Knowledge and adoption of ecological strategies among undergraduate Dentistry students

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ABSTRACT

The aim of this study was to evaluate the knowledge and adoption of sustainable Dentistry strategies by students of a private higher education institution in Belo Horizonte. The sample consisted of students enrolled in the 4th to 9th period in 2018 (n = 287). Data were collected through a self-administered Portuguese language questionnaire, tabulated and analyzed through descriptive analysis. About one third of the participants (93, 32.39%) adopt the ecological strategies that can be implemented in daily dental practices. Approximately half of the students (152, 53.0%) reported that they sometimes think about environmental and sustainability issues and 252 (87.8%) answered that they had never heard of Green Dentistry. However, 268 (93.4%) showed interest in getting to know it and 230 students (80.1%) considered it important to implement environmental education programs in the curriculum of Dentistry courses. Most students are unaware of Green Dentistry and do not adopt conducts that reflect concern about environmental issues. Only a portion of respondents use ecological strategies in their clinical routine, but not necessarily in their daily habits. The insertion of environmental education in universities is urgent and was supported by the students of this study.
Descriptors: Healthcare Waste. Environment. Dentistry Students. Environmental Education.

1 INTRODUCTION

Healthcare professionals, including dental staff, have the responsibility to preserve the environment and to reduce the impacts of waste generation, to reduce water, paper and electricity consumption, as well as avoid the use of toxic materials[1-5].To minimize these impacts, in 2009, the founders of ORA Dental Studio created in the United States the term Eco-Friendly Dentistry, Green Dentistry, whose work model is based on

the 4R principle: reuse, recycle, reduce and rethink[1,4,6].

In Dentistry, the 'reduction' is associated with the reduction of water and energy consumption, minimization of waste generation, the consumption of office material in favor of digital resources[1,2,5]. 'Reuse' is related, for example, to the instrumental and reusable stainless steel [1,2].

It is estimated that 80% of waste generated during dental activities is non-infectious (paper towels, dental packaging, mailing envelopes, plastic bags, tissue, plaster, lead blades from radiographic films) and household-like waste (cups). Disposables, magazines / newspapers, food scraps, ballpoint pens, matches, sponges, toothbrushes, paper) and which could be disposed of as common waste or sent for recycling[1, 2, 7]. Segregation errors cause these materials to be disposed of improperly, burdening healthcare services and increasing the amount of potentially infectious waste[7].

For decisions to be made consciously and sustainable practices implemented, it is essential that education and environmental awareness are included in higher education institutions[3]. In addition, there are few national and international publications on the theme. Despite this, some researches[3,5] shows that most students and professionals of Dentistry do not adopt ecologically correct measures. They also reinforce the need to understand how the subject is approached in universities, so that one can think, 'rethink' and adopt ecological strategies. Thus, this study aimed to evaluate the knowledge and the adoption of ecological strategies by students of the Dentistry course in a private educational institution in Belo Horizonte, state of Minas Gerais.

2 MATERIAL AND METHODS

This is a cross-sectional study, conducted in a private higher education institution, in 2018. The study sample consisted of 1,088 students from the fourth to ninth periods of the Dentistry course, who were already studying the disciplines with practical activities in dental clinics.

The sample size was calculated, using the finite population estimation method, considered a 50% prevalence of knowledge about Green Dentistry, 95% confidence level and 5% significance. A minimum sample of 284 students was obtained. To guarantee the accuracy and compensate for any losses, the sample was increased by 20%, resulting in a final sample of 341 students. Students were randomly recruited by lot, maintaining proportionality for each period of the course. The students' approach was carried out in the classroom, at times given by the teachers. Participants who agreed to participate signed a free, well informed consent form.

The questionnaire was structured based on the self-applicable scientific literature [1,3-5], with 32 questions divided into two blocks. The first (15 questions) addressed the adoption of ecological strategies in the students' daily life, as well as the knowledge about recycling, reverse logistics and Green Dentistry. The second block (17 questions) identified knowledge and the adoption of sustainable strategies in dental practice.

An initial pilot study with 10% of the final sample, i.e. 34 students was conducted. Thus, it was possible to analyze the comprehension of the language and the meaning of the questions, if the terms were clear and if the obtained answers were distributed among the presented options. The pilot study led to the reformulation of some points and then a second pilot study was conducted with the same 34 students to ensure that the adjustments met the suggestions. Participants in the pilot study were selected as a convenience and excluded from the final study

sample. Data obtained in the main study were tabulated and analyzed using descriptive analysis. The study was submitted to the Ethics Committee of the Newton Paiva University Center and approved under CAAE 68373417.4.0000.5097. 3.

