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Distance learning in dental radiology: immediate impact of the implementation

Educação à distância em radiologia odontológica: Impacto imediato da implantação

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ABSTRACT

Objective: This study assessed the immediate impact in terms of learning dento-maxillomandibular radiographic anatomy in intraoral periapical radiographs after entire replacement of the method of classroom learning by the distance learning using the Moodle platform. **Material and Methods:** Teaching of this subject by traditional educational setting in classroom was made until the first semester of 2011, "A class" (AC), using radiographic slabs from duplicated films with imprints indicating anatomical structures in images that is accompanied by textbook with its description and support teacher, who works closely with the classroom to support student learning. In the second semester of 2011, "B class" (BC), these same radiographic slabs were digitalized, including description of textbook, creating the Moodle e-course about dento-maxillomandibular anatomy in intraoral radiographs for distance learning. The impact was assessed by comparison of scores of students from two distinct classes, AC (N = 60) and BC (N = 62), after application of a similar test with all content of the topic of dento-maxillomandibular anatomy, using T-Student unpaired test ($\alpha = 0.05$). A voluntary and unidentified questionnaire with 12 questions, developed in Google Docs spreadsheets, was used to evaluate the acceptance of students for this e-course. **Results:** No significant differences ($p > 0.05$) were observed in scores of the students from two classes. Among other questions, all students of BC who completed the questionnaire had interest in content of the available material in e-course, and

RESUMO

Objetivo: Este estudo avaliou o impacto imediato em termos de aprendizagem da anatomia radiográfica dento-maxilo-mandibular em radiografias periapicais intrabucais, após toda a substituição do método de ensino em sala de aula pela educação a distância com a plataforma Moodle. **Material e Métodos:** O ensino desta disciplina no ambiente educacional tradicional em sala de aula foi feito até o primeiro semestre de 2011, classe A (AC), utilizando pranchas de filmes radiográficos duplicados com marcações que indicavam estruturas anatômicas nas imagens eum livro texto com a descrição da referida estrutura, além de professor de apoio, que trabalhava na sala de aula junto com os alunos como apoio de aprendizagem. No segundo semestre de 2011, para a "classe B" (BC), essas mesmas pranchas radiográficas foram digitalizadas, incluindo a descrição do livro texto, para criar o curso digital Moodle sobre anatomia dento-maxilo-mandibular em radiografias intra-orais para educação a distância. O impacto dessa substituição foi avaliado pela comparação das notas dos alunos dessas duas classes distintas, AC (N = 60) e BC (N = 62), após a aplicação de uma prova semelhante com todo o conteúdo do tema da anatomia dento-maxilo-mandibular, utilizando teste T-Student não pareado ($\alpha = 0,05$). Um questionário voluntário e não identificado com 12 questões, desenvolvido em planilhas do Google Docs, foi utilizado para avaliar a aceitação dos alunos em relação ao curso digital. **Resultados:** Não houve diferença significativa ($p > 0,05$) entre as notas dos alunos das duas classes. Em relação às respostas do questionário, todos os alunos da BC que responderam ao questionário tinham interesse no conteúdo do material disponível no

their satisfaction level on a scale from 0 to 10 had a mean of 8.47 (SD = 1.69). **Conclusion:** The method of distance learning of this subject using the Moodle platform can be utilized with same educational results as of those obtained from a traditional educational setting.

KEYWORDS

Distance learning; Computer assisted radiographic image interpretation; Dental radiography; Regional anatomy.

curso digital e o nível de satisfação medido em uma escala de 0 a 10 obteve média de 8,47 (DP = 1,69). **Conclusão:** O método de educação a distância sobre esse tema utilizando a plataforma Moodle pode ser utilizado com os mesmos resultados educacionais obtidos em um ambiente educacional tradicional.

PALAVRAS-CHAVE

Educação à distância; Interpretação de imagem assistida por computador; Radiografia dentária; Anatomia regional.

INTRODUCTION

The dental radiology tradition of the film-based radiography has been renovated by use of digital images. The digital image has gained strength mainly as a result of its high degree of dynamism, which enables computer-mediated manipulations to improve quality of specific diagnosis, and high degree of versatility, which enables an internet-mediated communication. As actually both systems have shown similar accuracy in clinical practice diagnosis, in several clinical and educational contexts digital images have been prioritized [1].

