The use of smartphones as a learning tool by dental students

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ABSTRACT

Technologies can be powerful and helpful tools for students' learning process, especially for the current generations. Smartphones are routinely used to search for a wide range of information, at anytime and anywhere. Thus, knowledge acquisition through this mobile device, for teaching and learning outcomes, seems to increasingly make more and more sense. Therefore, the aim of this study was to understand the profile of the use of smartphones as an active learning tool by dental students. The data of this cross-sectional study was collected by an electronic questionnaire, with open and closed questions regarding the socio-demographic characteristics, type of device and connection, general use for dental learning, as well as the students' attitudes towards the use of smartphone for learning. Out of the total number of students eligible for the study, 169 students responded to the questionnaire (response rate of 49.1%). Most participants were women, aged between 19 and 21 years. All students declared to have a smartphone, with internet connection. The main uses described were related to communication, time management, and education. The advantages pointed out by the participants were convenience, flexibility of use, access to different contents in different ways, ability to search for information, and rapid communication. The main challenges included distraction and overuse. The results of this study demonstrate that students use smartphones as an active learning tool, mainly to access e-books, scientific articles, to listen to podcasts, watch lives, and view publications of theoretical and practical content on Instagram.

Descriptors: Education, Dental. Smartphone. Educational Technology. Students.

1 INTRODUCTION

In the last decades of the 20th century, investigations on culture, development, mind, cognition, and behavior brought new evidence regarding learning, questioning conceptions about education and its role in pedagogical practices[1]. In this context, the concept of active learning stands out, in which the student is the protagonist of the learning process, searching and producing knowledge, as long as the teacher guides the pedagogical process. Freitas and Neumann (2009) [2] demonstrated that the efficiency of learning in

universities and training of professionals is very low when traditional methods are used (teacher-centered), since students only absorb information and are not encouraged to seek new forms of knowledge.

From this perspective, digital technology can play the role of an instrument to improve learning experiences that foster the development of modern solutions to problems and skills, as they provide the construction of knowledge with the aim of supporting students[3]. Technological development creates opportunities for information access, exchange of experiences, and active learning anywhere and anytime. It is also possible to propose, through technological resources, classroom management and participatory learning between students and teachers, making the teaching process open, flexible, collaborative, and more practical[4].

The study of Mafla et al. (2021) [5], with dental students, showed that the use of smartphones was positively associated with students' academic performance. In this new pedagogical scenario, the use of smartphones as an educational tool may increase inclusion and democratize education[6]. With the use of this tool, students become less information consumers and more collaborators, researchers and editors in constant movement[7]. Furthermore, according to Turkyilmaz et al. (2019) [8], students are using more online apps, learning modules, and social media (such as YouTube, Facebook, and Twitter) to enhance learning and understanding of the content taught in class; creating, sharing and exchanging information with other users around the world.

However, as with all technologies, in order to guide the development of appropriate educational innovations, it is essential to understand the users' abilities and their attitudes towards this emerging tool[6]. In Dentistry, literature on the use of smartphones as a learning tool is still scarce. Therefore, the aim of this study was to understand the profile of the use of smartphones as an active and mobile learning tool by Dentistry students of a federal institution in Southern Brazil.

2 METHODS

This cross-sectional study was carried out between October 5th and December 5th, 2020. The eligible population was composed by 344 undergraduate students, regularly enrolled in the Dentistry course at the Federal University of Santa Maria (UFSM).

This research was approved by the Ethics Committee for Research with Human Beings (CAAE: 36679520.2.0000.5346). The informed consent was sent online and, all participants signed it before responding to the questionnaire.

Participants were contacted through social networking sites (Instagram, Facebook, WhatsApp, and also via e- mail) and invited to voluntarily participate in the research. The data were collected by the electronic questionnaire, remotely available on the Google Forms ® platform. The questionnaire was adapted from the instrument used by Rung et al. (2014) [9], consisting of objective and open questions, which evaluated the use of smartphones, in order to investigate the relevance of its use as a pedagogical and learning tool by undergraduate dental students. The questions in the questionnaire were divided into five parts: (I) sociodemographic characteristics; (II) smartphone type and connection; (III) general use of the smartphone; (IV) use of smartphones for learning; and (V) students' attitude towards the use of smartphones.

