Learning styles preferences and e-learning experience of undergraduate dental students

Preferências nos estilos de aprendizagem e experiência com e-learning de estudantes de graduação em Odontologia

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Resumo

Introdução: A educação em ciências da saúde tem passado por profundas mudanças devido à incorporação de tecnologias de informação e comunicação (TICs). Os estudantes aprendem através de diferentes abordagens, de acordo com o seu estilo de aprendizagem. O ensino híbrido, que combina tecnologia (e-learning) com o ensino face-a-face, tem apresentado bons resultados. **Objetivo:** Os objetivos deste estudo são avaliar os estilos de aprendizagem de alunos de graduação em Odontologia e a experiência com e-learning. **Material e método:** Dois questionários eletrônicos foram enviados a 174 estudantes. Os estilos de aprendizagem foram determinados pelo Índice de Felder & Soloman (ILS), que avalia as quatro dimensões do aprendizado: processamento da informação (ativo-reflexivo); percepção da informação (sensorial-intuitivo); recebimento da informação (visual-verbal); e entendimento da informação (sequencial-global). Para determinar a experiência com e-learning foram usadas quatro perguntas (escala Likert de cinco pontos) sobre o uso das TICs. **Resultado:** A maioria dos estudantes apresentou um estilo equilibrado para ativo-reflexivo (60%) e sequencial-global (68%). O estilo sensitivo (64%) foi predominante. Uma porcentagem mais baixa apresentou características globais (9%). Não foram encontradas diferenças quanto aos grupos de idades (19-21 e 22-33 anos) e aos gêneros (P>0,05, χ^2). Contudo, houve diferença entre os grupos de idades considerando a ajuda dos websites no aprendizado (P=0,0363, Mann-Whitney). **Conclusão:** Os estudantes não têm os mesmos estilos de aprendizado e experiência com e-learning. Métodos alternativos ao ensino convencional, como o ensino híbrido, podem significar vantagens no ensino da graduação em Odontologia.

Descritores: Educação em odontologia; estudantes de odontologia; aprendizagem; internet; ensino.

Abstract

Introduction: Education in the health sciences has been undergoing profound changes due to the incorporation of information and communication technologies. Students learn through a variety of approaches, according to their learning styles. Blended learning, which combines technology-aided learning (e-learning) with traditional face-to-face teaching methods, has been found to improve learning outcomes. **Objective:** The aims of the present study were to evaluate the learning styles of undergraduate dental students and their experience towards the use of e-learning. **Material and method:** Two electronic questionnaires were sent to 174 students. The learning styles were determined by the Felder & Soloman Index (ILS), which evaluates the following four dimensions of learning: processing information (active-reflexive); perceiving information (sensorial-intuitive); receiving information (visual-verbal); and understanding information (sequential-global). To determine the e-learning experience we used four questions (Likert scale – five-point) which addressed the experience and the use of information and communication technologies. **Result:** Most students presented a well-balanced style for the active-reflective (60%) and sequential-global (68%) domains. The sensing style (64%) was predominant. A lower percentage presented a global characteristic (9%). We did not find significant differences regarding the age groups (19-21 and 22-33 years) and genders (P>0.05, χ^2). However, in terms of age the difference was significant concerning websites helping in learning (P=0.0363, Mann-Whitney). **Conclusion:** We conclude that the students do not have the same learning styles and e-learning experience. Methods such as blended learning could provide advantages when teaching undergraduate dental students.

Descriptors: Dental education; dental students; learning; internet; teaching.

INTRODUCTION

In the last decade, education in the health sciences has been undergoing profound changes due to the incorporation of information and communication technologies, as well as active learning methods in the classroom. These educational changes are not a local phenomenon - they have been happening around the world, independently of cultural, social and economic situations[1-5].

Individuals born in the 1980s and early 1990s are referred to as Generation Y (the Millennial Generation); they are technology competent, capable of multitasking and goal-oriented, usually preferring a stable job with a good income[6]. Students that are aged 21 or less, i.e. born in 1995 or later, are frequently referred to as Generation Z. The latter are the first generation to be born into a totally digital world; they are the most electronically connected generation and they are highly adaptable to technology[7,8]. Generation Z are electronic multitaskers; they prefer non-traditional teaching methods and like to use logic-based approaches and experimental learning. On the other hand, the large-scale presence of the information and communication technology in students' lives does not necessarily result in improved information retrieval, information seeking, or evaluation skills[3].

