrated with game activities. Students identify and try to achieve game goals (e.g. win against a competitor or complete a level) while also acquiring certain knowledge or skills. There have been several attempts to implement commercial video games with educational activities, but this is not widespread, mainly due to the expense of licenses and hardware. Another alternative is to develop games that have educational value - so called educational games or serious games. Due to a lack of resources and knowledge (teachers

don't know how to design games and designers are not familiar with pedagogy), there are not many educational games available. Some have even said that if we take the poorest video game and add the simplest pedagogy (like drill and practice) then we get educational games [1]. So how do we make serious games that have higher educational value and attract students' attention at the same time? We can't compete with commercial game developers - their games always look more attractive than serious games. Students see these games and are not interested in playing a game that looks inferior to the ones available from commercial competitors. But what if we focus on the game designing process instead of the outcome? Game design as a learning activity can be the objective itself [2]. Students are no longer game users, but creators

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and consequently they can't complain about the poor quality of the game interface.

This article describes how students in the 5th grade were asked to design a game that teaches topics of English as a foreign language. The case study is part of iTec project pre-pilots. iTec is an FP7 project whose goal is to develop learning scenarios and tools to engage students. The intent of this article is to provide a good example of how to motivate students and integrate innovative activities into teaching.

## 2. Background

iTec (<http://itec.eun.org/>) is a European project whose goal is to engage students through innovative learning activities and tools that support those learning activities. It involves different research institutes, universities, technology providers and representatives of ministries of education from 23 different countries. The coordinator of the project is European SchoolNet. The project is divided into five cycles. At the beginning of each cycle, innovative and engaging learning scenarios are developed. Out of several scenarios [3], one is selected and pre-tested in focus group schools. Based on the results of tests, teaching tools are developed. Finally the same scenario with tools is tested on a larger scale (200 schools in Europe). For the third cycle of the project (from January to December 2012) the scenario of "Students Designing Educational Games" was selected and pre-tested.

Using commercial games during learning activities or designing educational games that have clear teaching goals is nothing new, but this is still an approach that is rarely used in schools. This is because of its demands on technological resources and the amount of time needed to play the games. Still, an analysis of the IT industry shows that *gamification* (applying game elements like fun, play and passion in a non-game situation) will be a growing trend in the near future [4]. The easiest way to start game-based learning is to take existing commercial or educational games and combine them with curriculum topics. Unfortunately ready-made games cover a very

narrow part of the curriculum and playing games is time consuming. Another approach is to ask students to design educational games. In this case, game-based learning is shifted towards project-based learning, but it still contains important elements of games (e.g. to make a good educational game one should be familiar with the examples from that field). The learning activity focuses on the process instead of the outcome. The result can be a working game, although this is not always the case. The process can end with the paper-based prototype, with a game specification document or with a presentation and selling the game idea to an imaginary financier.

Game development as a learning activity is harnessed successfully at the university level [5] especially in courses that focus on game interaction or using game design as an example of larger software development projects. Game design approach is spreading also in primary and secondary schools [6]. Game development is a suitable activity for interdisciplinary projects, because it covers a wide range of topics like graphic design, defining game rules and logic, sound editing and programming. A good example is the development and implementation of *Scratch* – a programming environment for students. [7]

There have been attempts to use gamification in the process of designing educational software [8]. The design of educational games by students in primary and secondary school grades has not been investigated yet.

## 3. Description of the case

The Future Lab ([www.futurelab.org.uk](http://www.futurelab.org.uk)) - an iTec project partner organization – created the learning scenario in which students were given the opportunity to design educational games. It was selected from a list of learning scenarios as one of the most interesting and promising ones by project partners. After that it was tested in 9 pilot schools in different countries across Europe. One of these pilot schools was Gustav Adolf Gymnasium in Estonia. The following description outlines the case study at a national level. Data was collected through the internal

course blog, teacher's blog and an online interview.

### 3.1. Learning scenario

Originally the scenario was focused on developing math games for the secondary school level, but because it is difficult to find many secondary school math teachers who are willing to test this scenario in everyday teaching conditions, it was accepted that this scenario could be modified in terms of school level.

Next, there is a short overview of the original learning scenario [9]:

- To help the students understand that games can also have educational value, they are asked to present and describe games that seem to have teaching value to them.
- Together they discuss what makes a game interesting as well as educational and what criteria should be used to measure a game?
- The students then select a topic or concept from the curriculum that can be the starting idea for game development.
- Based on the idea, the students design a short, simple game and make drawings of the screens, levels and game elements and logics.
- After that they develop the game with the help of Scratch.
- If needed, the students can involve experts (e.g. teachers of other subjects or specialists from the game industry).
- Finished games or prototypes are published on the Internet (e.g. on the Scratch web page).
- Based on criteria created at the beginning of the process the students evaluate each other's work.
- Younger students are asked to play and test the games.

This project can be conducted both as individual or team-work.

### 3.2. Modified scenario

In reality this scenario was adjusted according to local conditions. The case study was conducted among a group of 15 students from the 5th grade (11 to 12 years old). It turned out that learning activities mentioned in the list above took a longer time than expected. One lesson (45 min) was spent per activity on average. Because this project started at the end of the school year there was not enough time for all the activities [10].

**Lesson 1** – In the introductory lesson, the teacher discussed with the students their learning preferences. Many of the students mentioned they'd rather study in a smaller group. They admitted solving home tasks by contacting each other via the Internet. After that the teacher guided students to the topic of educational games, where they were asked to find and describe games that seemed educational to them. That activity was also their personal home task and the results were presented in an internal group blog.

