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Ten years experience in an extracurricular undergraduate surgery course in medicine

Experiencia de 10 años de un curso extracurricular de cirugía en pregrado de medicina

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Palabras clave:
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ABSTRACT

Introduction: the different proposals to bring undergraduate medical students to surgical courses have allowed the development of surgical skills. The constructivist school provides surgical teaching with new opportunities by allowing a scaffolding where several additional skills are integrated. **Objective:** to describe our experience with an experimental undergraduate surgical group. **Material and methods:** by a descriptive study, we review the students prepared in eight years in 11 courses under an evaluation scheme of the Serrano/Anaya system in live models under a routine, awaiting their products. The students who emerged from this course were prepared as coaches or instructors. **Results:** based on 109 students, an initial qualification of 32 points and a final qualification of 70 to 80 points were obtained; 60 (70%) were students, and 22 (18%) were instructors. Additionally, 15 (13%) presented papers at congresses. **Conclusions:** the Serrano/Anaya process evaluation model allowed a sequential preparation similar to that of postgraduates, and the constructivist model provided the possibility of generating products such as encouraging students to create research projects.

RESUMEN

Introducción: *las diferentes propuestas de acercar a los alumnos en pregrado de medicina a cursos de cirugía han permitido desarrollar destrezas quirúrgicas. La escuela constructivista al permitir un andamiaje donde se integran diversas habilidades adicionales brinda la posibilidad a la docencia quirúrgica de nuevas oportunidades.* ***Objetivo:*** *describir nuestra experiencia con un grupo de cirugía experimental en pregrado.* ***Material y métodos:*** *por estudio descriptivo se reseña los alumnos preparados en ocho años en 11 cursos bajo un esquema de evaluación del sistema de Serrano/Anaya en modelos vivos bajo una rutina, esperando sus productos. Se prepararon como coaching o instructores a los alumnos que emergieron de este curso.* ***Resultados:*** *con base en 109 alumnos se obtuvo calificación inicial de 32 puntos y final de calificación de 70 a 80 puntos, 60 alumnos (70%), 22 alumnos fueron instructores (18%). Adicionalmente, 15 (13%) presentaron trabajos en congresos.* ***Conclusiones:*** *el modelo de evaluación de procesos de Serrano/Anaya permitió realizar una preparación secuencial similar a la de los postgraduados, asimismo el modelo constructivista brindó la posibilidad de generar productos como incentivar al alumno a crear proyectos de investigación.*

INTRODUCTION

The challenge of preparing a surgeon encompasses both the intellectual spheres (the written material in books and journals),[1,2] of skills and competencies (knowing the material and how to use it through manual actions),[3,4] the discipline, and if we were ambitious, creating an indoctrination of innovation,[5] above all foreseeing to train the surgeon to provide an immediate response to that unexpected transoperative events[6] seeking new answers to clinical-surgical problems.

Surgery from ancient times until the eighteenth century was a Lancastrian process

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by which students learned from their tutors rudimentarily according to the patients they encountered.[7] From the 19th century onwards, William Halsted established an educational system with a defined study plan and a series of scientific elements; the surgical resident performed surgical procedures under the supervision of a graduate surgeon until he demonstrated that he had mastered the technique (Halstedian method).[8-10] At the end of the 20th century, a new system was established based on competencies and skills development through a learning curve with elements of internet-based programs to complement the non-face-to-face hours.[11]

If we recognize that the training of the resident is based on careful preparation at the undergraduate level, we will find that this foundation will depend on the elements provided in the School of Medicine; hence the importance of including morphological, physiological, biomolecular, microbiological and, of course, clinical subjects, providing not only an anatomical approach but also a biomolecular physiological approach to support clinical decisions.[1] Although it is not the intention of the undergraduate program to train surgeons but to provide the essential elements for the student to aspire to be a surgeon someday, this stage has been considered crucial to develop skills independent of their formal curriculum with which they must comply in the bachelor's degree.[12,13]

An ideal scenario where the undergraduate student acquires his or her first real surgical experience is the university's experimental surgical laboratory within such facilities.[14-16] An ideal model to provide this teaching element is the assembly of a laboratory with the indispensable elements proposed by Dr. Luis Padilla-Sánchez at the end of the last century, meaning respecting national and international regulations regarding the right to life of experimental animals. Experimental surgery practices can be performed on small species,[17,18] being a successful model for postgraduate students that influenced some undergraduate students in the medium term.[17]

Getting a student to incorporate the theoretical elements into his practice requires models that allow preserving that knowledge.[19] The models in surgical teaching help preserve the students' improvement and base a practical experience, which leads them to form skills and master simple techniques.[6,20] This experience is very similar to the constructivist school of teaching initiated by Piaget, in which the subjects only learn through reflexive abstraction, making the live models of surgical practice an ideal means to consolidate this knowledge. The student is building this new knowledge,[20] where the elements taught are beams of a scaffolding that not only allow building a piece of new knowledge on the existing one, forming a reality different from positivism,[21] but also allowing the development of tangible products through practical exercises from the acquired elements.