Students learn through a variety of approaches; they can assimilate and process a several types of information in different ways[9]. A learning style can be described as a set of cognitive, emotional and physiological features that can be used as indicators of how a person can learn[10]. Learning styles are related to the ability of students to learn. However, there is no better or worse learning style; certain people merely tend to prefer one style rather than another[11,12]. Knowledge about learning styles can help teachers to use more appropriate teaching methodologies for students[13]. During the teaching process, an approach based on learning styles prepares professionals to pay attention to how their students learn (or not). Information about learning styles can provide valuable insights for students and teachers about their strengths and weaknesses in the teaching and learning process. Knowledge of learning styles can contribute to implement pedagogical approaches in order to improve students' performance. It has been suggested that the capacity to determine the learning of students styles can improve the educational experience[12].

There are several validated instruments used to evaluate the learning styles of undergraduate and graduate students[4,14,15]. Examples of such tests include: Kolb's Learning Style Inventory[9], the VARK survey[10,12,16], and Felder and Soloman's Index Learning Style (ILS) questionnaire[17,18]. Originating in the field of engineering sciences, the ILS questionnaire defines the characteristic preferences and strengths in terms of the ways that individuals take in and process information. It has been applied in many studies in the health sciences, such as medicine, nursing, pharmacy, and dentistry[13-15,18,19]. The ILS instrument classifies students' learning styles in four dimensions: active-reflective; sensing-intuitive; verbal-visual; and sequential-global[18]. Individual students have relative preferences among each of these four dimensions but they can learn to function in other directions[15,20].

Even though it is impossible to contemplate all learning styles simultaneously within a single class, teachers need to provide different learning strategies[21]. With recent advances in technology and access to electronic materials, blended learning, which combines e-learning with traditional face-to-face teaching methods, has been found to improve learning outcomes in areas such as prosthetic dentistry[1], radiology[2] and histopathology[22]. Blending learning combines the best of traditional teaching with information and communication technologies: information is available for students independently of time and space, and experiences can be exchanged with real people. From the pedagogical point of view, electronic education can contribute to changing the passive model of teaching (teacher-centered learning) to active student-centered learning[1,2]. Electronic learning (e-learning) should lead to improvements in the teaching process, faster availability of knowledge, and better connections between teachers and students, independently of time and place[3]. E-learning makes it possible to adapt educational content to suit the learning styles of individual students by incorporating more visual media, graphics, digitalized materials, interactive videos or web-based interactions, as appropriate. The use of technology and e-learning strategies is increasing in the health science education field[23].

There are currently few published studies concerning the learning styles of undergraduate dental students and we were unable to locate such research in relation to dental academics in Latin America, especially considering students from Generation Y (technology competent) and young students from Generation Z (highly adaptable to technology). Therefore, the aims of this study were to determine the learning styles of Brazilian undergraduate dental students using Felder and Soloman's Index of Learning Styles, their e-learning experience in a blended learning preclinical periodontal course. The following two null hypotheses were tested: gender (male/female) and age (different generations of students) have no influence (i) on learning style; and (ii) on e-learning experience.

MATERIAL AND METHOD

This study was authorized by the local Joint Research and Ethics Committee (CAAE - 09736212.9.0000.0105). The study was carried out with the participation of students enrolled in the school of dentistry during three consecutive sessions (2014-2016) of a preclinical periodontics course, which was conducted in a blended-learning method, combining face-to-face teaching and e-learning activities simultaneously. Each session of the preclinical course corresponded to an academic year that started in February and ended in December.

The survey used Felder and Soloman's Index of Learning Styles (ILS) for data collection, which has been validated as an appropriate psychometric tool to evaluate students' learning styles. The answers from each student's questionnaire were collected using Google Forms[24]. The link for the ILS questionnaire was sent directly by e-mail to all 174 students enrolled in the preclinical periodontics course. After receiving the links to access the questionnaires they were answered online, without identification.