In the same way, medicine and dentistry teaching has been going through a renovation from the traditional didactic system to an approach whereby students take a more active role in their learning. In this context, Internet-mediated education is becoming a frequently used tool, and e-learning is gaining more and more popularity. This form of asynchronous distance learning provides institutions and faculties with the ability to present course content to students at a place and time of their choosing [2-8].

However, traditionally, the teaching of the dento-maxillomandibular radiographic anatomy in intraoral periapical radiographs to undergraduate students is made through method of classroom learning using radiographic slabs from duplicated films. Therefore the learning time typically is equivalent to time attending classes. The order in which the radiographic slabs are presented to the students follows that of the complexity of the dental anatomy, support tissue and maxillomandibular structures. Thus the aim of this study was to assess the immediate impact in terms of learning of the dento-maxillomandibular radiographic anatomy in intraoral periapical radiographs after the entire replacement of the method of classroom learning by the e-learning using the Moodle platform.

MATERIAL AND METHODS

The teaching of this subject by traditional educational setting in classroom was made by way of radiographic slabs, from duplicated films with imprints indicating anatomical structures in images, which is accompanied by textbook with description these marked anatomical structures, in addition to a support teacher, who works closely with the classroom to support student learning, until the first semester of 2011, to students of A class (AC). In the second semester of 2011, these same radiographic slabs, including description of textbook, were digitalized to use in e-learning for students of B class (BC). Thus the students from two distinct classes, AC (N = 62) and BC (N = 60), had different learning experiences, as the main change the absence of support teacher, besides virtual environment.

The digitalization of the radiographic slabs was made with a Scanjet G4050®

scanner (Hewlett Packard Corporation, USA), using black mask, resolution of 300 dpi and amplification in 1:1. The tool of the scanner for automatic adjustment in brightness and contrast was turned off during digitalization. The digital images were saved in TIFF format and afterward, all necessary adjustments in images were finished by a researcher responsible for creation of the course.

The digital images and texts with description of the anatomical structures related to imprints in images were used to create the Moodle e-course (open-source software available in: http://moodle.com), which is completely free and open-ended (http://www.radiologianf.uff.br/moodle/). The e-course was designed as topics of questionnaires on which each question with description of the anatomical structures had associated an image. All questionnaires with multiple-choice questions were sorted in random mode between items and alternates. The image had an arrow to indicate the anatomical structure to be analyzed and a text in the native language explaining about it, as illustrated in Figure 1.

The evaluation of the impact of the entire replacement of classroom learning by the e-learning was made through comparison of the scores of students from two classes, AC (N = 60) and BC (N = 62), obtained after application of a similar test with all content of the dento-maxillomandibular radiographic anatomy topics. The association of the scores of students was made with T-Student unpaired test.

At the end of the semester, after final examination, a voluntary and unidentified questionnaire with 12 questions, as shown in Table 1, developed in Google Docs spreadsheets, was used to evaluate the acceptance of the students from BC for this e-course. The link to access this questionnaire was distributed by e-mail, indicating that its fulfilment was optional with students. The distribution of the response pattern was evaluated by the Chi-square test.

