

Digitization with 3D haptic technology in dental training

Digitalización con tecnología háptica 3D en la formación dental

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Received: 31 - III - 2022

Accepted: 8 - IV - 2022

doi: 10.3306/AJHS.2022.37.03.142

Abstract

Introduction: 3D haptic technology stands out in the field of dentistry as a tool that allows preclinical practice, which is very close to reality. The objective of this study is to collect the assessments of teachers, students, and other groups related to dentistry, on the use of this technology in the teaching-learning process.

Methodology: Exploratory, non-probabilistic study. A survey and interviews are given to 865 subjects from different fields of dentistry to collect assessments on the use of 3D haptic technology in teaching.

Results: The evaluation of different interest groups related to the teaching of the Dentistry degree, both in the interviews and in the surveys carried out, show a high degree of user satisfaction and the conviction that this tool can help in the learning of dentistry professionals.

Key words: virtual reality, dental health, education.

Resumen

Introducción: La tecnología háptica 3D se destaca en el campo de la odontología como una herramienta que permite una práctica preclínica, muy cercana a la realidad. El objetivo de este estudio es recoger las valoraciones de docentes, estudiantes y otros colectivos relacionados con la odontología, sobre el uso de esta tecnología en el proceso de enseñanza-aprendizaje.

Metodología: Estudio exploratorio, no probabilístico. Se realiza una encuesta y entrevistas a 865 sujetos de diferentes campos de la odontología para recopilar valoraciones sobre el uso de la tecnología háptica 3D en la enseñanza.

Resultados: La evaluación de diferentes grupos de interés relacionados con la docencia de la carrera de Odontología, tanto en las entrevistas como en las encuestas realizadas, muestran un alto grado de satisfacción de los usuarios y el convencimiento de que esta herramienta puede ayudar en el aprendizaje de los profesionales de la odontología.

Palabras clave: realidad virtual, salud dental, educación.

Introduction

A fundamental part of the teaching-learning process in the field of dentistry involves acquiring procedural knowledge, that is, it involves "knowing how" to do something, or knowledge in action¹. The automation of certain motor and executive skills is necessary to be able to carry out interventions in any of the treatments that current dentistry students will have to enact in their professional work.

To move from declarative knowledge, that is, having ideas and knowledge of how things should be done (theoretical knowledge) to procedural knowledge or knowing how to do them (practical application), the most important thing is to carry out practical activities continuously, habitually, and consciously to be able to acquire the necessary skills with a high level of automation. This is how, by doing things many times with the aim of acquiring the skills involved, the student will be able to reduce the cognitive load required to develop the activity.

In the field of health sciences in general and in dentistry in particular, where carrying out internships implies carrying out treatments with real patients, being able to exercise the necessary skills for learning is, in most cases, truly complex, and the same time, it entails a great responsibility, which is why it is necessary to use methods that allow the acquisition of preclinical skills with the maximum guarantees to face clinical application².

At the Adema University School, a center attached to the University of the Balearic Islands, we have state-of-the-art 3D haptic technology, which allows training through virtual practices in different oral and dental treatments. This technology is capable of transferring realistic sensations, allowing one to see and to feel at a tactile and auditory level, a high degree of similarity to reality, while performing multiple dental treatments³.

During the process of incorporating 3D haptic technology into dentistry degree studies, the opinion of the different users of the aforementioned technology has been collected in order to know their assessment. After using the simulators, they were administered a questionnaire and an interview was conducted through which their assessments were collected.

Material and method

Study is exploratory, qualitative, not probabilistic

1. Poll

The survey was conducted in autofill format through the Google Forms application, voluntarily and anonymously. A question was included in which the participants expressed consent for the use of the data collected for research purposes. No identification data was collected except for differences in interest groups: teachers, students, dentists and others.

The questionnaire was administered after using the 3D haptic simulators and included questions directed, first of all, to assess the degree of use that participants had in handling the computer devices. That is, if they used them on a daily basis and if they had had any previous experience with 3D haptic technology. The next questions assessed the use of 3D haptic tools in preclinical practice and their possible usefulness for practicing treatments of complex cases before treating real patients. Finally, they were asked about the degree to which it helped in their training, to use 3D haptic technology as a tool to acquire skills during the learning process.

2. Interviews

An undirected interview with open questions focused on assessing the experience of using the simulators, and the degree of application to the teaching of dentistry.

3. Selection of participants

The sample for both the questionnaire and the interview is a deliberate selection or intentional sample, since it takes into account the relationship of dentistry studies with the use of 3D haptic technology at the Adema University School during the academic years 2018-19 and 2019-20 (ceasing to collect information during a period in which access to the center was not possible due to a state of alarm due to covid-19).

Included in the sample are dental degree and undergraduate students, professors from the Adema University School, professors who visited the school and who teach the Degree in Dentistry at other Universities, Dentists in professional practice and representatives of dental brands. Likewise, taking advantage of other visiting professionals; politicians, directors and teachers from other centers were asked to assess the 3D haptic technology.