3 RESULTS

Of the 341 invited students, 287 (84.4%) agreed to participate and answered the questionnaire. Of this total, 223 (77.7%) were female and 64 (22.3%) male. The age ranged from 19 to 48 years, with a mean of 23.60 (± 4.6). Thirty-five (12.2%) students were in the fourth period, 57 (19.9%) in the fifth, 37 (12.9%) in the sixth, 75 (26.1%) in the seventh, 46 (16%) in the eighth, 35 (12.2%) in the ninth and two (0.7%) did not report the period which they were in.

The first block of the questionnaire investigated the adoption of ecological strategies at the university. About one third of the participants (93, 32.39%) adopted the ecological strategies that can be implemented in daily dental practices. Table 1 presents the details of the questions and their respective answers.

Regarding the waste segregation, it was observed that 123 (42.9%) students use the containers of the college for selective collection, 116 (40.4%) use them sporadically and 32 (11.1%) do not use them. Despite the existence of collectors, 10 (3.5%) claimed that there are no recycling containers on campus. Only six (2.1%) did not answer the question.

To find out if the students had knowledge to segregate the waste, they were asked to point the correct color of the container to the following waste: fruit scraps, napkin, soda straw, used toilet paper, broken glass and soda can. It was observed that, although most reported the practice of selective collection, few knew how to properly segregate waste. The results are detailed in graph 1.

It was observed that 129 students (44.9%) chose to purchase dental instruments and materials on a large scale to reduce the number of deliveries and packaging boxes for transportation. Another 107 (37.3%) said they had never thought about this question and 49 (17.1%) bought materials several times. Two students (0.7%) did not answer the question.

In the clinics, 192 (66.9%) students report protecting the surfaces of the dental equipment using the minimum necessary plastic disposable barriers, meeting the Biosafety standards. In turn, 74 (25.8%) said they passed more than one turn of plastic barrier over the equipment to ensure greater biological safety and 21 (7.3%) did not care about the amount used.

Regarding the future request for radiographic examinations, most students (131, 45.6%) will choose digital exams; 123 (42.9%) alternate between digital and conventional radiographs, 15 (5.2%) will request only conventional radiographs; four (1.4%) students will not request radiographs and seven (2.4%) did not know which type to order because they were unaware to differentiate them. A group of seven (2.4%) students did not answer the question.

Regarding the same exams, a total of 115 (40.1%) students will perform digital radiographs, 58 (20.2%) only conventional radiographs, 65 (22.6%) both types, 37 (12.9) reported that they do not intend to perform radiographs in the future, six (2.1%) do not know which type they will perform, as they do not know the difference between them and six (2.1%) did not answer the question.

By opting for digital radiography, 198 students believe there will be waste reduction. Among the mentioned waste, 109 (38%) students believe that plastic waste will not be generated, 104 (36.2%) paper, 136 (47.4%) x-rays lead foils and 107 (37.3%) believe that the packages / x-ray film boxes will reduce. In addition, 142 (49.5%)

believe that no x-ray fixer residues and 138 (48.1%) x-ray developer will be generated, chemical solutions used in conventional radiographic processing. It is noteworthy that the students could mark more than one option. Another 81 (28.2%) could not report which waste could not be generated and eight (2.8%) did not respond.

Regarding the behaviors related to water consumption, such as hand washing, the use of the dental spittoon and the possibility of installing a vacuum pump, most students (238, 82.9%) turn off the dental spittoon when the procedure does not require its use; 31 (10.8%) report that sometimes they turn it off, 17 (5.9%) never turn it off and one student (0.3%) did not respond. Almost all students (282, 98.3%) close the faucets after hand washing, two (0.7%) reported that they sometimes close, one (0.3%) never closes and two (0.7%) did not answer. Regarding the type of vacuum pump to be used in the dental office, 34 (11.8%) students reported that they want to use the common vacuum pump, 33 (11.5%) dry vacuum pump; 217 (75.6%) did not know the difference between them, so they do not know which one to use and three (1%) did not respond.