Under the motivation of Dr. Anaya-Prado's three-phase evaluation scheme,[22] the student was prepared in the first theoretical phase. In the second, a practical demonstration is given by an instructor. In the third, the student practices under supervision, evaluating three skill fields and observing the changes acquired.[23] In order to propose a live model, the NOM-062-ZOO-1999 regulations[24] for the use of animals and in the creation of the Sun Lee system for the use of experimental Wistar rats, and based on Dr. Padilla-Sánchez's teaching model for the use of small species for the practice of surgical procedures in an experimental microsurgical environment,[18] essential skills are developed (laparotomy, inguinal plasty, hepatic biopsy, and unilateral nephrectomy).

The constructivist teaching sense within the surgery is completed by having a didactic model that allows teaching and evaluation actions using a demonstrable product that makes it evident that the student acquired such knowledge; for the surgical area, it is a practical skill much more tangible and easy to evaluate according to Dr. Anaya-Prado's model.[22] There still needs to be a surgical group with published articles based on constructive teaching proposals, where

it is easier to apply this teaching theory in medicine.

Our objective was to describe how many students took the surgery course with the use of live biological models, how they were evaluated, how many of them are still in the career, how many concluded it, and how many have published or are about to publish papers within our School of Medicine of the Universidad Cuauhtémoc at San Luis Potosí (EMUCSLP).

MATERIAL AND METHODS

Based on a total of 11 surgery courses with the use of a live animal model between 2009 and 2019, in this case, the 250 g male Wistar type rat was used with the observation of the requirements of NOM-062-ZOO-1999,[24] as well as the ethical norms of respect for species for use in experimental surgery laboratories contained in the respective manuals,[25,26] placing our attitude more towards the bioethical personalist school of Hans Jonas than towards the utilitarian one of Hugo T Engelhardt by respecting its particularity as a living being.[27,28]

The students in the course were medical students from the second to the eighth semesters. They were taught a sequence of four blocks of knowledge to support the manipulations in the living biological model, ethical aspects, and respect for the life of small species, indispensable knowledge to perform the manipulations in the rat, fundamental knowledge to know the material to be used with the biological model, knowledge of the technique to be used and a practice module in the living model.

The sequence of knowledge to be acquired is suggested by Dr. Anaya-Prado's method,[22] in which these elements are acquired theoretically, the material to be used is known, and a teacher shows the technique to be developed. We describe for this work the results of two courses; the students perform three stations: 1) general laparotomy and biopsy, 2) nephrectomy, and 3) splenectomy.

The course is directed by a certified general surgeon and supported by a group of undergraduate medical students (coaching system),[29] of whom have already taken at least one similar course in experimental surgery in live biological models. These instructors have developed additional skills to their initial instruction and collaborate in monitoring the constant development of the skills of the new students in this course;[6] these skills were evaluated from the eighth course in 2014. The Anaya-Serrano system was used with the modification proposed by one of our alumni to evaluate the domains of knowledge, mastery of the instruments to be used, and mastery of the technique to be evaluated.[30]

The variables studied were the number of students who took the experimental surgery course in eight years, sex, and whether they managed to conclude the procedures without their rat dying, as a cross-sectional range. In a follow-up, students who reached the level of general instructors and senior instructors (general coordinator of instructors) were considered. Of all trainees, how many went on to medical school and how many presented papers at congresses are shown as percentages.

RESULTS

Out of a total of 11 courses, 149 students graduated, 137 belonged to EMUCSLP, and the rest (n = 12, 8.05%) belonged to other schools; 120 of them are still in the course, and the rest dropped out (n = 17; 12.4%); demographic data are shown in *Table 1*.

Our undergraduate group began using the evaluation system from the eighth course onwards; we observed that performance differed between generations. For example, we describe the results between two courses, each being group A and group B shown in *Table 2*; the overall average of the three modules was 7.9 in group A and 8.2 in group B. The so-called stations referred to, in number one, laparotomy plus biopsies. The so-called stations referred, at number one, to laparotomy plus liver biopsy, station two, nephrectomy, and station three, splenectomy. The evaluation was structured as follows: at each station, there was a knowledge stage, another stage

Table 1: Demographic results of undergraduate students in 11 years of an experimental surgery course at the Universidad Cuauhtémoc San Luis Potosí, 2009-2019.

	n	%
Subgroup developed by students		
Total number of students	149	100.00
Female	75	50.34
Male	74	49.66
Data of students who graduated from the course		
Concluded medicine	109	100.00
Students nominated as instructors	22	20.18
Students nominated as instructors' coordinators	4	3.67
Students with research projects presented at conferences	15	13.76
Instructors with an award at a scientific event	3	2.75

Table 2: Module ratings of the skill stations according to the Anaya-Serrano-Gámez model of undergraduate students in 11 years of an experimental surgery course at the Universidad Cuauhtémoc, San Luis Potosí, 2009-2019.