A total of 865 subjects distributed as follows: 90 Dentistry Students, 550 Undergraduate Students (includes Oral Hygiene Superior Technician, Dental Prosthesis Superior Technician and Baccalaureate students), 50 Dentists, 40 Dentistry professors of the School Adema University and 25 from other Universities, 30 dentistry visitors and 40 representatives of dental brands, 15 politicians, 5 school directors and 20 school teachers.

4. Target

The objective pursued was to assess, after the experience of using 3D haptic technology, its use-value as a tool to improve learning during undergraduate studies, and if it was considered that virtual simulation could be an element to improve the training of our students.

Results

The assessment and opinion collected by applying interviews and surveys to different interest groups related to

the field of oral health and the teaching of the Dentistry degree have provided the following results.

1. Poll

In relation to the level of knowledge regarding the use of computing devices, most of the respondents valued their level as medium or medium-high (Figure 1). Of the sample, only 3.5% indicated that they used digital technology little, or not on a daily basis, while 65.5% indicated that they had medium use.

56.7% indicated that they did not know 3D haptic technology before using it in Adema, while 40% indicated that they had known it before. When asked how long they had known it, 40% indicated that it was less than two years ago, 36.7% less than a year and 20% for six months.

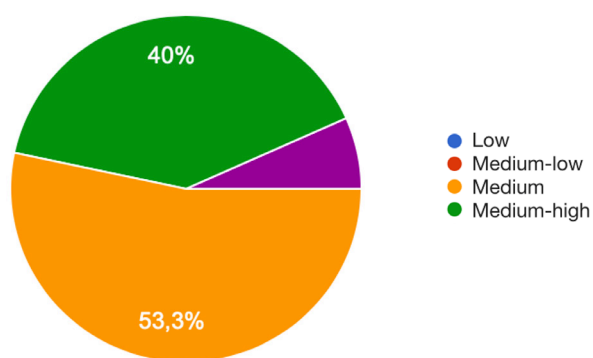


Figure 1: Level of knowledge in the use of computing devices.

They were asked about the degree to which the simulation was close to reality (Figure 2), to which the majority responded medium high and high.

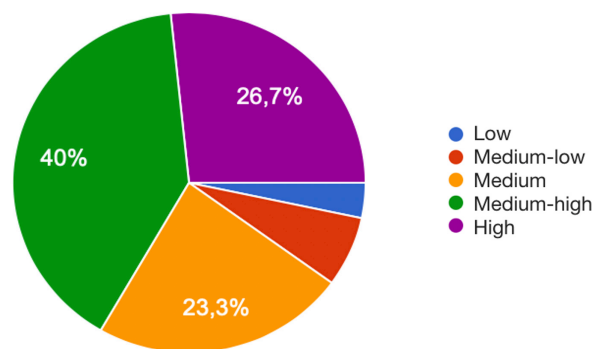


Figure 2: Degree to which simulators approximate to reality.

The foregoing implies the level of validity that this technology can have for the preclinical practice that all students must carry out during their training. Most respondents consider the validity to be medium-high or very high (Figure 3). They also consider that it can be a useful tool for training in complex cases, for testing treatments before carrying them out with patients (Figure 4).

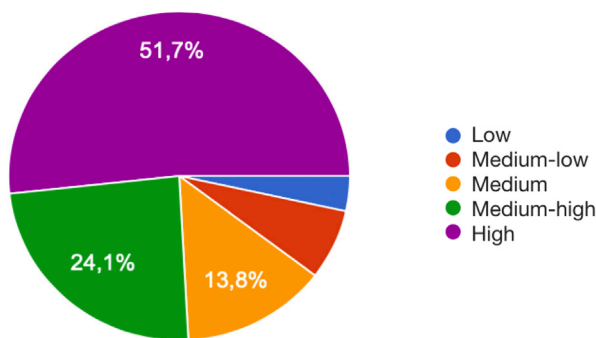


Figure 3: The level of validity that 3D haptic technology has for learning in preclinical practice.

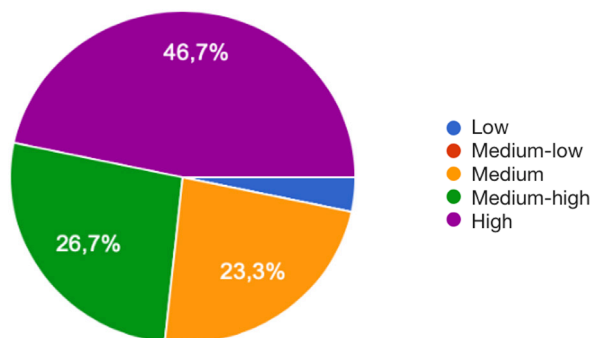


Figure 4: Usefulness of the technology for training before dealing with real cases.

When asked if our respondents would have liked to have had 3D haptic technology earlier in their learning process, and whether it would have helped them advance their obtaining skills, the answer was positive (Figure 5), in fact 86.7% indicated that they would have liked this technology earlier.

