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Original Research Article

Information and communication technologies in dental education: students' perceptions

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Abstract

Introduction: Among teaching and learning methods, those using Information and Communication Technologies as new dental education possibilities are based on the student's knowledge construction and the development of new capabilities such as innovation, creativity, autonomy and communication. **Objective:** To demonstrate the use of information and communication technologies (ICTs) as support tools for teaching-learning process in Dentistry by using an application that manages dental caries determinants. **Material and methods:** An application was used by students from a Dentistry Undergraduate Program from a public university in southern Brazil. Data collection comprised a qualitative study with Dentistry undergraduates, through focus group technique. Data analysis was performed according to Bardin's content analysis. **Results and Discussion:** Results are presented in categories: 1. Use of ICTs in Dentistry teaching; 2. Students' perceptions on the application; 3. The application as a teaching-learning tool in Dentistry. Data analysis showed advantages of using ICTs in dental teaching as key tools and process facilitators. The application is a decision-taking and action-planning tool, guiding students' clinical reasoning towards recognition of local reality. **Conclusion:** Relevance and potential use of ICTs in Dentistry teaching was detected, making them auxiliary tools in students' education in the face of their need to adapt to the current context of technological advances and the rapid expansion of scientific knowledge.

Introduction

Dentistry education should harmoniously follow the development of the health care system and attend to its needs. In Brazil the current educational model proposed by the National Curricular Guidelines (NCG) seeks a balance between technical excellence and social relevance and has a resolutive role towards the health demands of the population. Other elements have been added to this model such as curriculum integration as the use of interactive teaching-learning methodologies [4].

Among the teaching-learning methodologies, some are based on information and communication technologies (ICTs), seen as a new possibility in dental education, supported by the student's knowledge construction and by the development of new abilities such as innovation, creativity, autonomy and communication [7, 10, 14].

ICTs are tools of growing importance in Dentistry as well as in other health areas, as they allow the use of new educational media that provide students with the practice of seeking and selecting information, leaning independently and more autonomously and solving problems. The dentists are thus expected to be able to use these tools to look for the required information. Also, they should also be able to select these pieces of information as best as possible, and apply them to their professional practice routine whether as a clinician, researcher or professor. The addition of information and communication technologies to the curricula is a way of stimulating, potentiating and improving their use [6].

Although there has been a continuous debate over the efficacy of virtual learning applications, ICTs add value to traditional teaching methods and function as a complement to more traditional approaches [12].

An application used to study dental caries determinants, was used for this research. This study aimed to demonstrate the use of information and communication technologies as a support tool in the teaching-learning process in Dentistry through the use of this application from the point of view of undergraduate Dentistry students.

Material and methods

The software was developed by means of an interdisciplinary study conducted by Dentistry, Information System and Design professionals, together with undergraduate students from a public university in southern Brazil. Dentistry researchers provided the theoretical framework on which the necessary rules for the development of the software were established based on dental caries health-disease process determinants and identified by a systematic literature review. The Scientific Electronic Library Online (SciELO) and The United States National Library of Medicine (PubMed) databases were consulted by using the key words "Dental caries", "Epidemiology" and "Susceptibility" without the use of filters. Full-text articles were chosen whose topics were related to the Brazilian social and oral healthcare focusing on self-reported dental caries health-disease process determinants. Articles published in the last 5 years (2007-2011) were selected from SciELO database and articles published in the previous year (2011) were selected from PubMed database.

Books, theses and dissertations dealing with the dental caries disease issue with a focus on Cariology and Epidemiology and publications by the Brazilian Ministry of Health on Dental Public Health were also researched.

The Information Systems and Design professionals encoded the system by structurally developing HTML pages with CSS (Hyper Text Markup Language) and Java (Java Server Faces) as well as interactivities in Java Script. The database was developed and managed in MySQL (My Structured Query Language). These tools were primarily chosen due to their independent platforms, that is, systems that can be used by any other operational systems (Windows or others) without the need of prior download. MySQL database was selected by using SQL, the most widespread language for web systems, thus facilitating the system operational support, besides being a free access tool. The Design professionals created an intuitive aesthetically pleasant layout consistent with the software theme.

The application can receive, store and analyze data related to dental caries health-disease process determinants.