Students were asked about the possibility of recycling some materials generated during dental care and oral hygiene practices (table 2). Most of the students (265, 92.3%) did not have the habit of recycling toothpaste tubes and brushes. Only 20 students (7.0%) reported forwarding and two (0.7%) did not respond. The possibility of recycling amalgam waste was also addressed and it was found that most students (175, 61.0%) believe that these residues can be directed to recycling (table 2). Although most mentioned recycling, most (142, 49.5%) could not answer how waste should be packaged and stored. Another 54 (18.8%) and 29 (10.1%) students recommended storing in water-resistant glass containers and unbreakable containers, respectively. Only 60 (20.9%) students reported that amalgam residues should be separated into sealed plastic containers under a thin layer water. There was a loss of 0.7% because two students did not respond.

During daily decisions, 79 (27.5%) students always reported thinking about environmental and sustainability issues, 152 (53.0%) sometimes think, 55 (19.2%) do not think, and one (0.3%) did not respond.

Only 15 (5.2%) students answered that they had heard about Green Dentistry, 252 (87.8%) never heard and 20 (7.0%) did not answer. Regarding the 4R model it was observed that 237 (82, 6.0%) students do not know him. Only 47 (16.4%) reported having knowledge of the subject and three (1%) did not respond. Only 13 (4.5%) cited that one of the principles of the model is Rethink, 43 (15.0%) cited Reuse and Recycle and 33 (11.5%) cited Reduce. The majority (268, 93.4%) showed interest in knowing Green Dentistry. Some (14, 4.9%) reported no interest and five (1.7%) did not respond. Of the students who were interested, 201 (70.0%) would like to attend lectures, 54 (18.8%) theoretical / practical classes and 63 (22.0%) extension courses; 163 (56.8%) would like to receive information via online social networks, 93 (32.4%) via posters / folders and 115 (40.1) institutional videos. In this question, students could mark more than one option.

Most (258, 89.9%) said they did not know reverse logistics, 26 (9.1%) knew it and three (1.0%) did not respond. Of those who said to know it, 17 (5.9%) defined it correctly and nine (3.1%) made a mistake.

For 230 (80.1%) students the implementation of environmental education programs in the Dentistry course was considered important. In contrast, 53 (18.5%) did not value it and four (1.4%) did not answer the question.

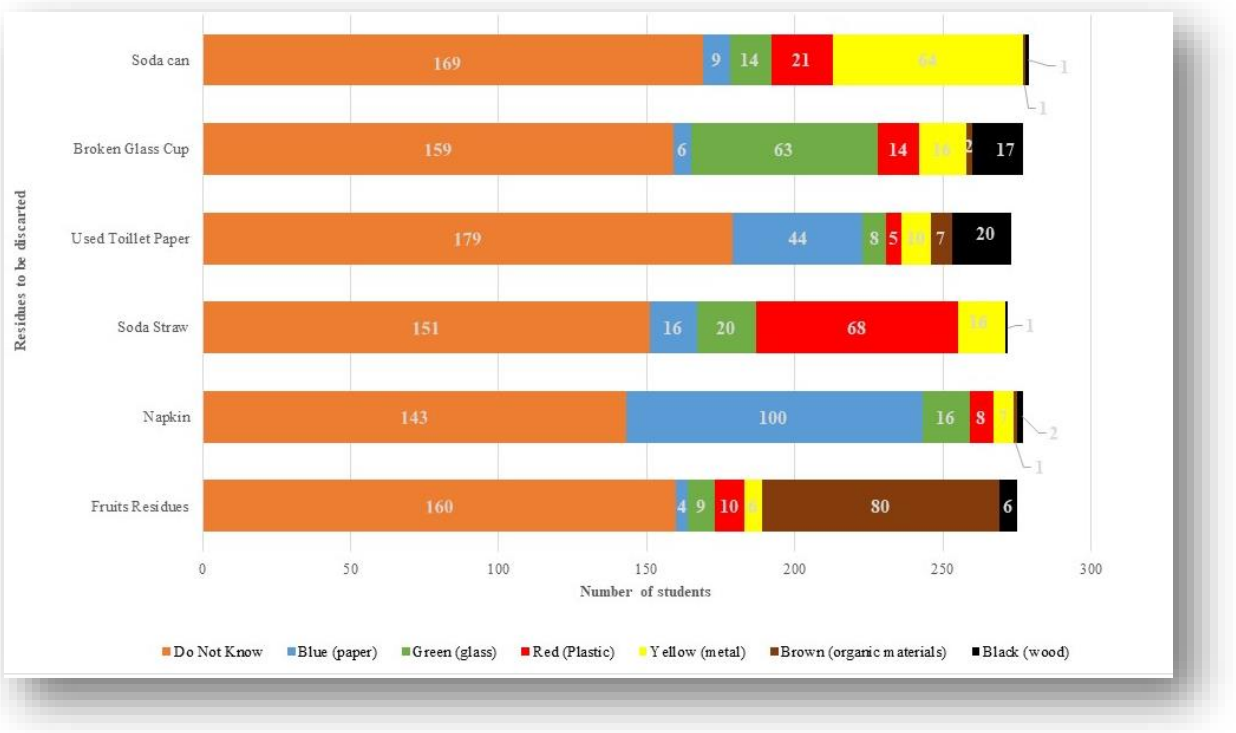
Table 1. Questions and answers related to reducing energy, paper and printing ink consumption in students' daily lives