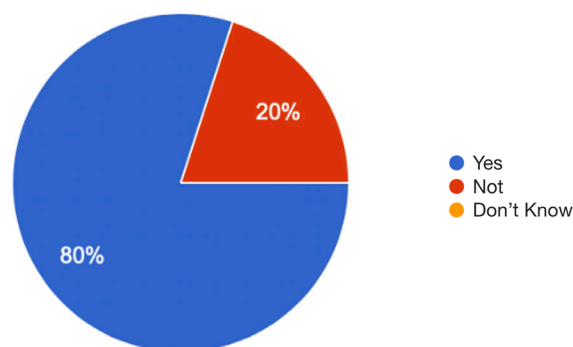


Figure 5: Degree to which 3D Haptic Technology would have allowed them to advance in obtaining skills.

Finally, we wanted to know if they considered it appropriate to use this technological innovation in our university school, to which the respondents answered affirmatively (Figure 6).

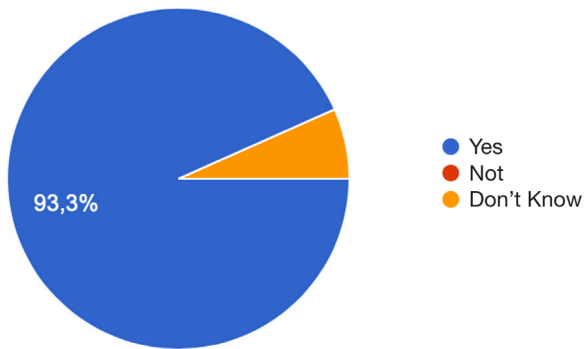


Figure 6: Assessment of the uses of technological innovations at the Adema University School.

2. Interview

After analyzing the content of the answers obtained after the interviews, the results are specified by interest groups, differentiating between students, teachers, other interested parties, and dentists.

Dentistry and undergraduate students:

- They enjoy playing and learning
- They feel new sensations
- They are having fun

Teachers from the Adema University School and from other universities where the Degree in Dentistry is taught:

- They find it a great tool for teaching-learning
- Students will be better able to acquire skills
- Students can improve learning outcomes.
- Teachers will have to update
- Teachers need training to prepare their classes using simulators

Other stakeholders including medical visitors, teachers, center directors and politicians:

- It is an advance in the methodology of teaching students.
- They see many possibilities

Dentists in professional practice:

- The benefit that they would have had at the beginning of their learning if they had had this technology at their fingertips.

Conclusions

Haptic technology is occupying an increasingly prominent place in the teaching and learning process of dentistry. It is a new technology that for a few years has been incorporated into undergraduate dentistry studies worldwide^{4,5}.

The Adema University School has been implementing the use of the aforementioned technology in Dentistry Degree studies for two years. It is a fundamental tool for learning

and work, since it allows the future dentist to enter the operative field from different perspectives, without time limitations, and being able to change the types and complexity of treatment. It is therefore positioned as a tool that simulates the real treatment process in a reliable way.

Throughout this process of incorporating technology into teaching, contributions have been collected from different interest groups on its use as a method for acquiring skills and generating procedural knowledge in the teaching-learning process.

From the results collected through the interviews and surveys, a high degree of user satisfaction and the conviction that 3D haptic technology can help dental professionals learn, is inferred.

In all cases, the great similarity of the simulation with real practice and its validity in preclinical practice stands out, alongwith the positive assessment of the tools as a method for training in interventions and case studies prior to carrying them out in clinical practice.

Equally, it seems a good way to solve some of the shortcomings that teaching within the degree of dentistry has had until now, thanks to the great similarity that the technology has with real exercises, and the possibility of unlimited practice that is allowed.

Throughout the interviews, the students have highlighted the most playful, dynamic, attractive and entertaining component of the technology, while the teachers emphasize the potential they represent for better acquiring skills and improving learning results.

We can conclude that haptic technology can be a fundamental tool for learning and work in the University Faculties and that the data obtained show that it is well received by students, teachers and other professionals related to the world of dentistry.

Discussion

In the review of studies we have verified that 3D haptic technology presents itself as an option in the teaching of dentistry at an international level and that it allows preclinical practices to be carried out in degree level training⁶.

The assessment in our study has been very positive and all the participants have seen the potential of this technology in the teaching process. We have not received negative evaluations regarding the use of the simulators. Presumably there are critical voices in relation to their application for student training, but perhaps the site in which the survey and interviews took place, the Adema university school, which has opted for the incorporation of technology, has inhibited this kind of

negative assessment. However, given the diversity of students, teachers and other professionals who have participated, we believe we are in a position to support a positive view of the incorporation of 3D haptic technology as a learning tool.

We have collected contributions from the teachers on the implications that incorporating this technology means for them when the need arises to train and master the technology to be able to use it in teaching. Certainly, the incorporation of technology supposes the modification of the teaching-learning model and requires a change in the conception of practices in the field of dentistry, providing

a new scenario to which centers, teachers and students will have to adapt.

It should be noted that this work is a first approach to learn about simulators and their use in the dentistry degree. It will be their practice and use in teaching in the different subjects, and the learning results that are generated, which will finally confirm the value of their use as indicated by the data described in this study.

Conflict of interests

The authors have no conflict of interest.

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