

# Multimedia resources as a complementary tool of teaching and learning. Case study of a game designed to teach immunology contents.

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## Keywords

Multimedia resources, game, immunology, medical education, e-learning.

## 1. ABSTRACT

In 2003 the University of Porto recognized the potential of internet based learning systems and in that year started a project to implement the use of learning management systems (LMS) in classes based on a blended-learning model.

The implementation of this project at universities large as the University of Porto (U.Porto) was a complex process that necessarily involved a large number of actors, so it was necessary for the University to define new ways to resolve their constraints. One of the strategies defined was through the Unit for New Technologies in Education (GATIUP) gives direct support to the teachers who wants to use e-learning platforms and also support the development of relevant educational multimedia contents to be used in the courses.

In the last years the number of teachers at U.Porto interested in multimedia contents with educational purposes grew, and the number of requests that arrive at the unit increased. To demonstrate the importance of this type of resources we intend to shortly present here one of ours recent works: a game based on basic immunology learning contents.

In this paper we intent to provide a brief description of what is one of the biggest concerns of today's University of Porto, the support of use and development of educational multimedia resources. We intend in a few words present a successful example of an Immunology course that uses multimedia contents - specifically games conceptualized by students - to support learning.

## 2. DEVELOPMENT OF MULTIMEDIA RESOURCES AT UNIVERSITY

The word multimedia means using two or more digital contents in a single application. These contents may be text, video, images, animations, sound, and simulations. This is an area that is constantly evolving and we can say that they are always emerging innovations in the development of multimedia and its application.

GATIUP has eight graduate collaborators, with different backgrounds, as Biology, Chemistry, Engineering, Multimedia Technology and Education & Technology, but all with specializations on e-learning as well as continuous professional development on this area. In combination with their daily work with focus on e-learning, to encourage a more completed teaching and learning process using new technologies, one of the most relevant activities that GATIUP also sustains since 2003 is the development of educational multimedia resources. The office has a small multimedia production team (four persons) that develops several contents requested by teachers that use the University e-learning platform.

The content types for which the team has development capabilities include: animation; simulation; video and audio (capture and edition); image (photo, illustration, paging, brochures/posters...); and web design (websites and other type of web documents).

In the last years the number of teachers interested in multimedia contents grew and the number of requests that arrive at the office increased. This service is available to all the teachers regardless of their area and the only requirement is that the content is requested by teachers who are following a blended or e-learning model.

All the requests are made through a form at the e-learning portal (<http://elearning.up.pt>). After receipt in the 1<sup>st</sup> stage the request is evaluated to see if it is liable to be executed by the team and achievable within the time appointed. If there is any probability that the team can not do the work for lack of expertise or short deadline, the teacher is immediately notified. However, regarding the deadline - which are often too short taking in consideration the number of products requested and the number of elements that work in development - the office always tries to discuss the delivery in order to satisfy the request.

Once analyzed and accepted in the 2<sup>nd</sup> stage the request goes to one member of the multimedia team and is allocated according to the type of content (who has more knowledge in the area), time available and priority level.

In the 3<sup>rd</sup> stage is necessary to organize a meeting between the teacher and the developer in a way to better define the concept of the product/content, this is probably the most difficult phase because most of the contents will concentrate on educational issues on which the team is worldly (e.g., civil engineering, pharmacology, psychology, etc.) and sometimes even though the teachers are asked to bring some materials to facilitate the developer understanding they only bring a vague idea of what they would like to do. So in recent years, the teacher is asked to send to the meeting a storyboard of the content, for example, if it is an animation in the storyboard they should describe each objects to be included and their behavior and specify the type of interactivity that the user will have with the interface. With this storyboard the developer can have a clearly idea about what is expected and it will be easier to understand the concept. To design the product is necessary to understand the concept, so it's almost as if the teacher had to teach a class on a particular issue to the development team and together they have to "build" a prototype.

