

# **Development and evaluation of a web-based game to teach immunology content to medical students**

<sup>1</sup>André Moreira, <sup>2</sup>Carlos Santos, <sup>2</sup>Pedro Macedo, <sup>2</sup>Petra Monteiro, <sup>2</sup>Ricardo Fernandes, <sup>2</sup>Sara Mota, <sup>2</sup>Sílvia Silva, <sup>1</sup>Luís Delgado

<sup>1</sup>Serviço e Laboratório de Imunologia, Faculdade de Medicina, Universidade do Porto; <sup>2</sup>Curso 2006-07 Imunologia Básica, Faculdade de Medicina, Universidade do Porto

## **Identificação da unidade curricular**

Nome: Imunologia Básica

Faculdade: Faculdade de Medicina da Universidade do Porto

Ano/Semestre: 2008-09; 1st semester

Plataforma: moodle.up.pt

Nº de Alunos: 288

Plataforma: Moodle

## **1. Background**

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 disciplines. In 2003, the University of Porto, recognizing the potential of internet based learning systems started the project “e-learning in the UP”. To the Immunology Department of the Faculty of Medicine of the University of Porto (FMUP) joining this project was an opportunity to, with the support of Department for Promotion of New Technologies in Education of the University of Porto (GATIUP) develop a new web based learning environment in addition to the traditional learning model in use.

The Immunology Department is responsible for the undergraduate medical education in the field of immunology both to medical and dentistry students from the University. Immunology is a diverse and growing discipline 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. We aim 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. Topics covered include: development and function of cells of the immune system; signalling in the immune system; regulation of the immune response; antigen processing and presentation; cytokines, chemokines and their receptors; infection and immunity; innate immunity; autoimmunity; allergy and asthma; hypersensitivity; primary immunodeficiencies; HIV infection; immunotherapy; vaccine development; transplantation; tumour immunology. 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.

## **2. Rational**

Basic immunology is a complex, vast and somehow theoretical discipline. Board games have been developed to facilitate students' understanding of more abstract concepts. However these are not feasible for routine use.

## **3. Aim**

We aimed to develop a web-based knowledge game on immunology for third-year medical students. We now describe the development and performance of this format, compared with a classic teaching lecture.

## **4. Methods**

A game was designed to boost student learning in the field of B cell development, activation, and differentiation. This educational tool was designed in a web based format, based on the original board game by *Eckert GU et al. Med Teach. 2004 Sep;26(6):521-4.* (see below resources and game devolpment). Students were randomly allocated into game (GG) and lecture (LG) groups. Lecture 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.

## **5. Resources and game development**

The game software was developed by the “Gabinete de Apoio para as Novas Tecnologias na Educação da Universidade do Porto” (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 answer to two questions in row in 30 seconds each (Figure 3 and 4). The objective is to reach first square 55.

