A new proposal for teaching/training in caries lesions detection: insights from the implementation of the method among undergraduate students

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ABSTRACT

The present study proposes a method for teaching caries lesion detection and assessment, using the International Caries Detection and Assessment System (ICDAS) as an auxiliary tool. Sixty-two 4-year undergraduate dental students from the University of São Paulo underwent three training activities using ICDAS, applied in different moments: regular theoretical class, activity with projected images and practical-laboratory activity with extracted teeth. The students answered questionnaires, before and after the activities, to evaluate the knowledge and the perception of the practices. A practical evaluation was also performed, with evaluation of extracted teeth. After the exercises, the mean number of correct answers to conceptual questions increased significantly and were maintained until the end of the activity. Those who believed to be well prepared at the beginning of the activity had three times more chance to reach a score above 5 in the second moment of the practical-laboratory activity (OR = 3.1; 95% CI = 1.0 - 9.1). It was concluded that the practical-laboratory activity contributes the undergraduate students' learning about caries lesion detection, including healing conceptual doubts that may exist after the theoretical class. However, the student's perception may not be impacted by the activity.

Descriptors: Dental Caries. Education, Dental. Dentistry.

1 INTRODUCTION

Caries lesion detection has been pointed out as a required topic in the Cariology classes of professional training courses in Dentistry[1,2]. On the other hand, it has been one of the most complicated tasks in contemporary Dentistry[3,4], due to the lack of consensus among different teachers and schools[4].

An attempt to create a scoring system for worldwide use, useful in the fields of epidemiology, clinical practice and clinical studies, has been carried out in recent years[3,5]. A group of researchers created the International Caries Detection and Assessment System (ICDAS)[3,5], which is a system that considers the caries lesion detection from their initial stage (non-cavitated lesions) to more extensive cavitations[3,5]. The inclusion of the initial caries lesions has been identified as important for the establishment of appropriate diagnostic and therapeutic approaches and guarantees a better prognosis in the treatment of the disease[6,7]. Moreover, a recent systematic review has indicated that the use of indexes improves the caries lesion detection when using visual examination[8].

The committee responsible for creating and training for the use of the index has a training manual and e-learning, available online (www.icdas.org). A previous study has shown that e-learning supports the learning of ICDAS by undergraduate students[9]. E-learning is an interactive program but does not allow interaction between student-teacher/tutor as occurs with practical activity. Conversely, since 2009, the Pediatric Dentistry, School of Dentistry, University of São Paulo, has used a new teaching-learning system to train undergraduate students to detect caries lesions, in a pre-clinical activity. This activity involves the lecturers and graduate students to guide the undergraduate students and comprises three stages, one theoretical and another two practical, using images and extracted teeth. At this point, it is extremely important that both the performance and the students' perception of these new activities are evaluated in order to support the use of these techniques in the teaching-learning process for the undergraduate students.

Therefore, the aim of this study was to describe the first insights about the implementation of a new theoretical-laboratory method for teaching caries lesion detection and assessment, using the International Caries Detection and Assessment System (ICDAS) as an auxiliary tool. To evaluate that, we consider undergraduate dental students' practical performance, theoretical knowledge and the perception of the teaching-learning activities.