After the elements of context have been defined the developer proceeds to the 4<sup>th</sup> stage. This is the phase in which all ideas will be implemented. By this time, is important to have detailed ideas on the content like the interface, language, interactivity, objects and what will be the combination of media elements. During this process the communication between the parts still active. When the prototype draw in the previous phase is developed, the product is sent to the teacher for correction and validation. Following the corrections indicated we enter in final stage, the changes are made and the product is sent back for validation, when approved is given as finalized and is sent to the teacher.

Is important to point out that the copyright of the product belong to the University, however, because the scientific coordination is made by teachers and the contents are mostly developed to be used in theirs course units, they are never published or used without mutual authorization.

### **3. IMMUNOLOGY CASE STUDY**

#### **3.1. Background**

The Immunology Department from the Faculty of Medicine is responsible for the undergraduate medical education in the field of immunology both to medical and dentistry students from the University of Porto. Immunology is a diverse and growing unit course that can be defined as the study of the cells and molecules involved in host defence mechanisms and disease processes where these mechanisms are disrupted. The goal is to provide students the knowledge of how the immune system develops, how the body defends itself against disease and what happens when it all goes wrong. One hour lectures are given twice a week and 90 minutes seminars every other week. Final grade is based upon final examination score (0 to 20) adjusted with student's performance during seminars and online quizzes.

### 3.2. Aim

In the last few years the appearance of new educational technologies, namely the use of web based systems, has provided educators with new tools to enhance the teaching of several areas.

In the academic year of 2007/2008 was proposed to students the creation of games based on the course unit learning contents. The results obtained with these games on paper were the motivation for a web-based knowledge game (based on the original board game by *Eckert GU et al. Med Teach. 2004 Sep; 26(6):521-524*) named "Who wants to B a lymphocyte?", that will be described. The aim of the teachers of Basic Immunology was to develop a web-based knowledge game on immunology for third-year medical students and compared the performance of students that had contact with this game with students that only had access to classic teaching lecture.

### 3.3. Game development

A game was designed to boost student learning in the field of B cell development, activation, and differentiation. The game consists in a simulation, built in Adobe Flash 8, which includes, 80 questions elaborate by students.

The game software was developed by the GATIUP and is played with virtual dice and "B cell-pawns" by as much as 3 players (Figure 1). At the end of the game board, there is a path with a total of 55 squares. This path contains 16 numbered squares with a question mark (Figure 2). The players roll the dice to decide to move their pawn according to the number rolled. Whenever a player lands on a green square has to provide the correct answer to two questions, that are sort randomly, in row in 30 seconds each (Figure 3). The objective is to reach first square 55.

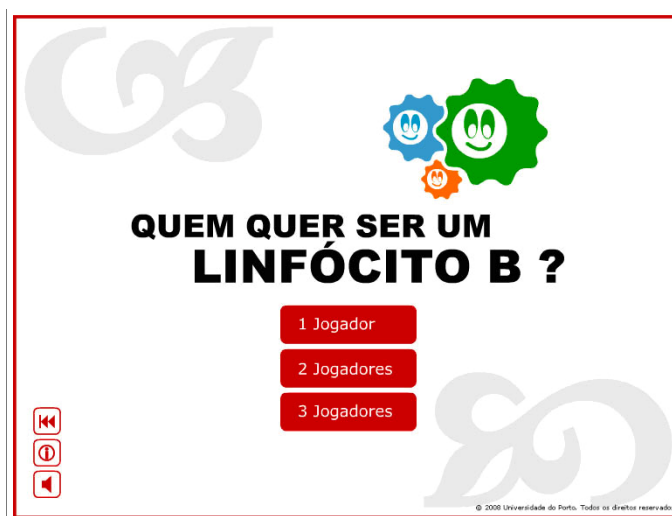


Figure 1 Beginning of the game and selecting the number of players.



Figure 2 Game board with players in action.