Felder and Soloman's Index of Learning Styles (ILS) aims to differentiate an individual's learning preferences and thereby provides

a useful insight into how teaching approaches can be altered to fit a large group of individuals with similar features. The instrument includes 44 questions, each with two answer options. Designed to evaluate preferences regarding four dimensions of learning styles, the ILS consists of four scales, each with eleven questions. The instrument is summarized into the following four scales: 1. Processing Information: active (learn by trying things out, enjoy working in groups) or reflective (learn by thinking things through, prefer working alone or with a single familiar partner); 2. Perceiving Information: sensing (concrete thinker, practical, oriented toward facts and procedures) or intuitive (abstract thinker, innovative, oriented toward theories and underlying meanings); 3. Receiving Information: visual (prefer visual representations of presented material, such as pictures, diagrams and flow charts) or verbal (prefer written and spoken explanations); and 4. Understanding Information: sequential (linear thinking process, learn in small incremental steps) or global (holistic thinking process, learn in large leaps). After completing the questionnaire, the results were organized in such a way that the respondent's learning preference was classified by using each of the four groups of learning styles. For example, a score from one to three indicates a fairly well-balanced learner in relation to two dimensions of the instrument. Results between five and seven denote a moderate preference for one dimension of the scale, indicating the student may learn more easily in that dimension. If the student scores from nine to eleven it indicates that he/she has a strong preference for one dimension of the scale, and consequently the student may have learning difficulties if this preference is not supported[18].

We applied a second questionnaire with a five-point scale which ranged from one ("strongly disagree") to five ("strongly agree") to provide information about e-learning. These four questions were taken from the Student Course Experience Questionnaire, a well-validated instrument in teaching evaluation[25]. The four selected questions inquired about online activities regarding learning and included the following: support from technological information; online learning resources; communication with peers and teaching staff; and the impact of online experiences on learning engagement. Likert scores for each question were obtained to represent the student's relationship with e-learning[26].

Initially, we conducted the statistical analysis with the description of the data considering the ILS scores. Due to small cell counts in some categories, we grouped some values, such as, "strong" and "moderate", and these preferences were combined at each end of each scale. Comparisons of ILS scales in relation to gender and age groups were evaluated using the chi-square test. The students' e-learning experience were elicited from a four-question questionnaire with a five-point Likert scale and they were evaluated by the Mann–Whitney U test (non-parametric). The alpha level of statistical significance was set at 0.05.

RESULT

Out of the 174 questionnaires sent to the students, 165 answered the ILS forms (response rate=95%) and 141 completed the e-learning survey (response rate=81%). Most students were female (74%) with a mean age of 21±2 years.

Figure 1 show the distribution of learning styles of the undergraduate dental students in relation to the four ILS scales. The majority were well-balanced across the domains of active and reflective (n=99, 60%) and sequential and global learning (n=112, 68%). The majority of students were sensing learners (n=105, 64%) who showed a preference for a visual learning style (n=69, 42%). A small proportion of the students preferred reflective (n=29, 18%), intuitive (n=1, 0.6%), verbal (n=24, 14%), or global (n=15, 9%) learning styles.

Although there were some differences in the ratio of males and females (Figure 2) concerning their preferred learning style domains, no statistically significant associations were found between learning style preference and gender (P>0.05).

Age was categorized into two major groups according to generation (Figure 2). Most of students were in the 19-21 year-old group (Generation Z), born in 1995 or later, with n=108 (65%), compared to the 22-33 year-old group (Generation Y), born before 1995, with n=57 (35%). There were no statistically significant associations between learning style preference and age groups (P>0.05).

The scores regarding the questions about e-learning online activities were mainly Likert score≥4 ("agree" and "strongly agree"), ranging from 68% (n=96) to 86% (n=121) of the students (Figure 3). There was no statistically significant difference between gender (P>0.05) for all the e-learning questions (Figure 4). According to age, only the e-learning question about websites supporting learning showed statistical significant difference (P<0.05), with a higher Likert score for younger students (Figure 4).

DISCUSSION

Our results showed that most of the undergraduate dental students were sensing learners (63%), who preferred a visual (42%) learning style. The majority were well-balanced between the active and reflective (60%), and the sequential and global (68%) domains. A small proportion of the academics preferred reflective (18%), intuitive (0.6%), verbal (14%), or global (9%) learning styles. Similar results were found in other studies with nurses and orthodontic residents, in which most were well-balanced between the active and reflective characteristics, and sequential and global learning. The largest number of individuals were categorized as preferring sensing, active and visual learning styles[4,15,23]. On the other hand, most of the undergraduate medical students were well-balanced across sensing/intuitive domains, and preferred the sequential learning style[5].