**Lesson 2** - In the next lesson the students presented their games to the class. Students evaluated the games and discussed their educational value. Evaluations were presented in the group blog as comments to game description posts. Students were asked to measure the educational value of the games on a scale from 0 to 5 (where 5 represents the most value and 0 has no value at all). It is hard to say how well the results describe the educational value of the game because the score also reflected how good the presentation was and how well liked the presenter was, but it still provides some information. Students were also encouraged to comment on the games. Teacher described this lesson as the most interesting one during the entire school year. Students were extremely interested in each other's findings. They were attentive and focused.

Games that were presented by students in the order of their educational value (evaluated by the students):

- Estonian Quiz – a board game about facts related to Estonia (<http://www.tactic.net/site/product.php>)

Product\_number=02382&category=Trivia&lang=EST).

- Listen – a CD based learning game about listening to English words
- Domino Quiz – a board game with domino tiles and question cards
- Professor Layton – an adventure-puzzle computer game where the player solves different puzzles (<http://professorlayton.nintendo.com>)
- L.A Noire – a video game where the player is a detective and solves different crimes (<http://www.rockstargames.com/lanoire>)
- Sims 3 – a simulation computer game about building the home and managing social relationships (<http://www.thesims3.com>)
- Little Big Planet – a game with a lot of puzzles and levels (<http://www.littlebigplanet.com>)
- NBA 2k12 – a basketball sports game (<http://www.2ksports.com/games/nba2k12>)
- FIFA11 – a football sports game (<http://www.ea.com/soccer/fifa>)
- Portal 2 – a puzzle video game (<http://www.thinkwithportals.com>)

Students also assessed what makes games educational on a qualitative level. What are the criteria for measuring the learning quality of games? Most of the students did not provide any ideas, but some of them mentioned the following:

- The game must be educational - to teach some practical skills or knowledge that can be used in real life. (Based on the comments of one student, we can say that young people of this age group do not see analytical thinking as a useful skill).
- The game must be interesting.
- The task in the game can't be too trivial.

These criteria can be a good starting point for evaluating games designed by students.

**Lesson 3** - Brainstorming for game ideas. Because this project took place at the end of the school year, the students were first asked to point out any topics suitable for games that they had during the previous school year. After putting the ideas into a list, the students

organized small teams around the idea. For composing the list of topics and making groups, the TeamUp Tool (<http://teamup.aalto.fi/>) was used. This is a tool that divides students into teams automatically.

The students were then asked to generate ideas suitable for educational games based on the topics already mentioned. The focus was on game design. They were not forced to finish the product. The game format was left open – both computer and board games were accepted.

Most of the game ideas were related to vocabulary taught during the 5th grade. One game focused on a narrower topic - dogs.

**Lesson 4** - During the last lesson students were asked to design game logic and make sketches of game interfaces or boards.

### 3.3. Games designed by the students

Here are some examples of games designed by the students.

**Escape from the Zoo computer game.** Animals from the zoo - monkeys and bears - get out from their cages and approach the zoo gate. They throw bananas and apples toward the player. The player has to avoid being hit by the flying objects and has to catch animals by translating and typing in words attached to the animals.

**Angry Dog computer game.** There is an angry dog on the road that tries to bite the player. The player must pass the dog and avoid being bitten by guessing and typing in the answers to the questions asked by the dog. If the player answers incorrectly the dog bites. Each bite reduces the player's health level. Each correct answer leads the player closer to passing.

**Dog board game.** The game-board is in the shape of a dog. Players have to roll the dice and step on the board. Different spots on the board have different numbers that are related to the activity cards. Players can conduct four activities such as:

- Translate items and aspects related to dogs from Estonian to English,
- Translate breeds from English to Estonian
- Answer questions about dogs.

Name body parts or items related to dogs in English.

#### 4. Conclusion

In total, students spent four hours on the scenario. It was not expected that students would finish their games, but one of the girls did finish the Dogs board game as an individual task and presented it to the teacher.

Because the school year was ending, students did not have time to develop the game, although they had had previous experience with the Scratch programme. During another course, they had to develop animated fairy tales.

In general we can say that the “Students Designing Educational Games” learning scenario is in accordance with iTec project objectives - to engage students through innovative activities.

The biggest risk, related to game development activities, is the fact that teachers are not familiar with the essence of game development or developing any other products. This aspect was also mentioned in the national project coordinators online meeting that was organized for the closing of the testing period. Participants in that meeting assumed that teachers were familiar with guiding projects for developing learning materials. Taking into account that educational games are learning resources, the development of serious games should be a suitable activity for teachers.

Another concern was related to the relatively long duration of the scenario. It had many important and interesting learning activities and sometimes it was too hard to find extra time in the lesson for additional tasks such as idea generation and code writing. To decrease this barrier, teachers could modify the scenario, leave out some activities or change selected activities. For example, in similar learning scenarios, younger students are asked to test the learning resources (also games) created by the older students. Usually teachers don't have time for this activity. One option is that students from the younger class could test the games created by the older students during the following school year when they reach the corresponding topic in the curriculum.

The final concern that teachers had was the question of how reasonable it is to integrate games and game design into learning activities. This case clearly showed that integrating game elements with educational processes could increase students' motivation in school and increase interest in learning. It doesn't mean that every activity has to be playful. Life is full of uncomfortable issues that cannot be resolved in a playful and enjoyable way. From this point of view perhaps the methods that teach us focusing and concentration (like yoga) become more valuable. Nevertheless, game-based activities provide pleasant variety in a traditional and strict school system.

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