Data were analyzed by STATA (version 14.0). Descriptive statistics were performed by frequency and percentage [n (%)], and mean and standard deviation (SD). The formation of word clouds was used as a visual representation of the responses. The word clouds were built using different letter sizes according to the frequency that

they were mentioned[10]. The answers to the open questions were grouped and the clouds built using the Infogram program, a free online tool. The clouds identified the most relevant words and the ones that were most repeated by the students. The most frequently cited words appeared with the largest font size.

3 RESULTS

A total of 169 students participated in the study (response rate of 49.1%). Out of them, 119 (70.4%) were women and only 1 (0.6%) was a foreigner. The age of the participants ranged between 18 and 37 years old, with the majority between 19 and 21 years old (54.2%). More than 1/4 of the sample (26.6%) declared to have a socioeconomic benefit provided by UFSM. Furthermore, 141 of the participants (83.4%) were exclusively dedicated to studying, without any paid activity; 23 (13.6%) were employed and worked up to 20 hours per week, and 5 (3%) worked between 20 and 40 hours per week. The distribution of responses per semester of the course are presented in figure 1.

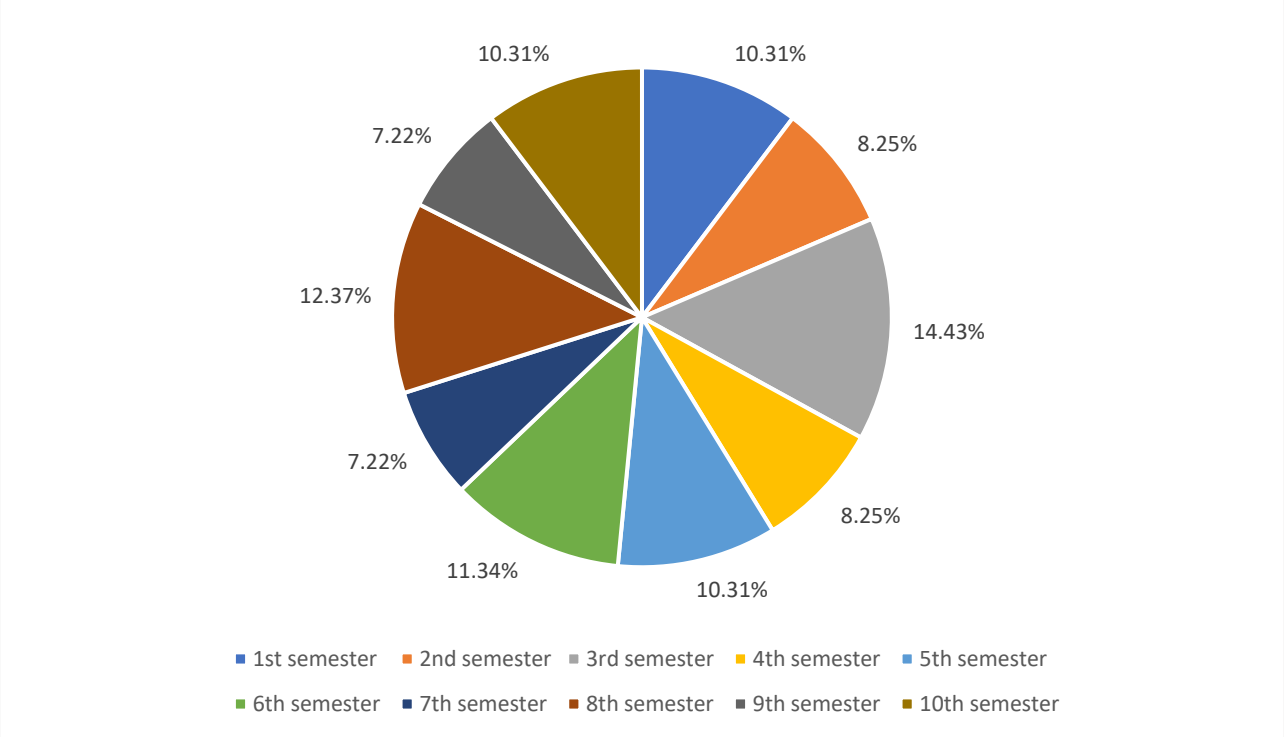

Figure 1. Distribution of responses according to the course semesters

All students declared to have a smartphone, 56.8% mentioned having an Android and 43.2% of them reported having IOS system. Internet access was reported by all participants, and 24 (14%) reported accessing it only through wi-fi connection.