Daily behaviors to reduce consumption	N	%
Power		
By completing the daily computer activities, you:		
Turn off the computer / notebook	185	64.4
Hibernates or sleeps	69	24.1
Keep it on	32	11.1
Did not answer	1	0.4
Which type of lamp do you choose to use on a daily basis:		
Fluorescent lamps	112	39.0
LED light bulbs	97	33.8
Incandescent lamps	20	6.9
Don't know what type of lamp they use	56	19.5
Do not use any of the options	1	0.4
Did not answer	1	0.4
Uses motion sensors attached to lamps in your home or work place:		
Does not use sensors	219	76.3
Use the device	48	16.7
Could not inform	18	6.3
Did not answer	2	0.7
Of the paper		
When you print a document, you:		
Previously certifies the need for printing	219	76.3
Does not certify the need for printing	67	23.3
Did not answer	1	0.4
To print, you:		
Have a habit of using only one side of paper	90	31.4
Uses both sides of paper	43	15.0
Uses both options, depends on the type of document to be printed	154	53.7
Regarding the disposal of paper sheets:		
Shred and recycle	14	4.9
Do not send for recycling	267	93.0
Did not answer	6	2.1
Your first option for sending texts and communications is:		
Social networks (facebook, whatsapp, among others)	133	46.3
Emails	77	26.8
Mobile text messaging (SMS)	14	4.8
Manual mailing	1	0.4
Did not answer	62	21.7
Printing ink		
To print documents whose version is not final, you:		
Uses normal quality mode	161	56.1
Uses draft mode	99	34.5
Do not know which mode uses	15	5.2
Did not answer	12	4.2
You use software that reduces printer ink consumption:		
Uses	38	13.2
Does not use	190	66.2
Don't know	57	19.9
Did not answer	2	0.7

Table 2. Dental students' knowledge about recycling strategies that can be adopted in the dental office

Questions related to Recycling	Yes N (%)	No N (%)	Don't Know N (%)	No Answer N (%)
Can papers generated in the dental office be recycled and shredded?	206 (71.8)	34 (11.8)	47 (16.4)	-
Can toothpaste tubes be recycled?	203 (70.7)	19 (6.6)	64(22.3)	1 (0.3)
Can toothbrushes be recycled?	83 (28.9)	119 (41.5)	83 (28.9)	2 (0.7)
Can the x-ray lead foil generated during conventional radiography be recycled?	142 (49.5)	52 (18.1)	92 (32.1)	1 (0.3)
Can sterilization wraps (paper and/or SMS) used during the sterilization process of dental instruments be recycled?	134 (46.7)	97 (33.8)	49 (17.1)	7 (2.4)
Should amalgam waste generated in dental practice be separated and sent for recycling?	175 (61.0)	107 (37.3)	NA	5(1.7)

NA: Not applicable ("I don't know" did not appear as an answer to this question).



Graphic 1. Dental students' knowledge about waste disposal during recycling segregation

4 DISCUSSION

Dental professionals should seek to reduce waste generation in the workplace. The use of artificial lighting by means of fluorescent lamps; turn off or put the computer to sleep; reducing paper consumption[1], sending texts online and assessing the need for printing, should be part of daily routine for these

workers. In the present study, it was observed that most Dentistry students already adopt these behaviors and may take them to their future professional practice. However, the usage of wireless sensor networks to save energy and software to reduce ink consumption in their homes is not usual. This fact reinforces the need to encourage draft mode printing and the use of software that reduces toner and ink consumption[1].