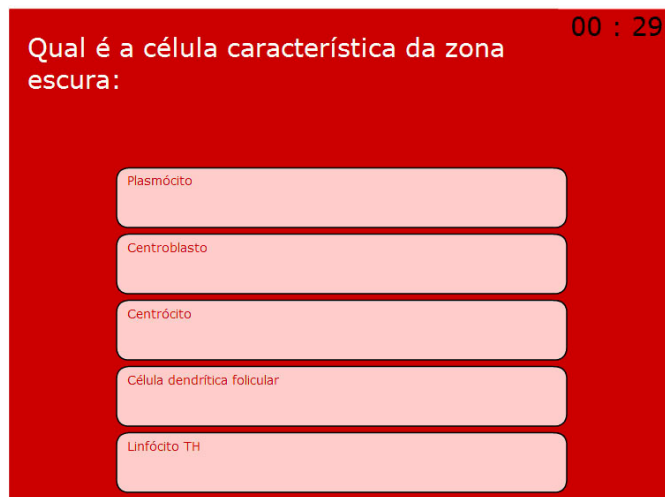


Figure 3 Page with a question and the time counter on top.

The importance of this game was confirmed by some tests made with students in the presential classes, and from our point of view is clearly a relevant study tool to the students. Students were randomly allocated into game (GG) and lecture (LG) groups. The LG consisted of an exposition of 60 minutes of the ontogeny, differentiation and activation of B cells. The GG played for 45 minutes. During the lecture students were able to discuss the subjects, while in the game the faculty did not intervene. An evaluating quiz based on 28 questions of immunology text-books was administered before and after the intervention. Changes in scores within groups were compared using paired t-test and differences between LG and GG were compared by analysis of covariance with baseline value as covariate.

### 3.4. Results

A significant improvement in number of correct answers of the quiz was observed after the lecture and the game in both groups, however the mean increase was significant higher in the LG ( $p=0.003$ ; mean change LG: 5.29 [95% CI, 3.57 to 7.00],  $p<0.001$  vs. GG: 1.81 [95%CI, 0.70 to 2.93],  $p=0.005$ ). A non-significant decrease in the number of wrong answers was observed in both groups with no differences between them (see Table 1).

**Table 1** Changes in test scores in Lecture and Game student groups. Data are presented as mean ( $\pm$ sd) unless otherwise indicated.

Score	Lecture, n=14			Game, n=11			Lecture vs Game
	Before	After	Change*	Before	After	Change*	p-value**
Correct	7.6 (2.92)	12.9 (3.40)	5.29 (3.57 to 7.00); p<0.001	8.6 (2.50)	11.5 (3.53)	1.81 (0.70 to 2.93); p=0.005	0.003
Wrong	12.3 (4.60)	10.5 (3.50)	-1.78(-4.77 to 1.20); p=0.219	11.0 (5.20)	10.4 (2.01)	0.45 (-1.91 to 2.82); p=0.679	0.303
Final	-4.7 (2.98)	2.43 (6.30)	7.07 (3.25 to 10.89); p=0.002	-2.5 (4.00)	-1.09 (3.67)	1.36 (-0.96 to 3.69); p=0.222	0.056

#### 4. CONCLUSIONS

Yet it remains common and necessary traditional teaching methods, the use of multimedia contents online has been significant and has become increasingly common in many areas of education like medicine for example. The development of the "Who wants to B a lymphocyte?" has been a successful endeavour in immunology education. Additionally to a being a creative and innovative educational tool, the evaluation shows that this game can improve the student's knowledge on complex issues such as ontogeny, differentiation and activation of B cells.

However, despite the encouraging opportunities that the use of multimedia in education has provided, it is important to understand that we should discuss and doubt the issues surrounding the development of educational products because the reality is that there are still few studies on this area.

Thus, if one of the main concerns of the office is to increase the number of multimedia resources, it is also important to develop contents with defined learning objectives, otherwise we will develop products without academic interest and not reusable.

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## **6. ACKNOWLEDGMENTS**

The authors wish to express their deep appreciation to the students Carlos Santos, Pedro Macedo, Petra Monteiro, Ricardo Fernandes, Sara Mota and Sílvia Silva for providing such a challenging and motivational learning experience environment, and also thank the students who participated in the evaluation of the game.