2 METHODS

Sample and description of teaching-learning activity

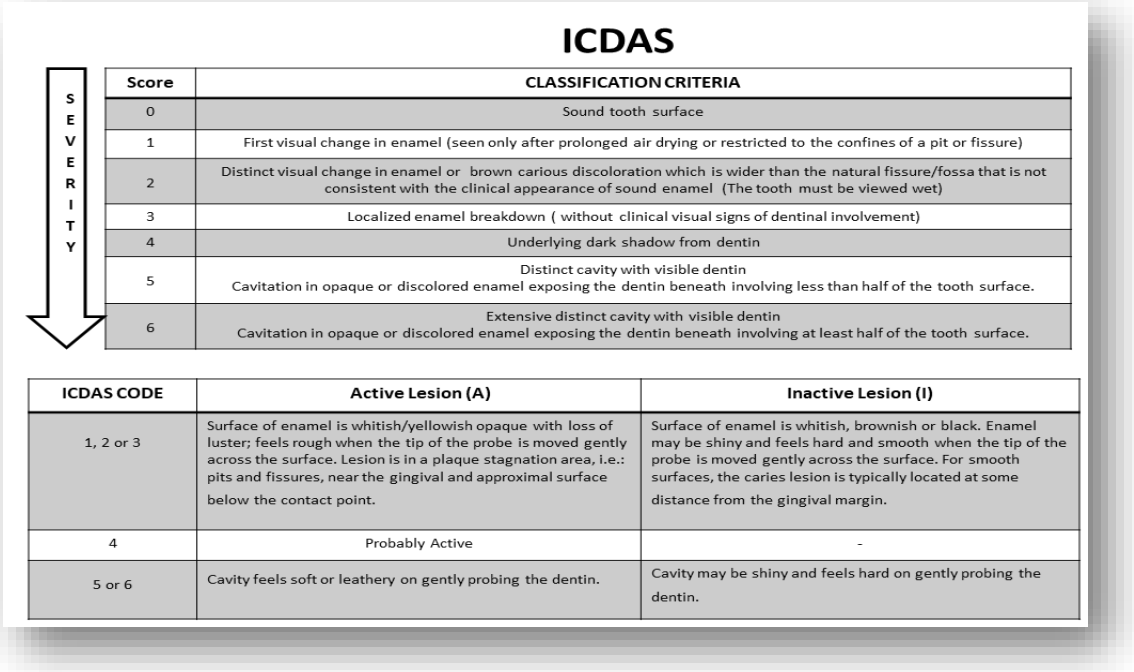
The study was approved by the Institutional Ethics Committee (CAAE 39632614.0.0000.0075). The sample consisted of the questionnaires and records filled out by the undergraduate students who attended the 4th year of the daytime course of graduation in Dentistry in 2009 (n = 62 students) and who performed the theoretical-practical activities. This manuscript was based on the collection of data from an intra-disciplinary evaluation of the new activity, implemented in the schedule of the course of graduation in Dentistry, by the Discipline of Pediatric Dentistry. The activity was firstly carried out in August 2009, with the participation of the professors, lecturers and graduate students from the discipline. The activity was performed in two days, with an interval of one week between them and consisted of the following steps:

Moment 1 (M1, theoretical activity – 1st day): conventional theoretical lecture (face-to-face) with a 50-min about "caries lesion detection". In

this class, caries lesions detection was contextualized as part of the diagnosis process of dental caries. Important aspects to be evaluated in caries diagnosis are also discussed, considering their role in lesion progression and its prognosis, as well as possible treatment decisions. Finally, the ICDAS (figure 1) was presented as a tool to aid in caries lesions detection when using the visual inspection method. In this presentation, an association was made between the clinical ICDAS scores, evolution of the carious process, histological depth and treatment decision.

Moment 2 (M2, laboratory activity with images – 2nd day): students were divided into eight groups composed of approximately 8 members (figure 2A). Each of these groups was guided by two to three graduate students (tutors). Students should classify, according to the ICDAS scores, the sites indicated in thirty clinical photographs. After the end of the projection, the tutors discussed in their groups, the scores assigned to each case. The images belonged to a bank of images and were chosen with didactic purpose. A single template was proposed to guide corrections and further discussions. The tutors were not only aware of the answers, but had also participated actively in the same activity, in a previous moment, and were calibrated to perform their role in the teaching-learning activity.

Moment 3 (M3, laboratory activity with extracted teeth - 2nd day): after discussion of each group guided by the tutors, the undergraduate students evaluated and classified 12 teeth of a sample of extracted teeth prepared exclusively for the activity (figure 2B). For the evaluation of extracted teeth, the students used air/water jet (triple syringe), artificial lighting and a ballended probe. To mimic the moisture conditions of the oral environment, students were instructed to moisten their teeth prior to assessments. After the evaluations, again, the tutors interacted with the undergraduate students, correcting the answers given and discussing possible divergences and doubts that occurred within each group.



