Technology Inclusion as an Alternative Strategy for the Teaching of Anatomy

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The teaching of medicine has historically been linked to the use of cadaveric models to understand the anatomy of the human body; however, as awareness of the ethical dimension of using cadaveric models for teaching purposes has increased, the creation of alternative teaching strategies has been encouraged. The incorporation of educational technology for medical education also represents a cost-efficient alternative that allows for the expansion of the experience so that a more significant number of students can benefit from it, also to successfully replicate the practice to reach the competencies. This study reports the implementation experience in a Mexican university using SECTRA Workstation IDS7 technology for the teaching of the Human Anatomy course. In this project, the sample consisted of 450 undergraduate students participating in the medical program, 50% of the participants had an internship with educational technology, and the remaining 50% received a course in traditional anatomy. The results show a significant difference (9.3%) since the approval percentage of the groups that participated in the experience was higher.

Keywords. virtual environments, academic performance, educational innovation

INTRODUCTION

Anatomy Teaching

The teaching of Human Anatomy in medicine has experienced many changes, ranging from when autopsies were forbidden to the use of dead bodies with different fixation systems for their preservation (Fonseca, 2012). One of the most common difficulties for this practice lies in the acquisition of dead bodies for teaching and the management that allows their preservation.

The management of human bodies also involves a series of ethical and legal considerations regarding their management and preservation, which are described in Articles 315 and 374 of the General Health

Law, as well as in Articles 49 and 90 of the Reglamento de la Ley General de Salud en Materia de Control Sanitario de la Disposición de Órganos, Tejidos y Cadáveres de Seres Humanos (Regulations of the General Health Law on Health Control of the Disposal of Organs, Tissues and Bodies of Human Beings); and that it is also identified according to Areas for reception, identification, storage, refrigeration, dissection and macro, and microscopic study, as well as for procedures and delivery of bodies to the pathological anatomy unit under NOM-016-SSA3-2012 No. 6. 5.1.2.3.2. Points based on the Federal Regulation for the disposal of organs, tissues, and bodies of human beings, with provisions within Chapters I, VII, VIII, for medical, scientific research and teaching purposes. However, this General Health Law shows limitations for access to dead bodies for research and teaching purposes. The problem for higher education institutions is to have a regulatory framework that allows access to dead bodies and their management.

In addition, there are several formulas for the management of specimens acquired through body donation procedures, which leads to many ethical and moral controversies over the use of dead bodies as a learning tool.

At this time, the status of dead bodies is a condition of human existence itself, based on Kant's fundamental principle: "Respect for all human beings because they have dignity"; thus involving a triple perspective: social-historical, medical and bioethical. (Pinto, 2018).

As innovation is incorporated into medical education, simulators and virtual anatomical models are increasing. However, most of the bodies used in amphitheaters are in unidentified condition, which enters into controversy with the ethical field, since they come from people who have been abandoned or rejected by society. These persons were not granted fundamental rights during their lifetime and after their death, without their presumed consent, they are used for anatomical dissection. This supposes their paradoxical conversion into an asset of the amphitheater, which are not treated with dignity or respect, since they are materialized only by their bodily components (Figueroa, 2016).

Due to the challenges mentioned above, there is a tendency to develop new digital representations of the human body, so some integrate resources such as applications or dissection tables that include reality or virtual cadavers (Table 1).

TABLE 1
EXEMPLIFICATION OF DIGITAL REPRESENTATIONS OF THE HUMAN BODY

Digital tool	Technology	Approach
SECTRA	Use of two software, one with clinical cases with different pathologies and the other for the dissection of a virtual cadaver.	Undergraduate medical students in the first semesters or dentistry. Also graduate students of forensic medicine, pathology, radiology and surgery.
App Complete Anatomy	Virtual cadaver where you can dissect some of its parts, see inside the organs, know the arrangement of the anatomical structures.	Undergraduate students in medicine.
3DOrganon	Clinical cases accompanied by anatomical models representing a healthy person.	Undergraduate students of the medical program
Anatomage	Anatomical atlas	Undergraduate students of the medicine program in the first semesters

Inclusion of Educational Technology

The use of technology in educational environments is a topic that is part of the discussion on the academic agenda. Some authors, such as Chamunyonga et al. (2018), indicate attributes that these resources convert abstract concepts into simple elements to visualize, this through the development of a virtual

training environment. The expectation in the use of technology lies in improving students' knowledge and skills.

For Palma (2019) the success of these implementations lies in the acceptance that students have about them. In one study, they found benefits from the introduction of Google Classroom (GC) for the development of face-to-face and remote activities, and documented benefits in school performance, collaborative work, as well as motivation in students since they generate attraction towards its adoption.

In addition to the student's benefits, it is important that institutions evaluating the adoption of these trends analyze their own capacity to do so in terms of infrastructure, human capital development, and economic resources to support implementation. These responsibilities involve the understanding that the inclusion of ICTs does not guarantee an improvement in educational quality, which depends on the educational strategies and didactics used (Gatica and Rosales, 2012).