Many researchers[11,13,14,19-21] have failed to consider the well-balanced category; they simply reported their results by combining the learning style preferences on each side of the four domain scales in a dichotomized way, reporting the results as "active" or "reflective" preferred learning styles, for example: ILS scores ranging from 3a to 3b indicate individuals who do not clearly demonstrate a distinct preference for either domain. Therefore, there may have been a bias in aforementioned studies, which makes it difficult to compare with our results.
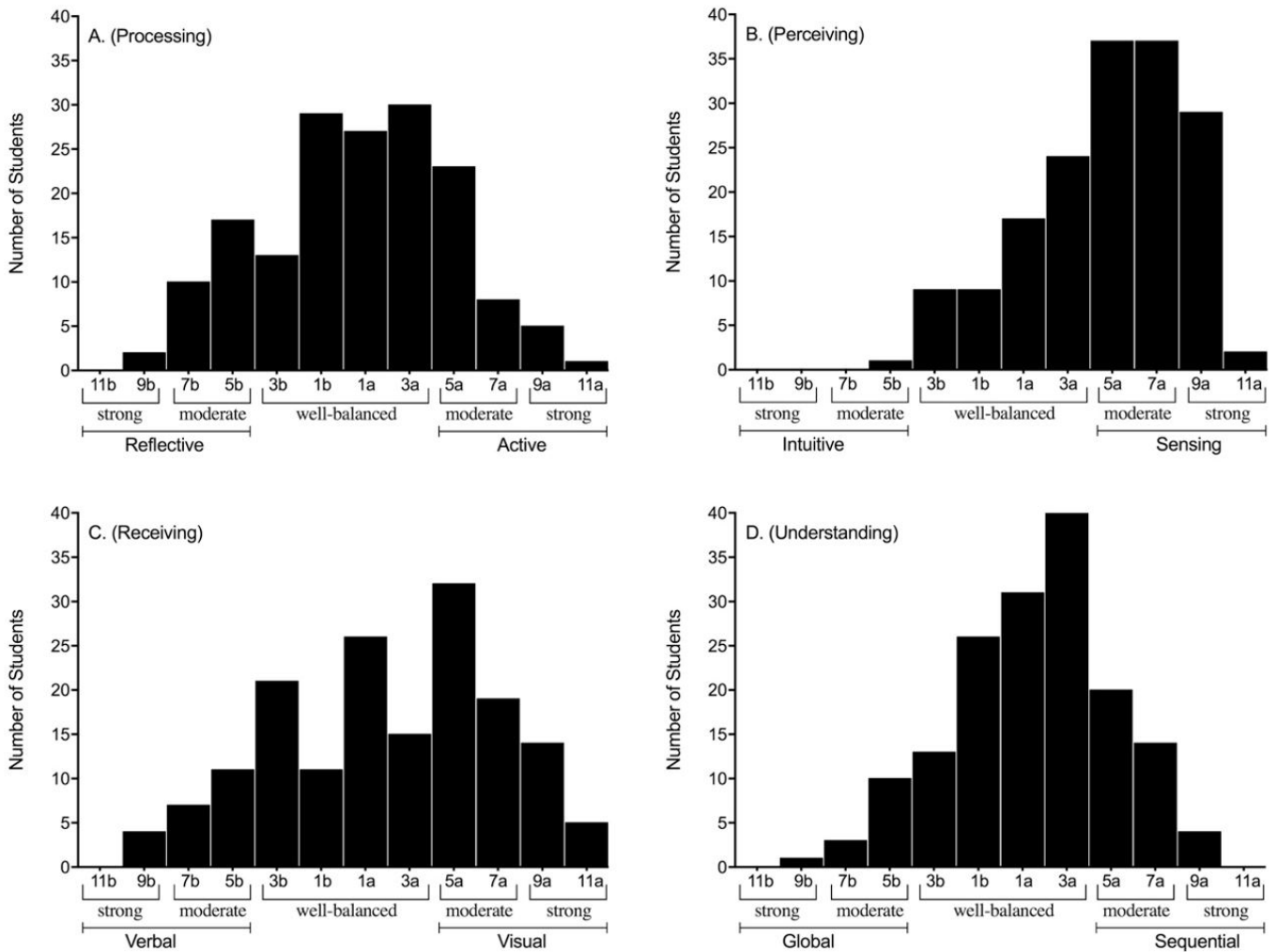
Figure 1. Distribution of students according to the four dimensions of Felder and Soloman's Index of Learning Styles (n=165). (A) Processing information (active or reflective); (B) Perceiving information (intuitive or sensing); (C) Receiving information (visual or verbal); (D) Understanding information (sequential or global).