Segregation of recyclable materials should also be encouraged on a daily basis, as dental offices can generate waste from Group D (classified by Brazilian Federal Law as similar to domestic waste), which can be recycled[8]. In the present study, it was observed that most of the students used the recycle collectors, but could not correctly indicate the color correspondent to the recyclable material. This result corroborates the study published by Carvalho[9], who observed a portion of students (32%) who did not correctly dispose of the waste in collectors placed on the university campus and another (25%) who said they do not know where to deposit the recyclable materials. It is assumed that a small portion (10%) of potentially recyclable material is generated and disposed of correctly[10]. The lack of involvement of the population may be due to accommodation and disinterest, the lack of spaces in residences for waste storage and the disbelief regarding actions by the government[11].

A high frequency of students adopts positive "reducing" habits in clinics, such as saving water during their activities. This measure is relevant since in most dental activities the dental spittoon and other equipment that consume energy and water are used, besides the obligation of hand washing before and after clinical procedures[1]. Considering these issues, it is imperative to use artifacts that reduce the environmental impacts of Dentistry as a healthcare service provider[12]. Water-saving devices should be installed in the sinks and flush toilets[5] while preserving the essential water resources[13]. We emphasize the need to discuss with students' other processes that reduce water consumption, as most participants are unaware of the advantages of using the dry vacuum pump and its differences from the common vacuum pump.

Opting for new technologies in the dental office, such as digital radiographs, can help reduce waste generation and eliminate the disposal of chemical solutions and radiographic films. The digital method allows images to be obtained by means of electronic or optical sensors sensitive to radiation[14, 15] and was the choice of most students in the present research, although the equipment is still expensive[18]. Students believe that waste will be reduced with digital technology, but the need to discuss the disposal of waste generated by the conventional technique, which is still part of the routine of dental offices[16], seems to be far from eliminated. Brussadori et al[17] identified that 61.1% of dentists had a habit of eliminating x-ray fixer and x-ray developer solutions directly in the sewage system, which could contaminate the soil and water[18]. X-ray film lead foils can be processed in facilities licensed for this purpose or sent to an industrial landfill for hazardous waste[16] or still be recycled[19].

Large-scale purchasing of consumable materials can reduce the number of deliveries and packaging for transportation[1]. Unfortunately, this conduct is not yet widespread among the participants of the present study and had not even been thought of. The reuse of cardboard packaging offers economic and environmental gains, reduces carbon emissions and the need for

environmental compensation[20]. The implementation of sustainable activities in dental offices can reduce by 90% the amount of waste generated and contribute to consolidate the binomial Dentistry and Environment[14].

Disposable materials offer advantages from a biosafety point of view, but increase the volume of dental waste[21]. Plastic film is recommended as a mechanical barrier to cover dental equipment[22]. Fortunately, in the present study, most students cover the surfaces using minimal plastic film, minimizing possible damage to fauna and flora[23, 24]. In the present study, *spunbonded/ melt blown / spunbonded* (SMS) was considered recyclable by most students. Pinter and Jardim[21] identified that 19% of the waste produced in the operating wards of a private hospital in São Paulo came from the SMS blankets. The researchers implemented a segregation flow of these blankets, sending them for recycling through reverse logistics. It is believed that this conduct could also be implemented in Dentistry offices and courses, through the insertion of strict material disposal and collection protocols. The present research showed that, despite knowing the strategies that can be adopted in the dental office, the students still did not have the habit of segregating and sending the waste to this process. It was evident that knowing did not imply the realization of sustainable practices[25].

Interestingly, most students did not consider that toothbrushes could be recycled, which is possible[26] and may be the destination for around 28 billion discarded brushes annually worldwide[27]. The reverse logistics policy, implemented by Brazilian Law No. 12,305, published on August 2, 2010, provides for the restructuring of return systems for products already consumed to the business sector, so that they can be reinserted into the production cycle or other environmentally appropriate destination, adding economic and environmental value to them[28, 29]. Among the existing reverse logistics programs in Brazil, there is the Colgate® / Terracycle National Oral Health Recycling Program, which has already recycled 2.6 million toothbrushes, toothpaste tubes and their packaging[26]. Although reverse logistics is inserted in Dentistry, it is observed that the subject is not widespread[30].