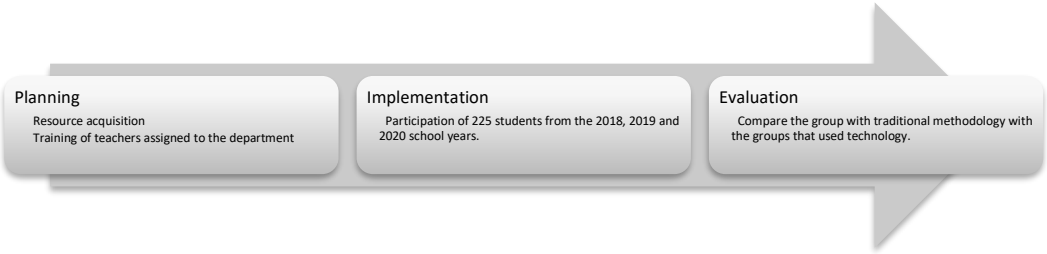
METHODOLOGY

The methodology of this study takes a quantitative approach with a descriptivedesign. The sample consisted of 225of students in the first cycle of their medical career which took the subject of Human Anatomy.

This project started as part of the adoption of simulation-based education by the UAG medical school strategies. Among these, the SECTRA Workstation IDS7 was acquired in order to complete the training of medical students. The objective of introducing this technology was to replace the use of human body models with virtual tools that, in addition to enriching the teaching and learning process, favor students' academic performance.

The implementation process included three phases: planning, execution, and evaluation. These are shown in Figure 1.

FIGURE 1
INNOVATION IMPLEMENTATION PROCESS



The planning phase began in October 2018, with the assignment of the SECTRA table for use primarily in the human anatomy subject in the amphitheater area. A first step was the training of the teachers assigned to the department to start teaching classes based on this technological tool.

In the implementation phase, the technology was used in the 2019 school year by 225 students, with the aim of making it a complementary tool to the study of human anatomy. The dynamics consists of 30 students entering the amphitheater per hour together with two assigned teachers, divided into 5 teams of 6 members, in order to participate in different activities, ranging from viewing and recognizing anatomical structures through dissection and interaction of the virtual cadaver. Finally, the acquired knowledge is integrated with the help of the SECTRA table where the patient interacts with the virtual cadaver and the different imaging studies provided by the clinical cases in the "Education portal" software.

There is a time of approximately 10 minutes per station in which techniques aimed at self-study are used and the teacher plays the role of a counselor. Once they are thoroughly familiarized with the use of the table, they are evaluated on it, together with the cadaver and anatomical pieces of the subject's multidisciplinary study.

As a continuation of the implementation phase, in 2020, with 225 students, we sought to demonstrate the benefit of integrating other tools for facilitating learning, incorporating the use of the application -Complete Anatomy- for theoretical classes simultaneously with the help of the SECTRA table in amphitheater practices.

For the evaluation phase, the groups of the 2020 and 2019 school years involved in the innovation were compared with the group of students who attended the 2018 school year under a traditional model.

Results

From the group of students who participated in the experience, there was an 89.33% of passing students, being 201 those who had a satisfactory grade in the course, compared with the percentage of passing students in the 2018 school year 80.07%. The initial application of virtual anatomy resulted in an increase of 9.26% regarding the passing rate in the subject (Table 2). With the introduction of the new technological tool in theory, the passing rate increased by a further 2.67%.

TABLE 2
COMPARISON OF ANATOMY COURSE PASSING RATE

Implementation year	Experience	Passing students	Students who did not pass
2018	Traditional anatomy course	180 (80%)	45 (20%)
2019	Virtual anatomy course (SECTRA)	201 (89.33%)	24 (10.66%)
2020	Virtual anatomy course (SECTRA + App Complete Anatomy)	207 (92%)	18 (8%)

DISCUSSION

In accordance with the data collected, the implementation of technology for the subject of Human Anatomy helped to improve academic performance by increasing the passing rate, achieving significant learning in the students. These results are consistent with authors such as González Gutiérrez et al. (2017), who using virtual tools, observed higher academic performance is reflected in the grade point average; however, another study implemented in the engineering area of the University of Altamira used simulation and found adverse results in the passing rate (Maya, Gonzalez, Ocampo, 2017). It is important to perform research that documents the impact of the use of technology on the motivation of students, as well as on the development of skills that are transversal to their university education.

On the other hand, the results obtained in this research are consistent with the intervention study by Alves et al. (2021), which sought to evaluate the acquisition of cognitive knowledge in CPR through training mediated by health simulation and to verify satisfaction with the design of the teaching methodology, obtaining, as a result, an increase in cognitive learning of 81.9%, concluding that the simulation was effective as a teaching-learning method. In this regard, it would have been beneficial for this research, in addition to being able to assess the aspect of satisfaction with these new learning environments since it is a way to determine factors related to academic quality.

Among the limitations identified is the interest of some teachers in training in the implementation of virtual models in their lesson plans. In addition, the population studied was only in medicine and could have been applied to other health careers. Another limitation found is the time required to manage financial and administrative procedures.

CONCLUSIONS

A crucialessential reflection for the teachers involved in this implementation refers to the demand in time investment for the first design of the experience since it requires a significant commitment from them; however, future performances will decrease in complexity due to this exercise. The feedback obtained from the students' comments, in turn, allows complementing the educational practice and detonates in the teaching staff a reflective practice on their work.

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