E-learning in undergraduate medical education: development and assessment of an online course on immunology

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Abstract

Traditional medical education makes use of large classroom lectures held on by teachers with specific clinical or research backgrounds on different disciplines. Current approaches to learning process put the emphasis on group orientated learning with supervisors acting as contributors. E-learning has become an important trend in medical education with several universities incorporating it in its general curricula. This paper reports a case study of the strategies for the design and evaluation of an undergraduate immunology course blended with a web based learning environment.

We include in the analysis data from the 201 medical students and 32 dentistry students attending the course, during their third year of academic training. A virtual immunology course was created within a WebCT Vista environment. The course homepage linked to seven content modules. A total of 68 portable document files, 30 power point presentations, 9 word and 1 HTML documents and 2 videos were made available in 8 learning content modules.

No significant differences between medical and dentistry students were observed concerning number or duration of sessions, and visits to organizer and content pages. Pages including lectures presentations and learning modules-seminars were the most visited. There was a significant correlation between how much a student used their web study materials and their final grade. Mean (SD) final grade of the dentistry students was 10(3), with non significant correlation with the use of the WebCT vista. Mean (SD) final grade of the medical students was 12(2), and had significant correlation with the number of sessions (p<0.001), total time spent (p=0.004), and number of URLs (p=0.364), organizer (p<0.001) and content pages visited (p<0.001). Qualitative evaluation was available for 32 (16%) of the medical and 8 (25%) of dentistry students. Identified positive issues were: coordination between classes and online material (n=36); nice organization that allowed easy finding of study materials (n=36); increased motivation (n=28) provided by online contents, and believing (n=36) that the online component of the course contributed to their final success.

Development of a virtual Immunology learning environment offered students access to high quality and certified learning contents. Although we have not used all tools provided by e-learning, mainly those related with interactive case problem solving, the final evaluation of the project so far is clearly positive. The definitions and articulation between classical teaching and web based technologies has to be better defined in the near future.

Background and motivation

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 develop a new web based learning environment

in addition to the traditional learning model in use, with the support of *Gabinete Apoio Tecnologias Informação da Universidade do Porto* (GATIUP),

The Immunology Department is responsible for 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. Additionally dentistry student's curriculum discusses mucosal immunology, caries immunology and oral immunopathology, while medical students cover immunodiagnostic and laboratory skills and techniques. One hour lectures are given twice a week and 90 minutes seminaries every other week. Final grade is based upon final examination score (0 to 20) adjusted with student's performance during seminars.

In order to offer students more than the traditional-curriculum scenario, web-based resources were developed as adjuncts to the usual teaching components. Our initial expectations with the e-learning experience were to create a set of e-learning resources; promote communication and active involvement of students in the learning process and to maximize the content knowledge expertise.

Objectives

We aimed to: (1) develop a virtual learning environment to blend with the traditional learning scenario; (2) provide interactive, multimedia learning materials covering special parts of the curriculum; (3) investigate whether on-line course tools enhance student's learning as measured by final course grades.

Methods

The study populations were third year undergraduate students attending the Immunology course of the Faculty of Medicine and Faculty of Dentistry Medicine of the University of Porto. The study design was a one group post test without control group.

WebCT: Virtual Course Environment was created using WebCT Vista with the technical support provided by the GATIUP.

Technical requirements: Students were required to have access to a computer and the software Internet Explorer, Microsoft Word, Microsoft Power Point and Portable Document File viewer. Special computer rooms were made available both in the dentistry and medical school.

Learning modules: Seminars were delivered as learning modules and made available in a sequential manner throughout the academic year. Small groups consisting of 3 students were assigned to each seminar. Seminar organizations included a learning plan with objectives and tasks. Handouts made available included recommended and additional reading and essential slides to use in a power point presentation. A variable number of case studies were made available in each seminar. Each member was encouraged to read the assigned module requirements and the materials made available. The seminar was prepared by the working group in cooperation with the teaching assistant. A report of the seminar was written and submitted to this instructor. The report includes a detailed view of a point discussed at the seminar and the list of keywords and their definitions as a glossary building up database. Students were expected to log in to the course at least once every week.

Evaluation questionnaire: At the end of the academic year a questionnaire consisting of 18 multiple choice questions and 4 open-ended questions, related to students compliance and satisfaction with e-learning was made available online by the University as an assessment tool for all the courses listed in all the Faculties.

Statistical analysis: Regression analysis was used to estimate the association between final grades (maximum 20 points) and number of sessions, time using the platform, and number of URLs, organizer and content pages visited. Comparisons between medical and dental students were done using the non-parametric test Kruskal-Wallis.