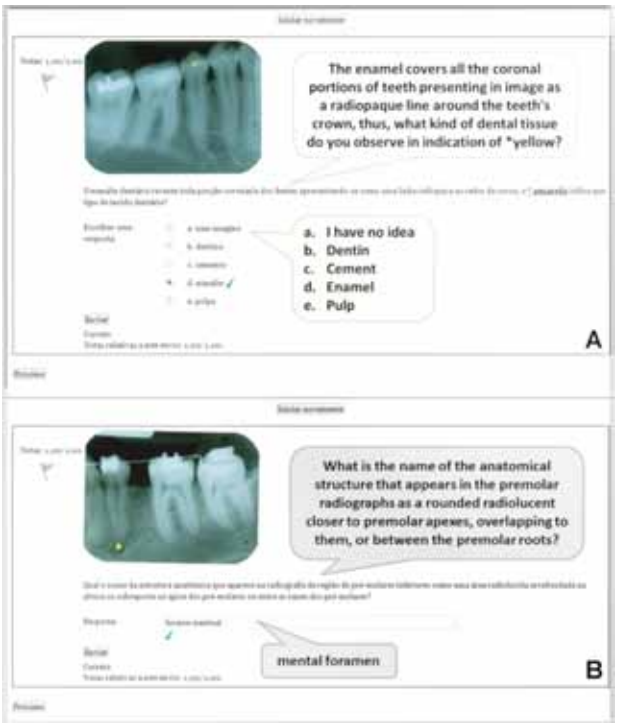

Figure 1 - Content of Moodle e-course with images associated with the question in the Portuguese language, the translation is displayed in balloons. In this case is shown two examples of questions which were correctly marked, in "A" with content at dental anatomy and in "B" with content at maxillo-mandibular anatomy.

All statistical analyses were conducted using the Stata Statistics/Data Analysis version 11.0 software (StataCorp, Texas, USA) with significance level setting at 5% ($\alpha = 0.05$).

RESULTS

Figure 2 is showing the distribution of the sample, a total of 122 students, 62 from AC and 60 from BC, in accordance to gender and age.

In Table 2 is showed results used in evaluation of impact of the distance education implementation. The scores of students from two classes there were no significant difference ($p > 0.05$, by T-Student unpaired test).

The response rate for the voluntary and unidentified questionnaire was of 56.7% (N = 34 students) from BC (N = 60), having 44.7% (N = 21) of female sample and 100% (N = 13) of male sample. The responses of questionnaire are shown in Table 3 and in Table 4.

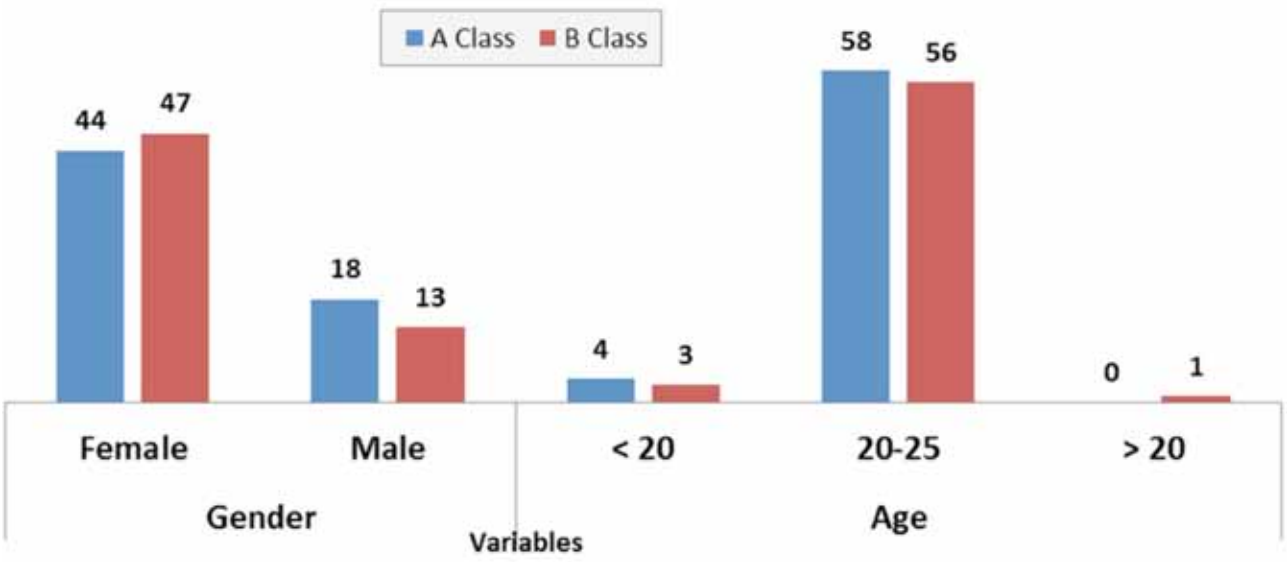

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Table 1 - Questions of the voluntary and unidentified questionnaire used to evaluate the acceptance of the students from BC for this e-course