Based on our results, the null hypothesis (i) was accepted, since gender and age did not influence the learning style. We did not find statistical difference considering gender and age groups. These outcomes were in accordance with another study concerning nurses, which also failed to show difference in the relation to factors of gender and age[4]. On the other hand, a further study showed a significant difference in the age factor in relation to preclinical and clinical medical students[5]. Our study involved students from the third year of undergraduate dental school. At this stage, these dental students have preclinical (periodontics, prosthodontics and oral surgery) and clinical (restorative dentistry, endodontics and dental integrated clinics) disciplines simultaneously, which may explain why our results did not show differences in the learning styles between age groups. Studies of undergraduate dental students which used Kolb's learning style inventory[9] and the VARK instrument[10,12,16] in countries such as Saudi Arabia, India and the USA, showed similar results between genders.

In the present study, we applied Felder & Soloman's Index of Learning Style. This instrument is designed to measure learning styles, and it is widely used because of its ease in relation to obtaining, managing, and interpreting data. Several studies have applied Felder

& Soloman's Index of Learning Style with dental, medical, nursing and pharmaceutical students in different countries[4,5,11,13-15,19-21]. The ILS has shown an acceptable internal consistency and reliability, with Cronbach's alphas ranging from 0.68 to 0.86[17]. The reliability of the four dimensional scales ranged from 0.55 to 0.77. ILS scales have shown test-retest correlation coefficients ranging from 0.7 to 0.9 after a period of four weeks between test applications, and between 0.5 and 0.8 for intervals of seven and eight months[18]. Felder & Soloman's Index of Learning Style has been translated into Spanish, Arabic, Portuguese, Mandarin, German and various other languages[11,14,20].