Results

We include in the analysis data from the 201 medical students and 32 dentistry students attending the Immunology course in 2005-06.

A virtual environment was created within WebCT Vista structured to provide a friendly way of finding information. Students accessed the course in the URL: http://webct.up.pt, using their personal username and password. The course homepage linked to a series of HTML pages, known in WebCT as a content module (Figure 1). A course menu was always available to handle easy and quick navigation in the course. Within the homepage, a framework of seven sections was created: Seminars, Information's, Animations, Glossary, Bibliography, Forum and Grades. On Information's section, contents related to academic matters were made available. Recommended text books and links to their available contents were found in the Bibliography. Web based animation and video material were made available with authors agreement in the section Animations. Seminars section also included power point presentations given at lectures. A total of 68 portable document files, 30 power point presentations, 9 word and 1 HTML documents and 2 movies were made available in 8 learning content modules.

For each medical students mean (SD) of WebCT Vista sessions was 43 (45), visits to organizer pages was 205 (174), and to content pages was 105 (78). Each one spent an average (SD) total time in the e-learning of 4h: 27min (3h: 52min). Dentistry students had a mean (SD) of Web Vista sessions of 36 (37), of visits to organizer pages of 198 (170), and of visits to content pages of 115 (110). Each one spent an average (SD) total time in the e-learning of 3h: 40min (3h: 54min). No significant differences between medical and dentistry students were observed. Pages most frequent visited were the ones that included lectures presentations and the learning modules-seminars.

There was a significant correlation between how much a student used their web study materials and their final grade. Mean (SD) final grade of the dentistry students was 10(3), with non significant correlation with the number of sessions (p=0.250), total time (p=0.067), number of URLs (p=0.888), organizer (p=0.948), and content pages visited (p=0.309). Mean (SD) final grade of the medical students was 12(2), and had significant correlation with the number of sessions (p<0.001), total time spent (p=0.004), and number of URLs (p=0.364), organizer (p<0.001) and content pages visited (p<0.001). Medical students had higher grades (p< 0.001) but no differences in the number of sessions (p=0.216), total time spent (p=0.074), and number of URLs (p=0.052), organizer (p=0.830) and content pages visited (p=0.727) compared to dentistry ones.

Qualitative evaluation was available for 32 (16%) of the medical and 8 (25%) of dentistry students. From these (n=40), the majority reported login to the platform either from home (n=36) or from the Faculty (n=23); computer use for emailing (n=37) or searching (n=38); with average (n=26) or good (n=13) knowledge of informatics. Identified positive issues were: coordination between classes and online material (n=36); nice organization that allowed easy finding of study materials (n=36); increased motivation (n=28) provided by the online contents, and believing (n=36) that the online component of the course contributed to their final success. Negative issues reported by students were intermittent difficulties accessing the contents (n=10); poor use of the forum/chat by students for posing questions (n=3), and report (n=8) that the overall use of the platform did not increased the teacher-student communication

Discussion

We performed a systematic search of studies reporting the results of the influence of the e-learning in basic immunology published in the Ovid MEDLINE(R) In-Process & Other Non-Indexed Citations and Ovid MEDLINE(R) (1966 to November 2005). Subject-specific search terms were: "e-learning" and "immunology". One publication appeared [1] reporting the Switzerland "Immunology Online", provided to Swiss students across five campuses; and the OCTAVE project, which will offer online training to investigators carrying out clinical trials of vaccines against HIV infection. The reference list of this paper was reviewed to identify other studies not captured by the electronic search and an additional manual search was performed. Although several medical schools incorporate e-learning in their curriculum [2-6], we were not able to found other specifically targeted basic immunology undergraduate e-learning experiences.

Development of the virtual Immunology learning environments offered students access to high quality learning contents. Lecture handouts, textbooks, test questions, and presentation slides could all be given as online versions, together with interactive assignments, and molecular immunology simulations. We found a correlation between the use of the e-learning platform and final grades only in medical students. This was not observed in dentistry students probably because the sample size was not enough to detect the correlation. However, these data should be looked cautiously, because a causal relationship can not be inferred. It simply could be that better students use more often the online course and not the other way round.

In our project we were not able yet to develop immunology case problems and not used all the available e-learning tools, a point to be better addressed for the next courses. The systematic evaluation of the project must become a practice if the web based education is to become a standard. Processes adopted for e-learning evaluation will need to efficiently cover the requirements for reliability and validity against time and cost. Also, the definitions of purposes and articulation between classical teaching and web based technologies have to be defined.

Acknowledgements

Conflicts of Interest

None declared.

Figure 1. Screenshot of the homepage of the online immunology course

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