The students reported using smartphones as a tool for the most diverse activities (table 1). The average time of usage was 6 hours (SD 3.3), with 45.5% of students believing that they use up to 5 hours a day, 34.5% from 6 to 10 hours a day, and 19.5% more than 10 hours a day.

Table 1. General use of the smartphones by participants.

Activity	No n (%)	Yes n (%)
Talking with friends	-	169 (100.0)
Social media	-	169 (100.0)
Listening to music	-	169 (100.0)
Taking pictures	-	169 (100.0)
Accessing email	3 (1.8)	166 (98.2)
Recording videos	7 (4.1)	162 (95.9)
Shopping	19 (11.2)	150 (88.8)
Editing photos	20 (11.8)	149 (88.2)
Uploading videos on social media	29 (17.1)	140 (82.9)
Syncing with computer/laptop	30 (17.7)	139 (82.2)
Bank transactions	37 (21.9)	132 (78.1)
Watching movies/series	41 (24.3)	128 (75.7)
Creating and editing texts	41 (24.3)	128 (75.7)
Editing videos	69 (40.8)	100 (59.2)

Table 2 shows how the available smartphones tools are used for studying. Only 3 students (1.8%) do not check learning contents on the internet. Figure 2 presents the most cited mobile applications for studying or learning. These applications help in terms of organization, time management, and general studying tools, thet may also be used to present specific Dentistry contents.

In general, most students agree that the use of smartphones may help the learning process (table 3). Participants also listed other possibilities for smartphones usage, such as, improving or contributing to the learning process (figure 3).

In the last part of the questionnaire, students answered open questions regarding the impact of smartphones on their academic performance. Ease of use and practicality were the most frequent responses.

> "The smartphone makes organization much easier, the use of reminders, virtual agenda and notifications, improves time management. In addition, these devices allow students to carry infinite notebooks and books in the palm of their hands, making research much easier. It saves time and facilitates access to the desired knowledge."

> "Smartphones make students' life easier. We can read a book on the bus, on the way home, or even during breaks. It facilitates the communication with all classmates via WhatsApp. They also allow easy access to questions and quick surveys when the teacher is not physically present. Besides that, they allow easy email sending and replying."

The impact of smartphones on learning is also associated with content interaction on social networks. Some students reported the use of the internet to acquire new knowledge, to accompany different professionals, and to get updated in a more relaxed way.

Table 2. How students use smartphones for learning.

Activity	No n (%)	Yes n (%)
Sharing Dentistry-related content with classmates	4 (2.7)	165 (97.3)
Accessing institutional student portal	8 (4.8)	161 (95.2)
Accessing smartphone during classes	8 (4.8)	161 (95.2)
Accessing institutional application	12 (7.2)	157 (92.8)
Browsing the web for learning material	37 (8.9)	154 (91.1)
Visualizing videos/photos	8 (10.7)	151 (89.3)
Visualizing publications	15 (14.8)	144 (85.2)
Watching lectures and online classes	31 (18.4)	138 (81.6)
Reading contents in e-books	67 (39.6)	102 (60.4)
Studying with e-books	68 (40.3)	101 (59.7)
Accessing applications related to Dentistry	95 (56.2)	74 (43.8)

Table 3. Degree of students' agreement on the use of smartphones for learning.