1) Do you have facility to use the computer and internet every day?
2) Did you have any trouble to do the e-courses due to use of computer or internet personal?
3) Do you believe that your studying was aggrieved due to use of outdated computer and slow internet connection?
4) Do you believe that if the University had more computers would have facilitated your studying with e-course?
5) Did you have previous contact with intraoral radiographs?
6) Did you find interest in content of the material available for study in the discipline of Dental Radiology?
7) Did you find applicability in content of the material available to practice of other disciplines?
8) Would you like to repeat the experience of studying using e-course in other disciplines?
9) Indicate your level of comfort in studying by the computer on a scale from 0 (worst) to 10 (best).
10) Indicate your level of facility with the content of the material available on a scale from 0 (worst) to 10 (best).
11) Indicate your level of facility with the Moodle platform on a scale from 0 (worst) to 10 (best).
12) Indicate your level of satisfaction with this experience, considering it as a whole, on a scale from 0 (worst) to 10 (best).

Table 2 - The mean and standard deviation of scores of students from two classes evaluated

A class	B class	p-value
7.01 (1.47)	6.78 (1.43)	0.867

Table 3 - Frequency and percentage of voluntary and unidentified answers of the BC students about the e-course

Question	Absolutely Yes	Partially Yes	Neutral	Partially No	Absolutely No	p-value
1) Facility with computer and internet	24 (70.59%)	5 (14.71%)	4 (11.76%)	1 (2.94%)	0	0.000
2) Troubles due to use of computer or internet personal	1 (2.94)	6 (17.65)	7 (20.59)	4 (11.76)	16 (47.06)	0.001
3) Aggrieved due to use of computer or internet personal	3 (8.82)	3 (8.82)	6 (17.65)	8 (23.53)	14 (41.18)	0.016
4) Facilitation due to use of computers of the University	26 (76.47)	1 (2.94)	2 (5.88)	1 (2.94)	4 (11.76)	0.000
5) Previous contact with intraoral radiographs	3 (8.82)	6 (17.65)	3 (8.82)	15 (44.12)	7 (20.59)	0.007
6) Interest in the content	34 (100.00)	0	0	0	0	-
7) Applicability of the content	31 (91.18)	2 (5.88)	1 (2.94)	0	0	0.000
8) Repetition of experience in other disciplines	12 (35.29)	20 (58.82)	1 (2.94)	1 (2.94)	0	0.007

Table 4 - The mean (standard deviation) and confidence interval of voluntary and unidentified answers in a scale from 0 to 10, using 0 as worst and 10 as best, of the BC students about the e-course

Question	Mean (SD)	Confidence interval	
		Lower	Upper
9) Level of comfort in studying by the computer	8.50 (1.69)	7.91	9.09
10) Level of facility with the content	4.56 (3.20)	3.44	5.68
11) Level of facility with the Moodle platform	5.35 (2.76)	4.39	6.32
12) Level of satisfaction with this experience	8.47 (1.60)	7.91	9.03

DISCUSSION

Several studies [3,5-7,9-11] have reported the potential use of distance learning by Internet, e-learning, in dental radiology as an educational tool supplemental to traditional classroom learning. In this cross-sectional study, by contrast, the e-learning was not supplemental. The traditional classroom in AC was entirely replaced by the e-learning in BC, without any in-person face-to-face instruction available to students and without any change in the content of the material for study of both classes (AC and BC). Therefore, immediate impact of this new educational methodology was evaluated by comparison of scores of students in a similar test from two distinct classes.

In terms of student's scores there were no significant differences between both classes in our study. The present findings are in accordance with the results of previous studies that indicated the e-learning to be an efficient method of learning [5-13]. In this case, the similarity in scores of students (AC and BC) obtained after application of similar tests used to assess the learning indicated that the content of the e-course had been assimilated, independently of used teaching tools, once the students were able to recognize the anatomical structures in radiographs reaching the educational goal. On the other hand, Kukolja-Taradi et al. [14] indicated that yet there is no clear evidence of the e-learning to be more effective than traditional learning, even if e-learning positively influences student outcomes. Al-Rawi et al. [5] indicated that any e-learning requires further assessments even after the observation of a positive results, indicating its effectiveness compared to conventional educational methods. Kukolja-Taradi et al. [14] added that learning through technology is just different from the traditional face-to-face learning, thus, there is a necessity to evaluate the contexts and purposes that these technologies should be used in learning. In our study the context was the absence of two professors in an initial tableau of three professors, without any possibility of instantaneous permutation due to temporary absences, and then the e-learning was proposed as an alternative for new students (BC). Without this tool the new students (BC) would not study this topic. However, we believe that every kind of technology targets to address a human need. Hence, whenever possible, if it is used as a complement and not as a substitute, then the outcome will be better.