The generation and disposal of amalgam residues is also a concern in dental practice, as its components can contaminate the environment and harm human health[6]. If not properly disposed and managed, amalgam residues may come into contact with the environment[5, 14, 31]. The main form of environmental contamination is the discharge through water systems. Dentistry' procedures are responsible for approximately 3% to 70% of the mercury load present in wastewater treatment facilities[1, 32]. Most participants in this study reported that amalgam waste can be recycled, but could not answer how it should be packaged and stored to be sent for processing. According to the Ministry of the Environment[33], amalgam residues should be collected and stored in a wide-mouthed container of inert and resistant material and be kept under a layer water. Proper conduct promotes reduction of the impact generated by this material. It is also recommended to install pre-capsulated or mercury-free alloy amalgam separators and filters in their composition[14, 31, 34, 35].

The lack of information, the teachers' insecurity, the lack of methodologies that associate the theme with the local reality and the lack of qualified professionals[36] lead to the lack of reflection on environmental and sustainability issues, as shown by our results. The inclusion of environmental education in

the curriculum of Dentistry courses was supported by the students of this study. Such a measure may result in behavioral changes that only happen from knowledge about environmental issues[37]. One of the recommended ways to disseminate the philosophy of Green Dentistry is the continuing educational intervention[4]. Although unknown to most participants in the present study, almost all showed interest in knowing the subject. This can be explained by the fact that the adoption of sustainable practices generates a competitive advantage, since the involvement of professionals arouses the support of people and creates a benefit for dentists who adopt this model[38], in addition to projecting a quality image and positive values to dental offices that adopt environmental care[39]. Knowing and applying Green Dentistry is an advantage in the market, because in addition to the added values, it also allows to diminish costs, reducing waste, saving energy and water, as well as enabling the preservation of the environment through the reduction of pollution, using more recent and sustainable techniques and procedures[4].

The limitation of this study was that it was conducted in a single institution. Despite the limitation, the research fits the local reality, has a representative sample of the group and internal validity; allowing to evaluate the knowledge and the background of the student about the studied subject. In this sense, our results suggest curriculum improvements inside the Brazilian universities in order to raise awareness and prepare the future professional to act on ecological strategies, reducing environmental impacts.

5 CONCLUSION

Most students are unaware of Green Dentistry and its principles, and do not know the reverse logistics policy. Students' daily decision-making also did not reflect environmental issues. In contrast, many have identified ecological strategies that can be adopted in clinical practice. Just identifying was not enough for students to adopt sustainable practices, such as sending office paper, packaging of oral hygiene materials and toothbrushes for recycling. It is important to emphasize that consumption reduction habits, such as the use of software and draft mode to reduce printer ink consumption was uncommon. The introduction of environmental education in universities is urgent and was supported by the students. Only through educational process can professionals involved in environmental causes be trained.

RESUMO

Conhecimento e adoção de estratégias ecológicas na graduação em Odontologia

O objetivo do estudo foi avaliar o conhecimento e a adoção de estratégias da Odontologia sustentável pelos estudantes de uma instituição de ensino superior privada de Belo Horizonte. A amostra foi composta por acadêmicos matriculados no 4º ao 9º período no ano de 2018 (n=287). Os dados foram coletados por meio de questionário autoaplicável em língua portuguesa, tabulados e analisados por meio de análise descritiva. Observou-se que cerca de um terço dos participantes (93, 32,39%) adotam as estratégias ecológicas que podem ser implementadas nas práticas odontológicas diárias. Aproximadamente a metade dos estudantes (152, 53,0%) relataram que pensam às vezes nas questões ambientais e de sustentabilidade e 252 (87,8%) responderam que nunca ouviram falar sobre Odontologia Verde. No entanto, 268 (93,4%) demonstraram interesse em conhecê-la e 230 estudantes (80,1%) consideraram importante a implementação de programas de educação ambiental no currículo dos cursos de Odontologia. Grande parte dos estudantes desconhece a Odontologia Verde e não adota condutas que refletem preocupação

com as questões ambientais. Apenas uma parcela dos entrevistados utiliza estratégias ecológicas na sua rotina clínica, mas não necessariamente em seus hábitos cotidianos. A inserção da educação ambiental nas universidades faz-se urgente e foi apoiada pelos estudantes do presente estudo.

Descritores: Resíduos de Serviços de Saúde. Meio Ambiente. Estudantes de Odontologia. Educação Ambiental.

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