



Original Article

E-learning Activities to Complement Education in Cariology for Undergraduate Students

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Abstract

Objective: To evaluate activities performed in an e-learning platform after 2-year of implementation in terms of contents and functionality. **Material and Methods:** E-learning courses were prepared and created by two lecturers. Contents were intended for last year undergraduate students attending the pediatric dentistry discipline, and included different topics considered as relevant to the area. Given tele-courses from 2010-2012 as well as statistics and contents, provided by the platform, were collected for analysis. **Results:** Five tele-courses were proposed and the total participation was 322 students (mean-per-course $\pm$ SD=64.4 $\pm$ 17.2). On average, 15 tutors/course accompanied the process. Caries lesion detection and fluoride therapy were discussed in all modules, but different activities were focused in various aspects. Other topics were also included: caries activity (60%), caries risk assessment, oral hygiene and clinical examination (40%). Two lecturers were responsible for preparing exercises and tutors helped in the creation, revision and correction. The main type of validation was open questions (83%). A High level of students' access was observed during the 2-year-period (mean-per-course $\pm$ SD=21372 $\pm$ 6775,2). More than 32000 external visits of the topics were also seen. On average, 14 tutor/student feedbacks were sent per student in each tele-course. **Conclusion:** The use of an e-learning system has been used especially to complementing teaching in caries detection and management using fluorides. Tele-courses have been highly accessed by undergraduate students and also, external participants.

Keywords: Education, Distance; Learning; Dentistry.

Introduction

Despite the decrease of dental caries prevalence in the last years, it is still a health problem in many populations in both children and adults worldwide [1]. Improvement in population's oral health is a matter of concern for the World Health Organization [2] and thus, professionals in Dentistry must develop the best possible skills to adopt appropriate positions in order to diagnose, manage and implement preventive measures for dental caries [3].

Education in Cariology is a current topic of interest due to an increasing requirement of a consensus for the development of such kind of skills in undergraduate dental students as future dentists [4]. In fact a recent series of papers have focused on the development of a curriculum in cariology on the basis of current scientific evidence and international consensus on the current and future educational needs in this field in Europe [4-11] and Latin America [12,13].

In this regard, well-structured courses must be offered to improve the attainment of competencies in the educational process [14]. The use of an e-learning approach could complement the conventional teaching process enhancing knowledge, efficiency and effectiveness of the educational interventions in the actual pedagogical challenges [15]. However, evidence in the field of cariology and e-learning education is weak and only few studies assess this kind of approach in dental students [16,17].

E-learning activities related to cariology have been performed with undergraduate students since 2009 at the Discipline of Pediatric Dentistry –Dental School, University of São Paulo to complement theoretical lectures. The aim of the present study is to evaluate such activities performed in an e-learning management system after two years of implementation, in terms of contents and functionality.

Material and Methods

A descriptive analysis was designed for this study. Free source e-learning software platform “Moodle” (Modular Object-Oriented Dynamic Learning Environment) was implemented by the Department of Pediatric Dentistry, Dental School, University of São Paulo - Brazil to complement theoretical lectures since 2008. This virtual learning environment, with more than 63 millions of users worldwide, helps educators to create online courses with a focus on interaction and contents collaborative construction [18].

In the beginning, e-learning courses were prepared and created by two lecturers. Contents were intended for last year undergraduate students attending the pediatric dentistry discipline, and included different topics considered as relevant to the area. Afterwards, postgraduate (MSc and PhD) students (tutors) were trained to develop teaching tools by means of Microsoft PowerPoint presentations, videos, complementary readings and associated scientific articles. Those tools were inserted to the platform by means of separated topics and specific exercises were also created with the objective of evaluating students' performance after material access.

Each student from each class had to register on the platform/specific course and then a tutor was assigned to him/her to follow and monitor their progress and the proposed activities

implementation. Tutors had to maintain contact with the students through feedback messages, generally sent weekly. This attempted to clarify doubts relating to the treated topics. At the end of each period (quarterly), tutors had to assign a grade to each student, which was posteriorly computed with the grades obtained in the clinics and the theoretical tests.

All given e-learning courses in the pediatric discipline, available at the Moodle platform, from 2010 to 2012 were included for assessment. Courses from 2008-2009 and 2013-2015 were not included in this study as some difficulties were found when extracting data from the platform. Although there were several topics and activities related to pediatric dentistry, and given its relevance in the current context, only those associated with cariology were included in data collection.

The number of undergraduate students as well as the number of tutors participating in each course was collected. Types of activities/exercises (analysis of clinical cases, specific questions, treatment decision making, guidance to patients etc.) as well as validation modalities (multiple-choice questions, open questions, self-validation) were also analyzed. Number of accesses and sent tutor-students feedbacks were calculated using the statistics' tool provided by the Moodle Platform. Data were collected and analyzed by two evaluators (JSL and MMB).