ICDAS

SEVERITY

Score	CLASSIFICATION CRITERIA
0	Sound tooth surface
1	First visual change in enamel (seen only after prolonged air drying or restricted to the confines of a pit or fissure)
2	Distinct visual change in enamel or brown carious discoloration which is wider than the natural fissure/fossa that is not consistent with the clinical appearance of sound enamel (The tooth must be viewed wet)
3	Localized enamel breakdown (without clinical visual signs of dentinal involvement)
4	Underlying dark shadow from dentin
5	Distinct cavity with visible dentin Cavitation in opaque or discolored enamel exposing the dentin beneath involving less than half of the tooth surface.
6	Extensive distinct cavity with visible dentin Cavitation in opaque or discolored enamel exposing the dentin beneath involving at least half of the tooth surface.

ICDAS CODE	Active Lesion (A)	Inactive Lesion (I)
1, 2 or 3	Surface of enamel is whitish/yellowish opaque with loss of luster; feels rough when the tip of the probe is moved gently across the surface. Lesion is in a plaque stagnation area, i.e.: pits and fissures, near the gingival and approximal surface below the contact point.	Surface of enamel is whitish, brownish or black. Enamel may be shiny and feels hard and smooth when the tip of the probe is moved gently across the surface. For smooth surfaces, the caries lesion is typically located at some distance from the gingival margin.
4	Probably Active	-
5 or 6	Cavity feels soft or leathery on gently probing the dentin.	Cavity may be shiny and feels hard on gently probing the dentin.

Figure 1. Assessment of the severity and activity of caries lesions based on ICDAS

Figure 2. Practical training in caries detection performed using clinical images taken from an images bank. Note the correction and discussion of undergraduate students mediated by a tutor (graduate student) (A); practical training in caries detection using extracted teeth. Note the distribution of undergraduate students into groups for performing the activity, as well as the interaction between them (B).

Evaluation of the results

To evaluate the theoretical content related to the topic of caries lesion detection, five questions were elaborated by a group of professors and graduate students. Two questions were focused on conceptual issues (questions 4 and 5). Other two questions (questions 1 and 3) addressed the students' ability to make decisions in different circumstances described about caries detection and, finally, one issue required that students were able to identify important aspects related to ICDAS and to recognize possible consequences in failing to classify them into scores during the clinical examination (question 2). This questionnaire was applied after the theoretical class, after activity with the images and after activity with the extracted teeth.

For the practical evaluation, extracted teeth were used. Students should evaluate specific surfaces pointed out, totaling 10-12 surfaces in all. This evaluation occurred in two moments (after a theoretical class and after images). For these assessments, a template was established by a reference examiner for both cases. The number of correct answers in each activity was considered and a score of 0 to 10 was assigned to each assessment based on that.

Another questionnaire was also used to evaluate the student's perception concern the teaching-learning activity. This is a perception questionnaire associated with the scale "State Trait Personality Inventory"[10]. For each characteristic investigated, a 4-point Likert scale was used (Absolutely not, Little, Moderately and Very). Students answered this questionnaire on the same occasions as the theoretical knowledge questionnaire. All the evaluation stages were carried out on the same day, corresponding to the

2nd day of didactic activity with the students.