To what extent do you agree with the following statements:	Totally agree n (%)	Partially agree n (%)	Disagree n (%)
Smartphones improve the access to my courses and learning material.	135 (79.9)	31 (18.3)	3 (1.8)
Smartphones help me learn more independently.	104 (61.5)	58 (34.3)	7 (4.2)
Smartphones should be more used by the university/teacher staff as an auxiliary learning/teaching tool.	93 (55.9)	72 (42.6)	4 (2.4)
The contents that teachers share via social media benefit my studies.	139 (82.2)	24 (14.2)	6 (3.6)
Smartphones are auxiliary study instruments that benefit students.	139 (82.2)	28 (16.6)	2 (1,2)
Websites created with educational content help my learning.	152 (89.9)	14 (8.3)	3 (1.8)

> "On Instagram, we have the opportunity to see clinical results of many dentists, and to view clinical tips and contents in a more attractive way."
>
> "I believe that I use my smartphone many hours a day, especially the Instagram social network. My learning was positively impacted when I started to follow professors, university pages or even dental students because I received additional information that increased my learning process.

The participants considered that the facility of taking and sharing photos with smartphones was a positive point, contributing during the activities and clinical case studies.

> "Regarding the use of smartphones, previously, it was being used to visualize radiographs at the clinic, taking pictures of clinical cases, and creating WhatsApp

groups with advisors and classmates, where it was possible to share the clinical cases treated weekly."

"Excellent, I can take pictures of the clinical cases, organize the treatment planning, and also, show it to the patient for a better understanding of the diagnosis and treatment."

Figure 2. Word cloud showing the most used apps for learning purposes by students.

Figure 3. Compiled responses regarding other ways to use smartphones as a learning tool.

Although most reports are related to the advantages and benefits of using smartphones, the excessive use and distractions were reported as the negative side of this tool.

"While I have learned several things using my smartphone, I also know that it acts as a distraction at times when my attention is demanded (like watching a class, solving an activity, etc.), especially, now in quarantine, when I have the illusion of being available/ online for contact all the time."

"When I use it properly (blocking notifications from social networks), I can study and clarify my doubts quickly, which ends up optimizing my studying time".

4 DISCUSSION

The new century has brought questions which have been intriguing educational researchers: Is it possible for the smartphone to be a learning tool? How do students see the smartphone? In which ways is it used (inside and outside the classroom)? What is the student's attitude about learning while using the smartphone? The results of this study suggest that the smartphone has the potential to be used as a tool to facilitate students' access to dentistry content and it may contribute to the learning process.

Young people want to learn differently, as they absorb information in different ways, not just through the conventional educational model (teacher-centered). Known as Generation Z (born between 1995 and 2010), most young people who attend higher education grew up at the peak of technology, in a society with the possibility of access to the internet, computers, cell phones, and virtual environments[11]. While past generations learned through texts, sounds, and images. So, this generation learns in the inverted sequence: images, sounds, and texts[12]. Therefore, there is a difference in how the generations of students and teachers have learned; hence, the students' generation is also an object of study in several segments, including Education[13]. The study by Noro et al. (2015)[14] revealed that the passivity of students, arising from an educational system based on the unilateral transmission of

knowledge for the teaching-learning process, which is still a barrier to the consolidation of the training of a health professional. On the other hand, the results of this study showed that the smartphone has the potential to change this scenario, allowing students to seek information beyond the classroom to complement their training. In this sense, it is essential to emphasize that teachers, as opinion leaders, have, more than ever, the duty to promote media education among their students, aiming at the development of their ability to critically analyze the diverse media, both as users and producers[15]. In practice, this attitude allows individuals to know how to differentiate facts from opinions, combat misinformation, have autonomy in the search for knowledge, and communicate responsibly on social networks and other media[16].

Smartphones support the user to install a type of software developed for mobile devices, known as applications. These apps allow interaction, personalization, and customizing according to the preferences and particularities of the daily activities of each individual. Applications can join, in a single tool, visual and sound effects, capable of stimulating the study, with the aid of attractive and intuitive interfaces[17]. In this study, some apps were judged as useful for learning purposes. Among them are applications for the personal organization (Trello, Pomodoro, and Forest), communication and social interaction (WhatsApp, Instagram, Google Meet, and Google Docs), general studies (Kindle, YouTube, Duolingo, and *Sanar Saúde*), and Dentistry-related (Dental lite, Dental simulator, Ident, Bull Guide, Negatoscope, and *Odontoconcursos*). The results found were similar for dental students from different countries, who also use applications for learning purposes related to dentistry, such as Dental Lite, Dental simulator, and, mainly, YouTube[18-21].