	Qualifications	
	Group A	Group B
Knowledge test		
Station one	8.5	8.4
Station two	6.8	8.6
Station three	9.6	8.2
Average	8.3	8.4
Examination of equipment and instruments		
Station one	7.2	7.7
Station two	6.7	8.5
Station three	9.5	7.9
Average	7.8	8.0
Skills test		
Station one	8.2	7.6
Station two	5.6	8.5
Station three	9.0	8.2
Average	7.6	8.1
Course average	7.9	8.2

to evaluate the knowledge of the material, and, at the end, the skills stage. In this way, we have the result of the student's performance in its theoretical aspect, knowledge of the material, and skills in three different procedures, with which an evaluation based on evidence was made and not on an affective-qualitative scale, but on an impartial quantitative scale, thanks to which it was possible to give feedback to the student in the areas where he could improve such skills or knowledge and, of course, also to the teacher himself. This approach helped us to propose the most outstanding students as instructors based on these averages. This way, emotional conflicts were avoided and helped support each student's final grade in the different courses.

As an unexpected fact, our study found that of the 120 students who completed the course, 15 (12.5%) have presented research projects in various forums, three of them won a place in a congress competition, and one of them has already published his work. In 2022 a specific manual for the course was published.

DISCUSSION

The initial approach we intended in the first four courses was to provide elements to undergraduate students to develop skills and bring them closer to abilities, which, although they are found in their undergraduate surgical area subjects, without intending to form a pre-resident,[1] we found that these skills allowed us to develop a dynamic model, maintaining the ethical principles regarding minor species[28] proposed by Sun Lee through the courses for postgraduates that are developed in our country.[14,16-18] Applying them to the undergraduate allowed us, from the eighth course of 2014, to implement a constructivist system, which obtained a quantifiable result, where the student's performance was evaluated, no longer in a practical way, but also more fairly and objectively allowed us to correct the defects of the three items to be perfected in the student,[22,23,30] eliminating the skinner's effect of only issuing a grade,

improving that intended scaffolding that in the future will allow the student to develop other skills. An incredible achievement was the teacher training of 22 instructors and the inclusion of 15 as research prospects by motivating them to present papers in congresses and a published article;[30] these last two, although they were not expected products of the course, were taken as a medium-term benefit of the constructivist actions. The achievement was not only to create a surgical scaffolding but also to develop another complementary scaffolding that would attract the student to surgical research, a fundamental piece in the indispensable innovation in our area.[5] We can say that we leave as a proposal for further studies that constructivism surpasses behaviorism not only by providing a single objective but also by developing more than two achievements in students who are prepared with this system in our experience (development of surgical skills and development of research skills).

Although Evans proposes that actual sessions should be reserved for complex procedures,[31] our experience in subjecting students to real situations was an approach that even motivated an unexpected by-product, such as the production of completed research papers. This motivation is described in other groups that manage the so-called "surgery clubs".[15,19,32,33] Although it is challenging to compare quantitative achievements with other Latin American groups, what is certain is that the success of all of us is to bring undergraduate students closer to actual surgical exercises, our variable being a constructivist system.

Programs and proposals with the help of simulators should be included to increase this skills[34] in different scenarios.[29,31] It is interesting to note that the construction of pre-delineated elements in surgical teaching provides opportunities to develop, in turn, new by-products such as the Moulton study, where from that scaffolding[6] elements were provided to students to respond to unforeseen surgical situations. The definition of these teaching model schemes is still pending.

CONCLUSIONS

It is also pending to develop programs that give congruence in the undergraduate student, not only to train as a clinician in our area (we do not intend to make specialists from this level), but to encourage the inclination towards surgical research and cultivate curiosity at the academic level, awakening their skills,[9] being personally a necessary combination of all of them.

As an unexpected aspect in our description, it was observed that students, in addition to the constructivist exercise of delivering a product, their simple qualification or the performance of their surgical practice, there was an additional product which was their intervention in research projects in 10% of those enrolled, which we consider that an additional achievement of the course was that students joined research projects with personal achievements of presentation at congresses, The course was a promoter of research in our school, fulfilling the expectation of how to bring the millennial generation, of cybernetic complexity,[35] to an actual practice with the development of intellectual skills in research and surgery, achieving a scaffolding that allows acquiring new elements in their personal development.

What is clear to us in terms of experience is to implement, at low cost and high impact, a constructivist system such as that of Anaya-Serrano-Gámez, not only in the development of surgical skills but also to motivate the student's natural approach to research, both tangible by-products (research papers, congress posters, and publications).

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Ethical considerations: concerning the live models (Wistar rats), the indications of NOM-062-ZOO-1999 were followed in order not to mistreat this species, prevent its suffering, and respect its integrity as a living being; in the case of survival to the practices, the students took charge of these animals, committing themselves

to take care of them as pets. In the case of the students, only the general productivity data were taken without requiring informed consent for each of them, considering not to mention the names but the general percentage data of each generation. The research committee with registration CEI-HGS-015-17 authorized the teaching studies.

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