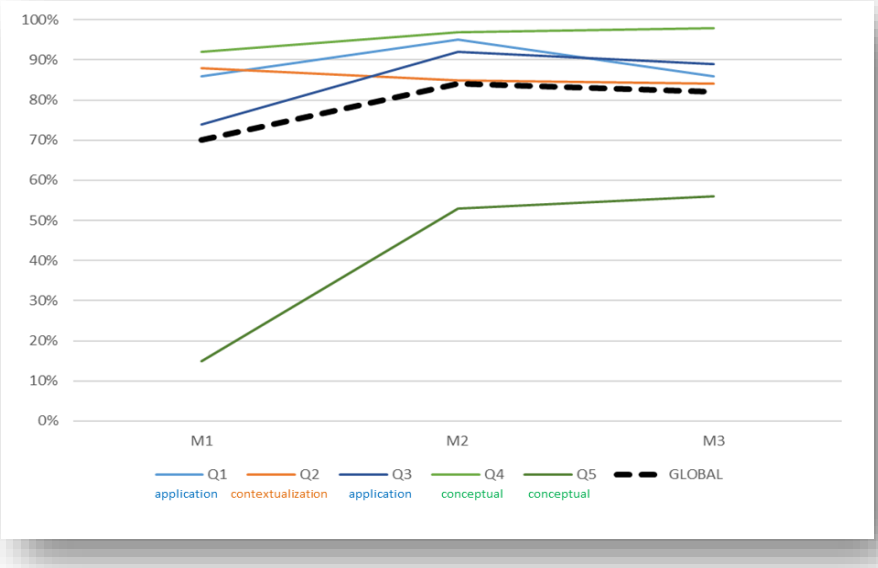
Data analyses

The relationship between the number of correct answers in the different theoretical questions in the three moments of the evaluation was described. The scores obtained from the practical evaluations were described by means, and the two practical evaluations of the extracted teeth (pre- and post-images) were compared by Student's t-test. Linear regression analyses were used to verify the association between the average scores obtained in the theoretical and practical evaluations carried out by the students. It was also tested, by logistic regression, the association between the students' theoretical knowledge and aspects of their perception regarding the activity. For this, it was considered, as an outcome, whether the student had scored more than 50% of the theoretical evaluation. For the questions related to students' perception before and after the activity, the data were expressed in a descriptive way. When necessary, the perception was converted into a scale of 0 (absolutely no) to 3 (much) for comparison by the Friedman test.

3 RESULTS

In general, the students presented a good performance (70% of correct answers) in the theoretical test after the theoretical lecture. This figure was increased by 10% after the evaluation of the images, correction, and discussion with the tutors (graduate students), without a significant increase after training with teeth (Figure 3). The number of correct answers was increased, with laboratory training, especially for questions 3 and 5, respectively, a question of knowledge application and conceptual knowledge (Figure 3). The application question addressed the differential clinical diagnosis of moderate caries lesions.