Our results revealed that our undergraduate dental students were very comfortable utilizing technology, and generally had a positive attitude towards e-learning. Similar findings were obtained in other studies involving dental students[1-3,15,22]. The null hypothesis (ii) was partially accepted/rejected, whereas we only found statistically significant difference regarding the websites as a support tool for learning in relation to age groups (Generation Z: 19-21 years and Generation Y: 22-33 years), where it was reported that younger students considered websites as a tool to help in their learning more than older students. Academics that are aged 21 or
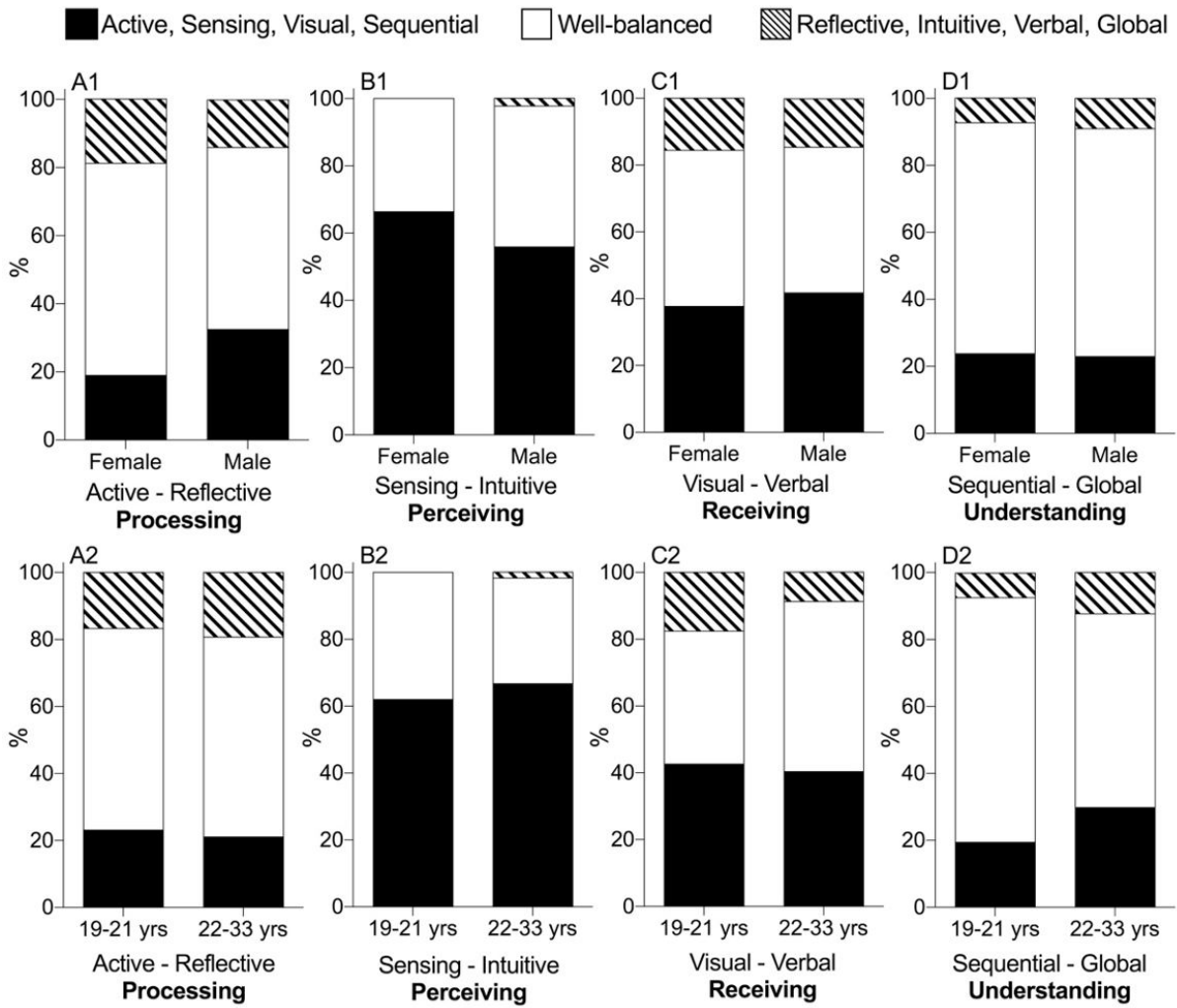
Figure 2. Percentage of students according to gender and age, considering the four dimensions of Felder and Soloman's Index of Learning Styles (n=165). Gender: (A1) Processing information (active or reflective); (B1) Perceiving information (intuitive or sensing); (C1) Receiving information (visual or verbal); (D1) Understanding information (sequential or global). Age: (A2) Processing information (active or reflective); (B2) Perceiving information (intuitive or sensing); (C2) Receiving information (visual or verbal); (D2) Understanding information (sequential or global). P>0.05 (not significant, χ^2 test).
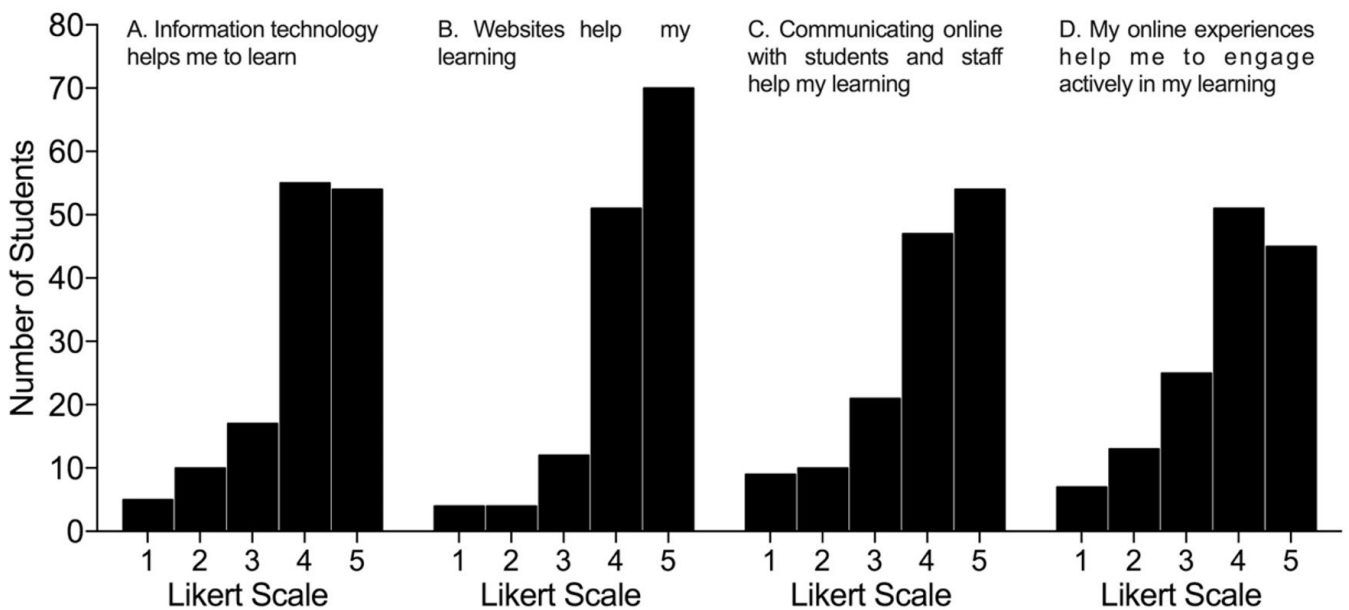