Software operational characteristics

System access is done through an Internet password from the Federal University of Santa Catarina provider. Accesses were divided into user and administrator logins with personal passwords. The main differences from other access profiles are the tools available for registration, data collection and storage, as well as stored data queries and

analyses, the latter being restricted to the system administrator (figure 1).

The software consists of a Self-reported Individual Questionnaire, which seeks to understand the individual profile, general and oral health condition, in addition to his habits and lifestyle, and includes a Professional Perception Form (figure 2) including an oral physical examination and the dentist's subjective perceptions related to the respondent's interests and response consistency.

The fact that the software results can be shown either on an individual or group basis is worth mentioning, that is, the software allows the individual's data to be grouped by family, classroom, school, street, neighborhood, city, county, state or country. The most relevant information on tooth decay health-disease process determinants can also be viewed for each group; additionally, it allows comparisons between groups to be made.

The application also includes the dental caries disease spatial expression, which is a helping tool for the identification of territorial influence on the health-disease process in oral health. Other relevant features are its greater coverage due to its online availability, its ability to act as a database for the dentist, and the possibility of generating data and statistical analysis for the planning and management of dental services.

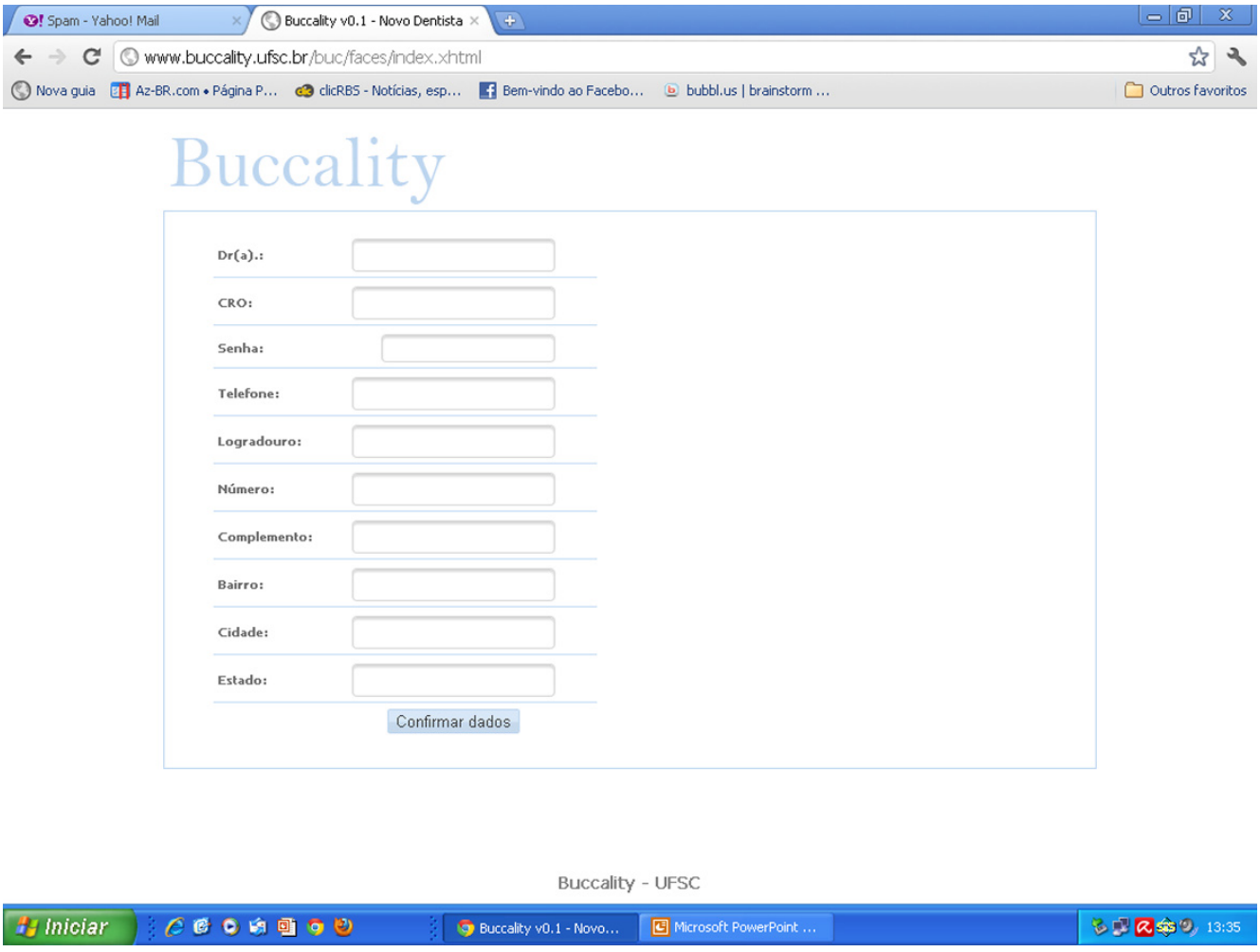

Figure 1 - The user access with personal password

Figure 2 – The software consists of a Self-reported Individual Questionnaire, which seeks to understand the individual profile, oral and general health condition, habits and lifestyle. Includes a Professional Perception Form

The use of the application as a teaching-leaning process support tool was developed by means of a qualitative study whose investigation process was based on the focus group technique. The data obtained through this technique resulted from carefully planned discussions. During these, the participants expressed their perceptions, beliefs, values and attitudes on the information and communication technologies issue as a support tool for the teaching-learning process in Dentistry. This aimed to capture the participants' collective thinking during the dynamic interaction process when speech unveils opinions and emotions, whether convergent or conflicting, as well as to debate problems, conflicts and proposals so that solutions could be reached within the application scope [2, 16].

The research subject universe comprised the 3rd year Dentistry undergraduates from a public university in southern Brazil who carried out different activities at Health Care Centers of the municipal school network. These activities were extended to the other public schools located within the coverage area of the health care centers.

The research project was submitted to the Ethical Committee in Research of the Human Being of the Federal University of (UFSC), the Institutional Review Board (IRB) of Santa Catarina, and approved by regulation no. 2100/12. All participants were asked to sign an Informed Consent Form.

Data collection was divided into two phases:

Phase 1 – Use of the application as a support tool in the teaching-learning process in Dentistry: the application was presented to a team of four

students from a Dentistry Undergraduate Program so that they could become familiar with its operation and thus be able to use it fully. Afterwards these students used the application with 40 teenage students from two public schools where activities referring to Dentistry in Public Health contents within specific courses were developed between October and November 2011 (figure 3).

Figure 3 – The dental students used the application with 40 teenage students of two public schools, where activities referring to Dental Public Health were developed

Phase 2 – Report on the use of the application as a support tool in the Dentistry teaching-learning process: the report on the application use was made by means of the focus group technique [2, 16]. This second phase aimed to know the students' perceptions towards the application use and to discuss its teaching and dental care potentials. The analysis of the transcribed data was done according to Bardin's Content Analysis assumptions [3].

Results

The results were grouped into three categories referring to students' perceptions on the use of information and communication technologies in Dentistry teaching, in addition to perceptions on the application use itself and the ways this tool can be used in the teaching-learning process in Dentistry.

The use of information and communication technologies in Dentistry teaching

The students evidenced the advantages of using information and communication technologies (ICTs) in Dentistry teaching.

> *The use of technologies make it much easier, they are fundamental to everything that is related to education, mainly because nowadays everything is linked to the question of the speed of information transmission, and in Dentistry the use of these technologies are also critical for teaching* (A.M.).

According to them, these tools played a fundamental role in teaching by being closely related to the teaching-learning process, acting as facilitators of this process and increasing the information transmission rate. The students also pondered that ICTs had been present throughout their undergraduate program, which was shown by the fact that they thought of themselves as belonging to a young adult generation that tried to search for contents by using these tools. The use of the computer as an important teaching tool is emphasized, once it is, according to them, often used in carrying out research and papers, consulting materials provided by professors, as books and papers; it also enables access to Moodle® virtual learning environment, individual email accounts, and social networking sites. The students also believe that the computer facilitates the teaching-learning process because they can access contents far from the university, as from home.

Students gave several examples of the use of ICTs along their academic education, reporting the use of social networks as being an important teaching-learning tool for case and doubt discussions. Interestingly, students have reported the existence of virtual study groups on Facebook® through which they study collectively, exchange experiences, clear each other's doubts, and share materials, mainly before tests. Another tool highlighted by students was Google® website where they search for information related to Dentistry as well as for news sites through which they can also come across related contents.