Two lecturers were responsible for preparing the e-lectures/presentations, exercises and supplementary material to be uploaded to the platform and postgraduate tutors helped them in creating, revising and correcting the proposed activities. The main type of exercises was clinical cases but Cariogram® [19] analysis, treatment decision-making and patient's orientations after given results were also addressed.

Data were express in number and percentage for qualitative variables and mean and standard deviation for quantitative variables.

Results

A total of five tele-courses were proposed from 2010 to 2012. Three hundred and twenty two students participated in the proposed distance-learning activities (mean per course $\pm$ SD=64.4 $\pm$ 17.2) during this period. On average, 15 tutors accompanied the process per course. Table 1 shows the distribution of students and tutors per course.

Table 1. Students and tutors' distribution per e-learning courses offered from 2010 to 2012 at the pediatric dentistry discipline.

E-learning Course/year	Students n (%)	Tutor n (%)
2010	58 (18%)	14 (18.7%)
2010/2011	87 (27%)	16 (21.3%)
2011	48 (14.9%)	14 (18.7%)
2011/2012	78 (24.3%)	16 (21.3%)
2012	51 (15.8%)	15 (20%)
Total	322 (100%)	75 (100%)

Caries lesion detection and fluoride therapy were topics discussed in all modules, but different activities such as cariogenic diet (frequency and contents) (70%), clinical examination, caries

risk assessment (60%), lesion activity assessment (60%) and oral hygiene education (40%), were focused in different aspects in each course. Most of the validation was performed using open questions (83%). However, multiple-choice test was also used in this process. A high number of students' access to the platform has been observed during this 2-year-period (mean per course $\pm$ SD= 21372 $\pm$ 6775,2). More than 32000 external visitants also accessed the contents in the same period. On average, 15 tutor-student feedbacks were sent per student in each tele-course.

Discussion

For the best of our knowledge, this is the first study performed in the area of Cariology and pediatric dentistry assessing the potential of a tele-course in complementing the traditional lecture for teaching cariology and associated topics. Cariology in the pediatric dentistry is a fundamental subject of interest since caries is one of the most prevalent oral diseases in the child population [20]. In this way, contents addressed in this educational tool are important for the apprenticeship of dental students.

E-learning methods are useful to enhance both teaching and learning and bring a wide range of advantages in the learning delivery area [15]. Among these are an increased accessibility to information, ease in updating content, personalized instruction, ease of distribution, standardization of content and accountability [15,21]. The e-learning platform assessed in our study met all these advantages becoming a meaningful tool to supplement classroom teaching modality.

Studies that compare the utility of computer-based instruction, web-based learning and e-learning modalities in different areas [22,23] showed a more efficient learning and better knowledge retention measured by pre-post tests. Our study showed a high rate of accesses of the e-learning activities by undergraduate dental students and external participants but that does not necessarily refer to a student's higher learning. Other analysis should be performed in order to assess its impact in terms of learning enhancement.

Since this approach is quite new in the area of Cariology and the evidence in this field is weak, the accomplishment of this study is important to know and explore various aspects such as the degree of achievement of an e-learning complementing course. This could be the first step to find out whether it is really being effective or whether it needs to be modified.

One of the major advantages of this approach is the possibility of a personalized instruction through the feedback between tutors and students promoting learners' efficiency, motivation, cognitive effectiveness, and flexibility of learning style [15]. This walks in a direction where the student acquires knowledge, skills and attitudes faster and more efficiently (improved motivation and performance) compared to the traditional methods [24].

According to the tackled topics, the given e-learning courses in the discipline of pediatric dentistry in our faculty assessed the main topics included in the First Consensus Workshop on the Development of a European curriculum in Cariology [5] (caries lesion detection, fluoride therapy, diet, clinical examination, caries risk assessment, lesion activity assessment and, oral hygiene

education were listed in this learning tool). Other topics are planned to be included (or have been included already) in the subsequent tele-courses such as etiology of dental caries and non-carious lesions, saliva, early childhood caries, clinical and histological appearance of dental caries and non-carious lesions, radiological and non-radiological tools for detection of caries lesions, remineralization and, Atraumatic Restorative Treatment - ART.

In the field of caries lesion detection, various techniques have been taught to undergraduate students including visual, tactile and radiographic criteria [25]. However, it is a challenging procedure since the detection of some stages of the caries process is not as simple as it seems [26]. In fact a 3D tool was developed aiming at facilitating the understanding of the caries process and its different stages with their histological correlation [27,28]. With the implementation of such teaching mechanism, the learner could complement given theoretical information in the classroom and amplify the spectrum of examples of the different stages of the caries lesions before he/she has to deal with real clinical situations.

Conclusion

We can concluded that the use of an e-learning management system in Pediatric Dentistry has been used especially to complement teaching in caries detection and management using fluorides with a high rate of access by undergraduate students and external visitors, and with a good level of interaction between students and tutors.

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