Figure 3. Distribution of responses for Likert-scale about e-learning questions (n=141).
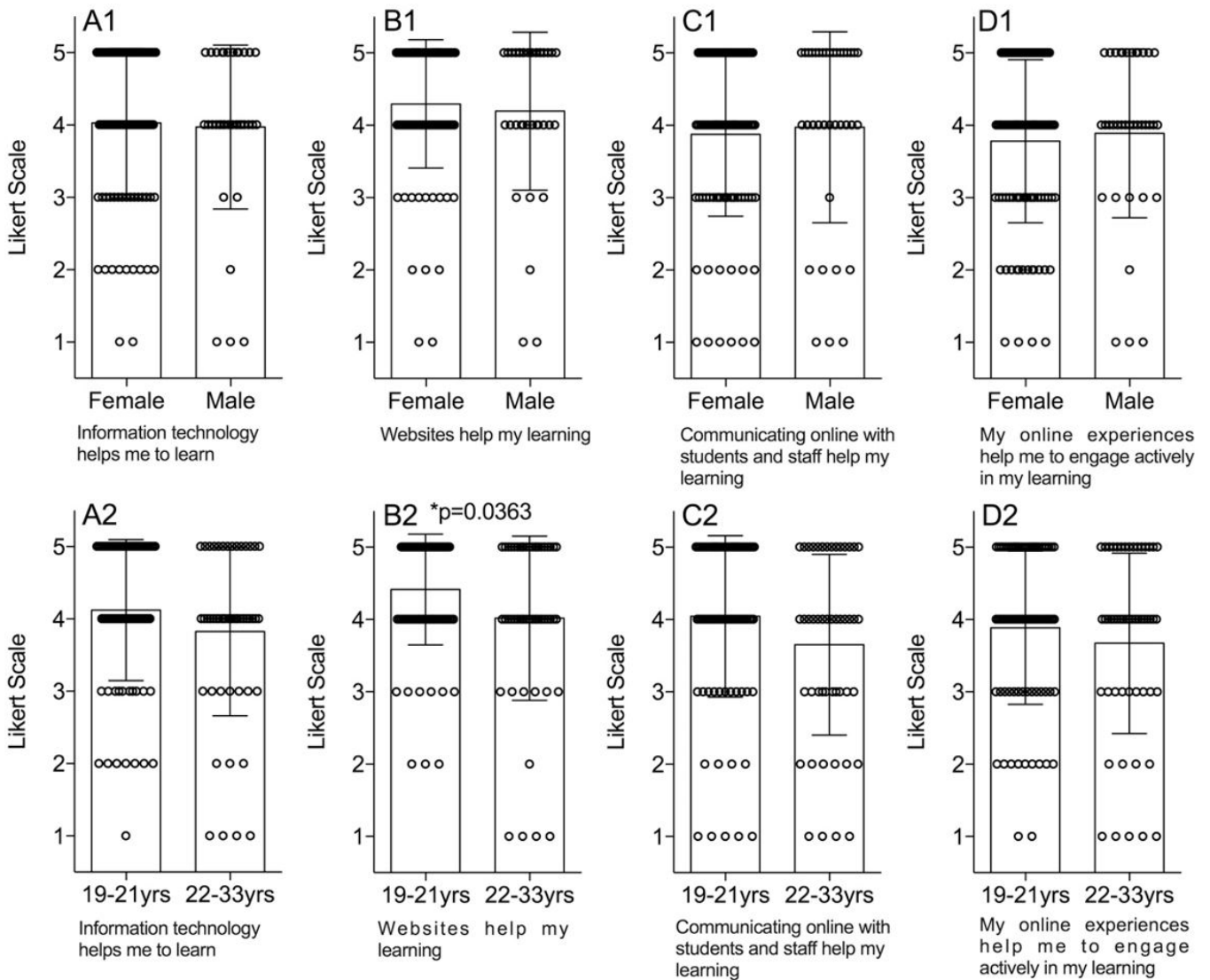
Figure 4. Mean (bars) and standard deviation (lines) of e-learning questions according to gender (n=141) and age (n=141). Gender: (A1) Information technology helps me to learn; (B1) Websites help my learning; (C1) Communicating online with students and staff help my learning; (D1) My online experiences help me to engage actively in my learning. Age: (A2) Information technology helps me to learn; (B2) Websites help my learning; (C2) Communicating online with students and staff help my learning; (D2) My online experiences help me to engage actively in my learning. Dots correspond to each student. P>0.05 (not significant, Mann-Whitney test).