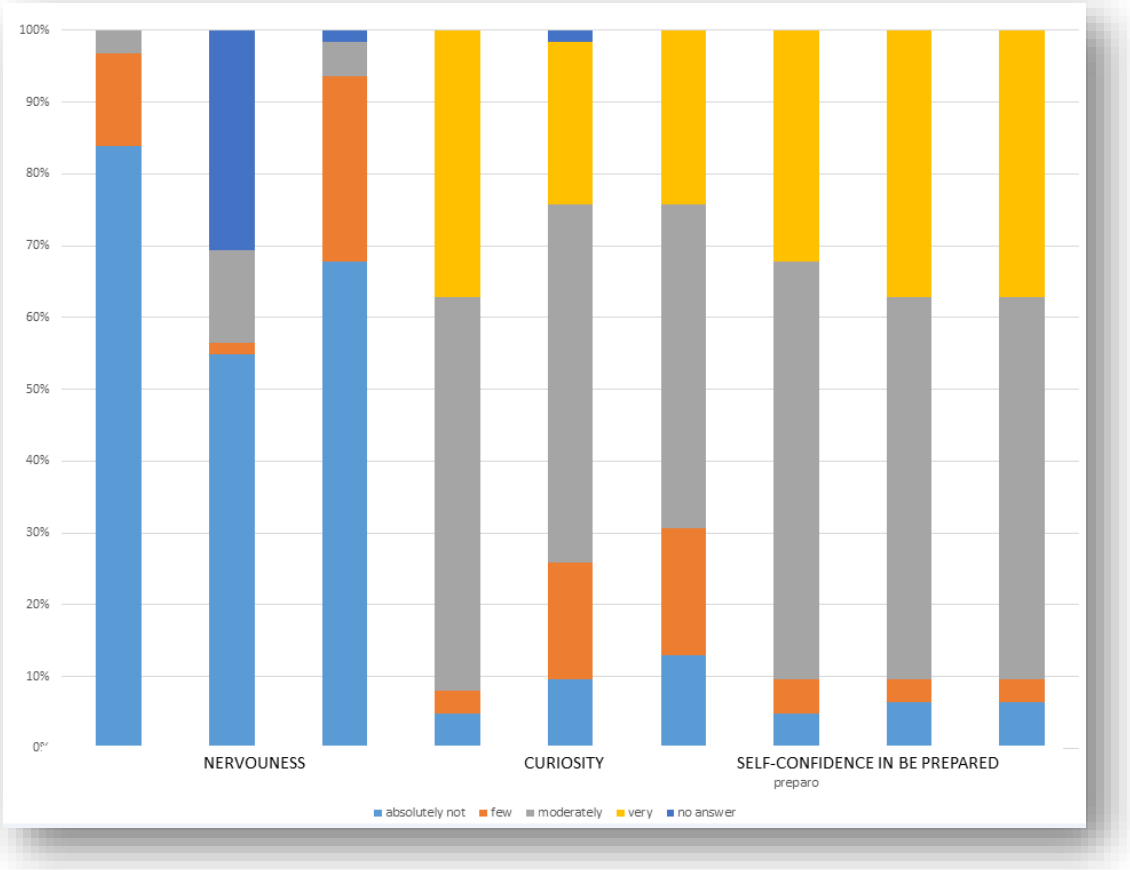
Among the students who made a mistake during the theoretical evaluation, about 50% still believed to be well prepared for the caries lesion detection in simulated cases in images and extracted teeth.



Graph 1. Percentage of correct answers in the theoretical assessment in 3 different moments. M1: after theoretical class; M2: after image scoring; e M3: after scoring extracted teeth. Qn: question ID (linked to the type of assessment).

The students also showed a slight improvement in the practical activities with extracted teeth, comparing those performed at the beginning (mean ± standard deviation: 5.1 ± 1.4) and at the end of the activity (mean ± standard deviation: 5.3 ± 1.4; p = 0.04). The students who took the highest grades in the theoretical questionnaire in the third (final) moment obtained a higher grade at the end of the practical activity as well (Linear regression coefficient = 1.68, SE: 1.09, p = 0.001). After the theoretical class, the majority of the students (85%) did not present nervousness, irritability, nor were angry before starting the activity. Approximately 90% of the students reported moderately or very curious about the activity and 60% of the students said to be moderately or very well prepared for the activity.

After the practical activity, the number of students who said they did not present any nervousness discreetly decreased compared to the beginning (figure 4). The level of curiosity tended to decline slightly until the end of the practice. However, the student's confidence perception of being well prepared showed that the responses did not change from the beginning to the end of the activity (p = 0.73). Those who believed that they were well prepared at first had 3 times more chances to take a grade higher than 5 in the second moment of practical-laboratory activity (OD = 3.1, 95% CI = 1.0-9.1).



Graph 2. Distribution of students' answers regarding their perception in different moments. M1: after theoretical class; M2: after image scoring; and M3: after scoring extracted teeth

4 DISCUSSION

The didactic activities played related to caries lesion detection for undergraduate students should allow them to practice it clinically within the process of diagnosis of dental caries and can opt for the most appropriate form of treatment for their patients.