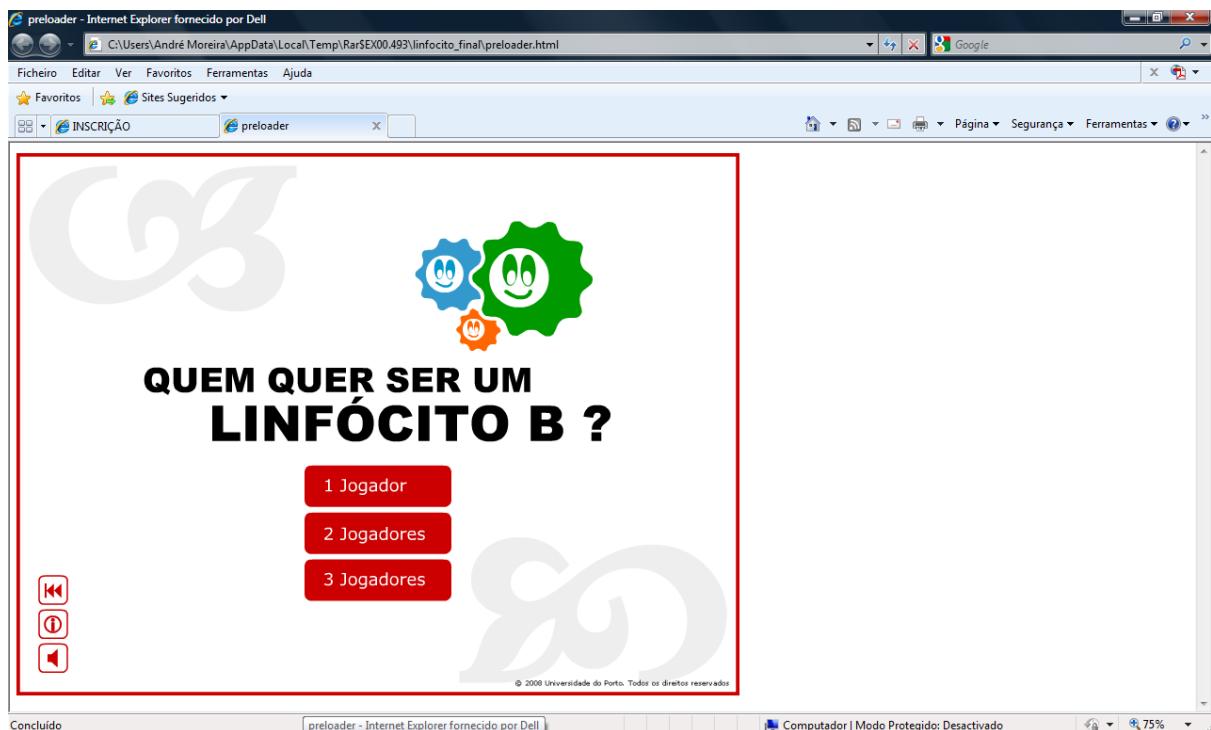


Figure 1. “Who wants to B a lymphocyte?” homepage

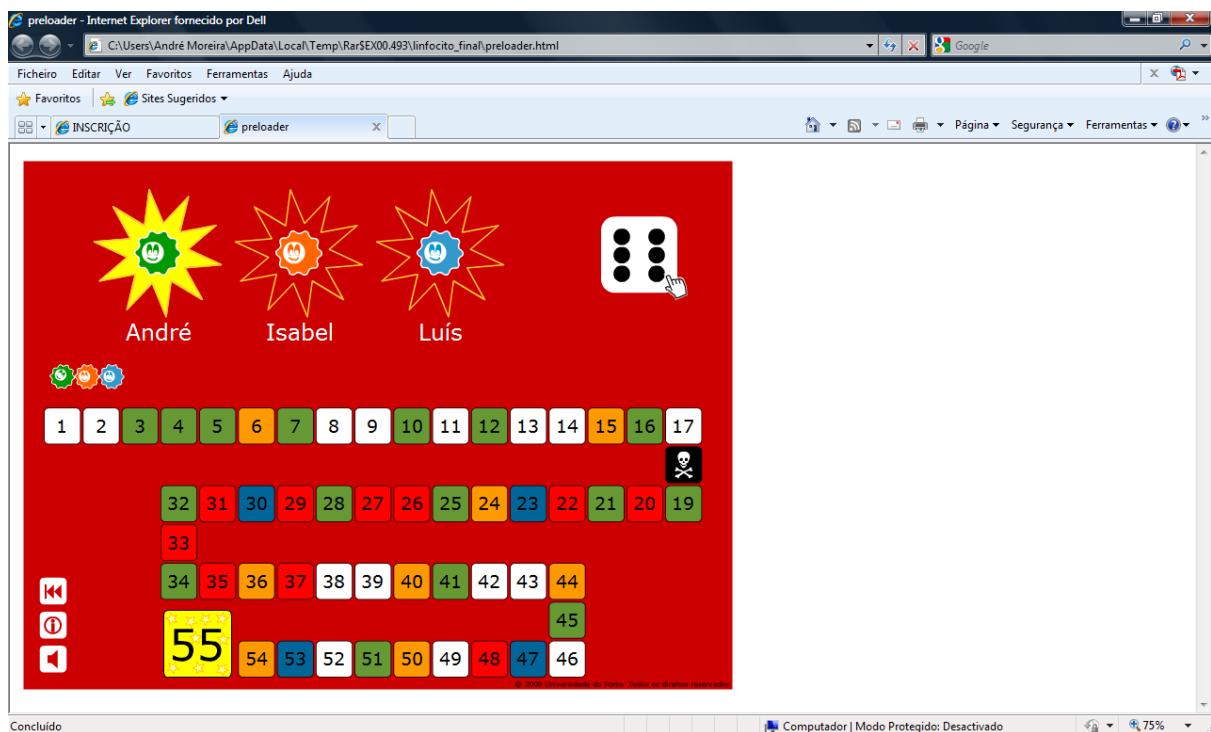
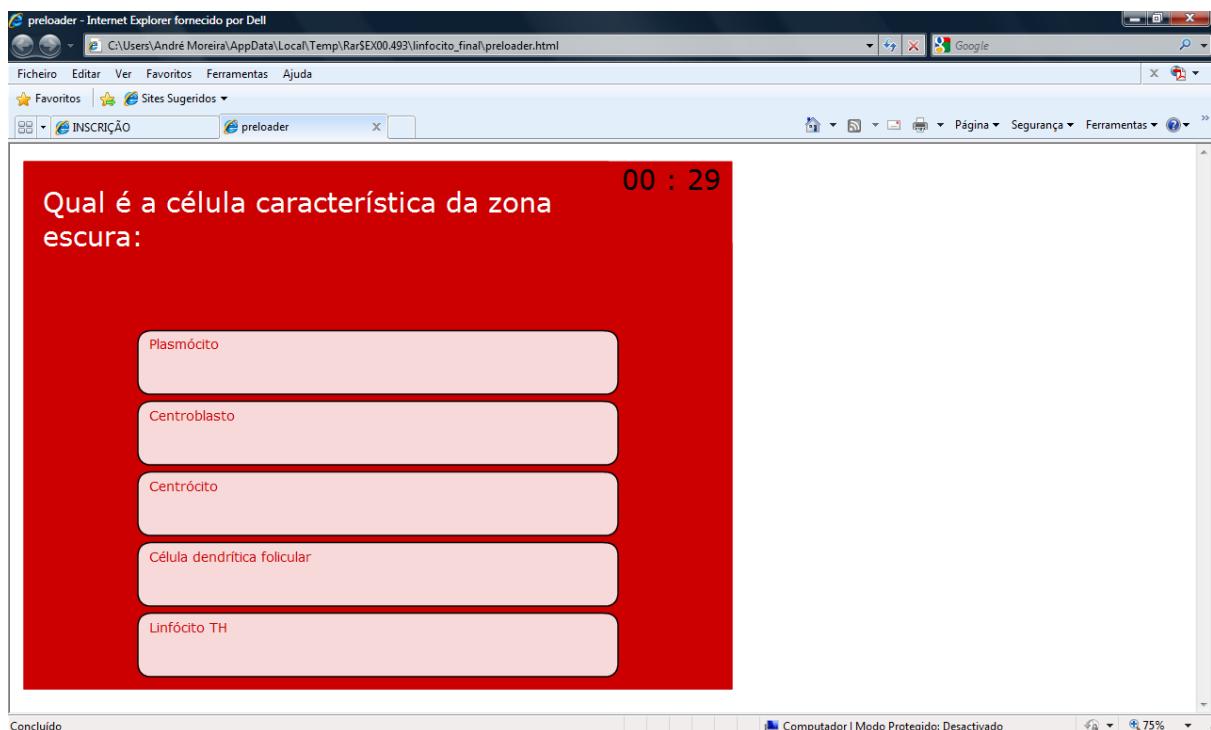


Figure 2. Who wants to B a lymphocyte?” gameboard



**Figure 3.** “Who wants to B a lymphocyte?” square question



**Figure 4.** Who wants to B a lymphocyte?” question page

## 6. 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

Score	Lecture, n=14			Game, n=11			Lecture vs Game
	Before	After	Change*	Before	After	Change*	
Correct	7.6 (2.92)	12.9 (3.40)	5.29 (3.57 to 7.00); <b>p&lt;0.001</b>	8.6 (2.50)	11.5 (3.53)	1.81 (0.70 to 2.93); <b>p=0.005</b>	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

in the number of wrong answers was observed in both groups with no differences between them (**table 1**).

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

## 7. Conclusion and future developments

The development of the “B cell game” has been a successful endeavour in immunology education. Additionally to being a creative and innovative educational tool, the evaluation shows our web based game can improve the student’s knowledge on complex issues such as ontogeny, differentiation and activation of B cells. We have now finished two more original games aiming to assist education on antigen presentation – the “Imunocinkinlinha” and on the generation the Membrane Attack Complex – “o MACaco mais rápido”.

## 8. Acknowledgements

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