younger belong to Generation Z. They are the first to be born into a totally digital world and they can sometimes suffer from being "over connected" as a result of the overuse of technology. Generation Z students are accustomed to playing games or watching videos using mobile phones, tablets, or computers from infancy[6]. They use mobile phones for 15.4 hours per week, which is more than they spend using any other electronic device[7,8]. Communicating with Generation Z has become a complex activity because their thoughts and behavior are very different from the thoughts and behavior of Generation Y[6]. This profile may explain our results regarding the issue of website support in learning.

E-learning make it possible to adjust educational content to fit the individual learning styles of students by incorporating more visual media, graphs, digitalized materials, interactive videos, or web-based interaction, as appropriate. This is reinforced since e-learning is facilitated by the use of mobile devices that offer easy

accessibility[8]. Online learning could constitute a good option to help university teachers educating future dentists. Teachers should embrace that can change unfavorable attitudes by introducing more e-learning courses and they should stimulate students to use internet tools in their education and communication with their teachers and peers. Conventionally, teaching in dentistry has relied on more visual techniques, so students are more interested in visual rather than textual transmission. Despite the continuing debate regarding the efficiency of traditional versus e-learning courses it seems that an integrated learning model is more likely to be useful and accepted by undergraduate dental students than face-to-face teaching or e-learning alone[1,3]. The use of technology and e-learning is increasing in the health science education field. The ILS active-reflective and sensing-intuitive learning styles domains have been shown to be most common predictors of heath science students' attitudes towards e-learning[23]. In our study, both

questionnaires (ILS and e-learning) were sent at different moments and anonymously, and it was not possible to establish a correlation between ILS and e-learning.

There were some limitations in this present study including the sort of sample that was used, which was a convenience sample of students with different gender distribution from one public educational institution. In Brazil, undergraduate dentistry courses are offered by public and private dental schools. In public schools the students do not pay any tuition fees, whereas in private institutions students pay a monthly tuition fee, or they apply for a scholarship offered by the government or directly by the institution. Another limitation is that the questionnaires were anonymous and scored by the researchers. For this reason, the students were not made aware of their own learning style. Moreover, the anonymous nature of this study precluded the possibility of associating student learning styles with academic performance.

Many dental students show a preference for various learning styles; however, in general, dental faculty overwhelmingly teach in a single mode, i.e. lectures. Lecturing is basically a passive learning approach that stimulates rote memorization and notetaking as the principal methods of assimilating knowledge[16,21]. References to learning style applications may change if a student notices this as necessary for learning purposes. A preferred learning style may not always be the best way to learn because it is influenced by specific conditions. Students may need to adjust to learning approaches that are different from their own preferences due to real-world environmental restrictions. Some dental students may change their learning preferences as their learning environment alters from classroom to preclinical laboratory, and then patient clinic[16,19]. Designing courses to include a variety of teaching approaches that will adapt to students with several learning styles may be problematic but it can be very beneficial[10,15]. Different learning styles there are not one superior to each other; each has its own strengths and weaknesses[12,21]. Faculty should stimulate adequate learning by encouraging students to be conscious of their own learning styles and help them to embrace the most suitable methods for their style. Furthermore, faculty should also encourage students to develop other learning styles in order to adapt to different teaching methods[5]. The presence of information and communication technology in students' daily lives has not always resulted in enriched learning. For some students, immediate access to a widespread range of resources may give them the impression that they are within an unending maze because they have to make judgments about how to filter and choose which information to retain or discard. A good pedagogical approach is still the best option in terms of getting good results in teaching and learning, regardless of the space or the place where learning occurs, and with or without the aid of information and communication technology[13].

We conclude that the large majority of undergraduate dental students are sensing learners who showed a preference for a visual learning style, though many were well-balanced between active-reflective and sequential-global learning. The undergraduate dental students demonstrated good experiences regarding to the use of technology and e-learning. Consequently, whether applied to current teaching methods or combined into future distance learning-based situations, we consider our recommendations can offer a way to adapt varied learning styles within dental undergraduate courses so that each student's learning needs may be better assisted. Therefore, since adult learning is a multifaceted and active process, further studies are required to determine if comprehension study strategies and the incorporation of e-learning will result in a noticeable enhancement in general learning methods.

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CONFLICTS OF INTERESTS

The authors declare no conflicts of interest.

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