The ICDAS is a method indicated for use in education, but it has not been taught to undergraduates at all universities yet, because it is relatively new. On the other hand, we know that it is important to use an index to improve the accuracy and reproducibility of the visual examination of caries lesions[8]. Besides, the inclusion of initial lesions in caries detection may create more doubts and induce more considerable variability between the examiners[11,12]. In this sense, one can argue about that as the greater concern occurs in the students' training to use such system in clinical practice. The preliminary insights of this practical activity that we proposed for undergraduate students suggest that preclinical activity, from different points of view, significantly modified students exposed to it. Based on that, we expect that these students tend to be more prepared to use this index clinically (comparatively to when the traditional teaching model (only lectures) was used).

Regarding the theoretical knowledge, we noticed that the number of correct answers increased after the practical training with images and teeth. This is probably due to the opportunity that the students had to discuss with the other members of their group and with the graduate students (tutors) who were guiding them and clarifying possible doubts that remained after the theoretical class. In fact, practical activities have been shown to have a positive influence on knowledge, skills, and attitudes among students from different areas [13,14]. However, there was no improvement in the theoretical knowledge of the students between the end of the activity and the exercise with the images, because probably the greatest conceptual doubts and applicability of the system were healed in the first practical exercises.

The practical-laboratory activity allowed the student to better understand aspects important for the classification of the lesions clinically (e.g., differentiation between ICDAS scores 1 and 2; the distinction between ICDAS scores 3 and 4). Especially, in this last case, classifying adequately could lead to differences in clinical decision-making. However, on average, there was no improvement in the students' opinion about possible clinical implications of the error in the diagnosis. Probably, this kind of question, when answered incorrectly, may require students to have greater clinical experience to notice and correct the failure themselves. On the other hand, during the activity, students may be very focused and eager to carry out the diagnosis and cannot interpret possible situations of errors.

A significant part of students made mistakes about question 5, revealing a possible student's difficulty to segment some concepts assimilated in the theoretical class. When questioned about what the ICDAS scores were able to identify, many students answered that caries lesion severity and activity, even after the practical activities, where they used the ICDAS scores to only estimate the caries lesion severity. In fact, the classification in scores only evaluates the severity, but as the students know that in the clinic, it is also necessary to evaluate the caries lesion activity status. Thus, we believe they may have chosen the most complete answer to show their actual assimilated theoretical knowledge.

Although it is more complex to teach severity and activity in the same practical activity, it may be important that this association occurs to assist the student in the final clinical application of this knowledge and not confront concepts that are interrelated. On the other hand, since the caries activity has a dynamic character, reproducing fully

its evaluation in the laboratory is a complicated task. Therefore, questions related to the activity are discussed, and students are trained to see characteristics related to the differential status of the lesions.

In the practical evaluations with extracted teeth, there was also an improvement in the students' performance. Although the possibility of examining extracted teeth was a way to familiarize students with the index before doing it clinically, the fact that the students had, on average, more right answers in the second exam than in the first one may indicate that the laboratory activity improved students' performance on caries detection. Besides consolidating theoretical concepts, also reverted them to a better final application of these concepts. On the other hand, students may also have improved their performance by repeating the activity and gaining more ability to perform the exams. Therefore, the results of this study should be viewed with caution and studies with more specific designs should be conducted to evaluate the actual impact of this educational proposal for teaching caries detection among undergraduate students.

The training time (about 2 hours), as well as the interval between evaluations, were short. The improvement in performance could be even more significant if the training time was longer and the students had greater clinical coexistence with the use of the index, or if the students used some other method to consolidate the learned content in a long-term analysis. Following these students, for example, until the end of the undergraduate course or even after some time of formation, could help both to answer the question if this knowledge is sedimented with clinical experience, as well as about the retention of this knowledge learned during the long-term graduation[15,16].

The students who had higher grades in the theoretical evaluations in the beginning, probably had already had certain prior knowledge accumulated (previous knowledge and theoretical lecture) were more likely to perform better in the practical evaluations. We believe that this student can already start the activity more motivated and confident, performing the following activities with more caution and reflecting their good results during the practical evaluations. Although the practical training is seen as significantly important, certainly, it does not eliminate the theoretical sessions, either by building an initial knowledge background or by motivating the student for the theme[17].