According to students, information and communication technologies have great potential for the teaching of Dentistry and could be better exploited during the program; as to copyright and intellectual property, the present literature discussion refers to it as a new unsolved worldwide

issue of artistic, scientific and literary property control brought about by the use of ICTs. From the students' point of view, the incorporation of ICTs to course methodologies neither necessarily change the pedagogical relationship nor does it replace the professor but rather changes some of his roles. Students understand that the professor must be a stimulator of the student's curiosity so that the latter develops an interest in learning, researching and searching for relevant information. The professor develops a new approach in the construction of the student's knowledge.

Students' perceptions on the application

The use of the application was deemed valid by the students.

They were pleased and interested on it, mainly because it was thought to be simple and easy to keep. The students reported that, after the first explanation, they already had an idea on the application purposes; with reference to its operational characteristics, the students highlighted the mere fact of having to use the computer made it a much more interesting activity. The use of the tool was facilitated by its availability on the Internet, which allowed it to be used at different locations by different computers simultaneously, thus making it possible for its users to interact.

It was also reported that the software characteristics made the work much easier, mainly due to the application speed as compared to paper questionnaires, even when there were several blank items to be filled in; because of these characteristics, the application could also arouse a higher respondent interest.

> *I noticed something very interesting is that when I finished using the application, when I finished asking, and before the physical examination, before I examine the child's mouth, it seems that I already knew what I would find, I was able to "predict" the oral health condition of the child, based on the answers she gave* (A.M.).

Students stated that they were able to identify some issues related to the health-disease oral process in the school environment more directly, speeding up the identification of dental caries determinants during the application use. The application questions were directed towards clinical reasoning so that they knew what to expect in oral condition terms and based on the answers given by the patients before the physical examination was performed. The students also considered the questions as guiding tools that supported the oral-related instructions passed on to the teenage students. What the students perceived upon physical examination corresponded to what they expected to find regarding each individual's oral health.

The application as a teaching-learning tool in Dentistry

> *The questions of the application served as a tool to guide some issues related to oral health. I asked about oral habits and, according to which it replied, I was giving guidelines for oral hygiene and healthy eating. I know this was not the purpose of the work, but as we were there with them, and they are children, if it was an adult I may not speak, but sometimes parents do not say to their children that they have to brush their teeth* (B.M.).

The students believed that the contact with schoolchildren would be the most appropriate moment and that the use of the application served to mediate their contact. Before its use, the students believed that the application would bring confidence to the teenage students, acting as a bond-building tool, which was in fact observed; from the students' viewpoint, the teenage students felt more comfortable with the use of the computer. Health guidelines were given according to the teenagers' responses to each question. Although it was not initially meant, the students passed on instructions simultaneously with the interview.

During the face-to-face interview the students had already initially identified determinants related to the dental caries health-disease process in the teenagers, such as the presence of tooth plaque, halitosis or a high candy intake. With the application use, they were able to identify the most common determinants which were related to the dental caries health-disease process in the school environment at this age group, as poor toothbrushing, high candy intake, and health service underuse. They concluded that the application helped in the identification of the school reality, developing a collective overview by the use of all available data for planning action within the school environment.

The data obtained by this activity guided collective actions to be taken within that environment. The students were able to plan activities, especially

those related to health education, based on what had been identified by the application use; they were also capable of identifying those teenage students who had the worst oral health condition so that future interventions, as topical fluoride applications, ART and other educational activities in oral health could be performed.

Discussion

The findings of this present study agree with those reported in literature which show ICTs as new paths towards teaching-learning methodologies and new possibilities in Dentistry education, which is supported by the construction of knowledge by the student and the development of abilities such as innovation, creativity, self-esteem and communication [7, 10, 14].

The literature has evidenced that the use of ICTs is an increasingly important tool, not only for Dentistry but also for other fields of knowledge. These tools enable the use of new educational media, provide the ability of searching and selecting information, and result in independent learning and problem solving skills. Dentistry programs must offer activities that involve the use of ICTs in their syllabuses so that iniquities among professionals from different countries do not grow bigger, insofar as a critical factor in the use of these tools currently is the great skill variability of professors and students in the use of computers [6].