All participating students reported listening to music on the smartphone, demonstrating connectivity and ease of accessing audio content, which may also be an opportunity to implement the use of podcasts as a pedagogical tool. Also, the preference for watching live or recorded videos provides the student with new learning opportunities. Thus, recording video lessons may represent an active learning methodology for the students as well as the digital content created may facilitate the understanding of colleagues on the subject.

Smartphones represent innovative ways to learn and teach. According to Rung et al. (2014)[9], its use for didactic activities may have the potential to improve students' participation during classes. Teachers feel encouraged in using new methods when the learning content is accessible and the interaction is feasible using mobile devices, regardless of faculty intervention[9]. Some studies used active methodologies for the teaching-learning process, through portfolios, online games, manipulation of materials, and object construction[22-24]. Using active methodologies, by employing educational technologies, may increase the level of interest and concentration in activities, it may also encourage students to study, research, think, a discuss, and it also promotes independence and participation[24]. More than 90% of the young people in this study use their cell phones in the classroom and more than 95% agreed that smartphones help to learn more independently, and these students believe that smartphones should be used more by the university or by the teaching staff as an auxiliary tool. Focusing on teaching and learning, smartphone use in the classroom could be directed towards access and creation of didactic content, and recording and sharing progress with colleagues and instructors[9]. Moreover, a significant number of students reported finding learning material on social media and considered this activity useful for learning[25,26].

In this same context, technological resources enabling the digitization of objects and procedures show a great impact on Dentistry. Patient assessment and professional communication have currently been performed based on digital photographs and radiographs, computerized tomography scans, intraoral scans, three-dimensional (3D) prints, and virtual simulators. In education, e-learning has enabled both the transfer of knowledge based on the web and the better acceptance of digital education[27]. The undergraduate students in this study considered the smartphone also as a tool with the potential to connect students and teachers, allowing the exchange of knowledge and experience. According to Dror et al. (2011)[28], technology should be brain-friendly. The brain's cognitive system has limited resources and, when information is presented properly, the cognitive load is reduced, optimizing and improving learning. Other approaches to using the smartphone for learning, suggested by the students in this study, were video classes, podcasts, discussion groups, gamification, and question games. Thus, mobile learning has the potential to shift the paradigm from passive teacher-centered learning to active student-centered learning[29]. The aim of education should be on what students learn and how they learn, which knowledge and skills are acquired, and which remain in the long term for use in clinical practice[28]. It is worth noting that the patient must consent to the use of digital data, respecting ethical regulations.

Mobile technology has the hazard of blurring the lines between work and leisure. Social media simplified interpersonal contact but made it difficult to disconnect the real from the virtual world. Digital media and social networks need to be inserted into academic life, so universities stop being just a consumer of existing information, to become a producer of cultures and knowledge[30]. In this study, the students described social networks as another smartphone tool to connect with clinical outcomes and tips from other professionals, while viewing their content, improving learning in a relaxed and engaging way. Thus, personal and academic/professional profile blend on social networks and match the content with the reality of the students.

Despite all the advantages of smartphones, it is a device with great distraction and dependence power, demanding user's discipline and organization. Excessive use can increase anxiety, interfere with concentration in professional life, reduce personal interaction and academic performance, and lead to potential relationship problems[31-36]. The results from the present study do not show excessive use of smartphones. However, some students' reports suggest that the frequency of access to social networks can negatively impact learning. For Silva and Silva (2017)[37], digital technologies present a variety of simultaneous information, such as new message notifications, task reminders, and several applications demanding attention. These simultaneous appeals hinder maintaining concentration on a given activity, giving the user the challenging task of selecting the main issue or inhibiting distractions[37]. The feeling of losing some information when being away from the internet (Fear of missing out – FOMO)[38] can lead to irritation, nervousness, agitation, or excessive concern. Furthermore, the feeling of isolation and exclusion can be a catalyst for excessive use of mobile devices and an indicator of how the internet can originate stress and anxiety, harming users' health[38]. The studies of Blath and Gaur (2019)[39] and Younes et al. (2016)[40] showed that the easy availability of the internet and the ease of taking smartphones anywhere, to bed included, could have increased the time spent using the internet on the smartphone at night. The global trend indicates that sleep duration and quality have been dropping and technology dependence may be one

of the reasons. However, it is important to consider the direction of this association, as people with pre-existing sleeping problems could be using the smartphone and internet at night because they could not sleep[40].