In this study, the initial involvement of the students to make the e-courses was our major problem. As an activity without supervision to be made outside the institution, the adherence of the students to the e-course was low. Same after they having been informed that it would be the unique opportunity to study the topic in discipline. Then, as a strategy for this involvement, each activity had a value. The students should hand over the report activity to acquire a score. Thus, the non-hand over of the report activity until the agreed date would a disadvantage, because the student would receive no score missing it. Nevertheless, this problem already had been reported, [15] indicating that undergraduate dental students would not use any learning material and educational tools extracurricular without a good reason. Thus, for successful implementation of any e-learning into an existing curriculum should be accompanied by evaluations with some value. [11]

At the moment, there are many software technologies that can be used to implement e-learning and each of these technologies has its strengths. The Moodle platform is one of the most popular open-source web applications, known as a Course Management System (CMS), Learning Management System (LMS) or Virtual Learning Environment (VLE), and can be used to create online learning sites. The Moodle has within its features the possibility of the student registration into site with fine-grained tracking of their use, besides a wide communication system between students and teachers through chat rooms, e-mail and discussion forums. [16] Considering that for radiology the role of the web is clearly more crucial than it is for other general disciplines as the diagnostic imaging increasingly uses digital images. [1] The availability of hypermedia documents (made up of text, audio, images or video) is particularly useful in radiology given that the necessary consultation of a large amount of data and images is made in computer. [17] However, the success in our experience occurred mainly due to tracking of site use, possibility to free up several archives to download and e-mail communication, besides, of course, facility to create courses with questions linked to images making available automatically feedback to students enabling the correction of the wrong answers.

In relation to questionnaire response, completed by 56.7% (N = 34 students) of sample from BC, a better acceptance of the

e-course by male students was observed, in spite of the fact that dentistry course is predominantly composed of female students. Our results agree from those of the literature [2,15,18] that indicated a masculine preference to do activities through computer. In our experience was initially observed a great acceptability of female students to do the e-course, however, after some time this acceptance was transformed in apathy. Oppositely, the male students, which wrangled to do the e-course from the beginning, showed a great involvement with this activity confirmed via adherence to questionnaire. Our results were not linked to use of computer and internet by students, because 85.3% of the sample who completed the questionnaire reported to use these every day for other purposes. 58.82% had no trouble to do the e-courses by use of personal computer or internet, but 17.64% believed that were aggrieved by use of outdated computer or slow internet connection. As a result, 79.42% of students believed that if the University had more computers, it would have facilitated their study with e-course. The students always wanted an easy access to e-resources, both outside and inside the University, [9,10] mainly, when forgotten to complete the activity at home.

As regards to acceptation of the content of the material used in e-course, when students started their study 64.71% of the sample who completed the questionnaire had little contact with intraoral radiographs, however, 100% of students regarded this content as interesting, and 97.06% recognized the applicability of this content in other disciplines. Meckfessel et al. [10] showed that e-learning is appreciated by students especially when included topics that use real-world examples, as in case of dental radiology. Even with all difficulties discussed the level of comfort in studying by the computer was high, in spite of difficulty with content of the e-course and low level of facility to use of platform. Finally the level of satisfaction with this experience related by students was high, confirming the satisfactory outcomes of our experience. In our overview there are several challenges of implementation of e-learning in dental radiology as infrastructural problems, of the quantitative of professors disposed to work with distance learning, and mainly about new way of learning detached from the traditional methodology.

Within the limitations of this study and considering all difficulties of implementation of a new methodology to learning, and its specificities, we found that the method of e-learning of this subject using the Moodle platform can be utilized with same educational results of those obtained from a traditional educational setting.

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