Examples of these tools have been mentioned in literature, such as *Case Studies for Dentistry®*, a computer case simulator software that allows students to learn in an interactive and self-directed way [1], *Tooth Atlas 3D®* version 6.3.0, developed for the teaching of dental anatomy containing three-dimensional models of teeth and support structures and including the anatomy and morphology of these structures, a dental radiograph database, besides practical tests for evaluation purposes [13]. Still, others are 3D viewing software for teaching radiology as a helping tool in radiographic interpretation learning [18], virtual reality software for Dentistry teaching [9, 17] and virtual learning courses of the Atraumatic Restorative Treatment (ART) technique [5].

The importance of understanding ICTs as new communication, educational and learning practice structures is necessary, and that includes the formulation and implementation of public policies aiming to re-democratize their access. Thus the professor's permanent education would be required to enter this expanding and changing universe of higher education [15]. The relevance of giving attention to the teaching-learning process at the university in connection with new technologies expands towards a teaching performance improvement in higher education with reference to the use of these technologies aiming to improve the student's education. A systematic reflection on the best ways to achieve an integrated view of contents and the role of computer tools in this process is needed, calling the university professor to rethink from the new aiming to introduce competent professionals into the labor market who can both interact with and benefit from new technologies [11].

Generally the participating students showed good acceptability as to the application use. According to literature, students react positively towards the use of ICTs as a teaching tool [8].

The use of ICTs would be a way to achieve an important goal in Dentistry education: the ability to access, evaluate and apply new knowledge to the patients' benefit; it is necessary, however, to promote a greater integration of these tools in teaching and learning, as well as evaluation, activities [7]. The professor still needs to pay close attention to the condition under which new professionals graduate by taking into account the social appropriation of new methodologies and technologies that will enable to bring individuals from different cultures and backgrounds close together in favor of health care improvement, thus leading to improved learning in higher education [11].

The study has been limited to the students' educational experiences at Health Care Centers of the municipal school network. Results cannot be extended to other undergraduate Dentistry student contexts, as their educational backgrounds may differ.

This study is based on the first-year experiences in the use of information and communication technologies as support tools in the Dentistry teaching-learning process through the use of an application to analyze dental caries determinants by Dentistry undergraduates who carried out different activities at Health Care Centers of the municipal school network. A report at this early stage is important for three different reasons:

- First, the application provides a potentially useful tool for service management and the teaching of Dentistry. It was developed aiming to expand the dentist's horizons towards a new approach on the caries health-disease process so as to reach the correct diagnosis and intervene appropriately based on scientific evidence;
- Second, this study can benefit subsequent public oral health classes. The software can

be a helping tool in oral health daily clinical practice; it also serves as an instrument for data collection as well as a management and planning tool for various organizations such as private oral health clinics, dental offices, and health insurance and public services. Also, it can be an important tool in the planning of educational and preventive actions for caries control both at individual and collective levels. Information and Communication Technologies are increasingly necessary tools that can be used for electronic health data capture and analysis improvement;

- Third, the results of this study will benefit dental education, insofar as it introduces a new support tool to the teaching and learning process in dental clinics and oral health services where training activities occur, assisting in the training of professionals and students alike, who will develop the ability to scientifically and critically understand dental caries related to actual conditions and needs, both at an individual or a specific population level.

The encouragement to use Information and Communication Technologies as new possibilities in dental education, supported by students' knowledge building and development of new capabilities, such as innovation, creativity, autonomy and communication, is reinforced. In addition, this study provides contemporary information on professional socialization to use Information and Communication Technologies as new possibilities in dental education, because the number of studies on this topic is limited.

Conclusion

This study has provided a deeper knowledge on the use of information and communication technologies in dental education. It is worth emphasizing the importance and potential of using these tools, which play a fundamental role in supporting the students' academic education in the face of the need to adapt to constant technological advances and the rapid expansion of scientific knowledge.

The obtained results point out to a positive attitude of the Dentistry students towards to ICTs use as teaching tools. However, the professor's new attitude is needed so as this new Dentistry practice can be built. The professors ceases being a mere information transmitter to become a mediator and a facilitator in the knowledge construction process, able to adapt to daily challenges that a new generation of students brings into the Dentistry undergraduate program.

The use of ICTs is emphasized as a complement to traditional educational processes. In addition, the use of these instruments enables a new outlook and a new involvement with the school by means of an opening that brings out the possibility of students and teachers alike having access to knowledge by means of research and experience exchange among other students and professors from different institutions, thus contributing to the formulation and dissemination of new knowledge.

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