The better performance in the activity with images in relation to the final practical activity also reiterates that the student engaged in the activity tends to maintain its good results along it. The activity with the images resembled the activity of e-learning[9], regarding the classification of the photos of carious lesions; however, the difference was that the students were practicing in groups where they could talk about doubts, discuss with their colleagues and clarify them with the graduate students who acted as tutors, which contributes significantly to assimilating the topics[18]. In the ICDAS e-learning, the student often practices alone and without a support to ask questions. This also reinforces the importance of a laboratorial activity composed of these different phases as proposed. The different stages tend to reinforce the theoretical knowledge from the conventional classroom gradually[19].

The future professional should be able to use the method, but also well trained to assess his patients' caries lesions clinically. Undergraduate students, at this stage of learning and training, should be encouraged to perform self-assessment and comprehend what they need to improve and how their knowledge status on given subject is. Although the students' theoretical and practical performances showed their improvement, the student's perception about that was not changed along the study.

Although they are able to perform caries lesion detection, they may not be able to notice or discriminate their improvement from the beginning to the end of the laboratory activities. This observation might suggest that the student may not have a mature sense of self-criticism, or students may avoid showing them as excessively self-confident, even when they were. It is important to state that students' perception answers were collected before the discussion of right answers in tests, contributing to their uncertainty about their actual performance on evaluations. We believe, therefore, that this may have been a reason for not having had an impact of the activity on the students' perception.

Regarding the students' posture facing the new activity (not usual for the moment in which they were living-end of the course), it is remarkable that a great majority was curious at the beginning of the activity. The level of nervousness increased a little in the second moment, showing that some students might be tense with a unknown activity, involving assessment of their performances. Even though they had been clarified in advance about the activity, the separation of the room into random groups, the expectation created by a new activity and the insecurity by the interaction with the colleagues and graduate students may have generated a situation of agitation among the evaluated students and also a high degree of initial curiosity. On the other hand, these findings may reflect students' interest in a new activity, since it is a laboratory activity approximating to the clinical reality, as objective of an active learning methodology like that[20].

5 CONCLUSION

The practical-laboratory activity really contributes to the students' learning in the detection and evaluation of caries lesions, solving even conceptual doubts that may exist when using the theoretical teaching method alone. However, the students' perception of their knowledge remained the same at all times, evidencing that these students tend to show positive postures regarding the activity.

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RESUMO

Nova proposta para ensino/treinamento na detecção de lesões de cárie: *insights* da implementação do método entre estudantes de graduação

O presente estudo propõe um método para o ensino de detecção e avaliação de lesões de cárie, utilizando o Sistema Internacional de Avaliação e Detecção de Cárie (ICDAS) como ferramenta auxiliar. Sessenta e dois estudantes do quarto ano do curso de graduação em Odontologia da Universidade de São Paulo foram submetidos a três atividades de treinamento para uso do ICDAS, aplicadas em diferentes momentos: aula teórica convencional, atividade com projeção de imagens e atividade prática-laboratorial com dentes extraídos. Os estudantes responderam a questionários, antes e após as atividades, para avaliação do conhecimento e da percepção sobre as mesmas. Também foi realizada avaliação prática, com avaliação de dentes extraídos. Após os exercícios laboratoriais, a média de respostas corretas para questões conceituais aumentou significativamente e se manteve até o final da atividade laboratorial. Quem acreditava estar bem preparado no início da atividade teve 3 vezes mais chances de alcançar nota acima de 5 no segundo momento da atividade prática-laboratorial (OR=3,1; 95% IC=1,0 – 9,1). Concluiu-se que a atividade prática-laboratorial contribui para o aprendizado de estudantes de graduação na detecção de lesões cárie, inclusive sanando dúvidas conceituais que possam existir após a aula teórica. Todavia, a percepção do estudante pode não ser impactada pela atividade.

Descritores: Cárie Dentária. Educação em Odontologia. Odontologia.

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