Therefore, in order to avoid distractions, and improve smartphone use as a beneficial tool in academic institution, some students cited using tools to block apps and notifications. For Skiba (2011)[41], teachers should be aware of the use of smartphones by students and, instead of simply prohibiting its use, transform the device from a potential distraction source into a learning tool. The study by Blath and Gaur (2019)[39] corroborates this research when it exposes that there is a growing need to discourage the internet and smartphones excessive use and increase awareness of their possible association with psychological problems. Educators must have the competence to encourage the use of these technologies, checking and respecting professional ethical principles, reliability of the outcome, data source, and scientific relevance. Hence, this study endorses the relevant statement of Parry (2011)[42]: "The key element is recognizing that the mobile computing power in our pockets radically changes not merely our classrooms but, more important, the spaces that students inhabit and the conversations they have outside of our classrooms."

The interpretation of the results of this study requires caution. The research was carried out with a convenience sample from the UFSM School of Dentistry, thus not allowing generalization for all students' profiles. Data collection took place during the COVID-19 pandemic, and, therefore, may be biased toward students' responses with more access and ease of use of mobile devices, maximizing the use of the smartphone as an alternative study device. On the other hand, due to the circumstances, some students without an internet connection perhaps did not have access to the questionnaire.

This research also raises the need for faculty to instruct the use of smartphones for learning purposes, to maximize its benefits, and avoid distractions. Moreover, more research is required to understand the impact of mobile devices on students' performance, including outcomes in theoretical knowledge, clinical competency, and continuing education.

5 CONCLUSION

The results of this study demonstrate that students are using smartphones as an active learning tool, mainly to access e-books, scientific articles, podcasts, lives, and Instagram theoretical and practical content.

RESUMO

O uso de *smartphones* como ferramenta de aprendizado por estudantes de Odontologia

As tecnologias podem ser potentes facilitadoras do processo de aprendizagem dos alunos, principalmente nas gerações atuais. Os *smartphones* são ferramentas rotineiramente utilizadas a qualquer momento e em qualquer lugar na busca de variadas informações. Assim, a aquisição de conhecimento por meio deste dispositivo móvel, alinhada com as perspectivas de ensino e resultados esperados para o aprendizado, parece fazer cada vez mais sentido. Neste contexto, este estudo foi proposto com o objetivo de conhecer o perfil do uso de *smartphone*s como ferramenta de aprendizagem ativa e móvel por estudantes de Odontologia. Trata-se de um estudo transversal, realizado por meio de um questionário eletrônico, composto por perguntas objetivas e abertas, as quais avaliaram características sociodemográficas, tipo de aparelho e conexão, uso geral e para aprendizado odontológico, bem como a atitude dos alunos em relação ao uso. Do total de estudantes elegíveis ao estudo, 169 alunos responderam ao questionário (taxa de resposta de 49,1%). A maioria dos participantes eram mulheres, com faixa etária de 19 a 21 anos. Todos os estudantes afirmaram ter *smartphone,* com conexão à *internet*. Os principais usos descritos foram

relacionados à comunicação, gerenciamento de tempo e educação. As vantagens relatadas foram praticidade, flexibilidade de uso, acesso a diferentes conteúdos, capacidade de pesquisar informações e de se comunicar rapidamente. Os desafios identificados incluíram distração e excesso de uso. Os resultados permitiram concluir que os estudantes utilizam os *smartphones* como ferramenta de aprendizagem ativa, principalmente, para acessar *e-books*, artigos científicos, escutar *podcasts*, assistir *lives* e visualizar publicações de conteúdos teóricos e práticos no *Instagram*.
Descritores: Educação em Odontologia. *Smartphone*. Tecnologia Educacional. Estudantes.

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