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Effectiveness of distance teaching for basic principles of veterinary surgery

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Abstract

During the confinement due to the SARS-CoV-2 (COVID-19) pandemic, the effectiveness of distance teaching of the basic principles of surgery was evaluated using the Virtual Learning Environment platform. A total of 209 fourth-year Veterinary Medicine students participated, and instruction was carried out asynchronously through forums, readings, and podcasts. Synchronous sessions were also held via video conferencing. To evaluate knowledge acquisition, a questionnaire was applied at the beginning of the course (week 1) and at the end (week 10) using the Google™ Forms platform. Students participated voluntarily and only their institutional email address was collected to link the initial and final questionnaires. The questionnaire questions covered different areas of knowledge: anesthesia (10 %), asepsis (20 %), hemostasis (10 %), delicate tissue handling (20 %), and suturing (40 %). In the initial questionnaire, the average score was 5 out of 10, while in the final, 8 out of 10. Using the Wilcoxon signed rank test, a significant difference ($P < 0.0001$) was found between the initial and final scores. The need to reinforce knowledge in the delicate handling of tissues and sutures was identified. These results indicate that this distance teaching model has the potential to improve the effectiveness of students' self-learning in the basic principles of surgery.

Keywords: Mixed learning; Distance learning; Undergraduate surgery; Veterinary Medicine; Veterinary education.

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Additional information and declarations can be found on page 7

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Vol. 11 2024

Study contribution

This study provides evidence on the effectiveness of distance learning as a process that supports and guides an autonomous construction of knowledge with the aim of promoting the learning of the basic principles of veterinary surgery in college students.

Introduction

In clinical-surgical education, various approaches, such as lectures and problem-based and team-based learning, have been used. However, the COVID-19 pandemic has radically changed the way we teach, forcing the gradual implementation of remote virtual models.[1] This has been a challenge for teachers who have had to quickly adapt to online teaching. The effectiveness of these new educational models must be evaluated, especially in the clinical and surgical disciplines.

Halsted's proposal for teaching surgical processes is summarized in the phrase "see, do, and teach." These activities can be adapted to the online environment, whether synchronous or asynchronous, especially at the beginning of college teaching. However, there is a more complex approach based on the social cognitive theory, which suggests that learning occurs through the interaction between cognitive, behavioral, and environmental factors, and emphasizes the active role of the individual in his/her own learning process and development.[2]

This is how students' performance will depend on the context in which the teaching-learning process takes place. Therefore, providing varied and dynamic environments can help students approach content in different ways, adapting to their preferences and learning styles.[3] This study evaluated the acquisition of theoretical knowledge about basic surgical principles in a group of Veterinary Medicine and Zootechnics students using a distance education platform.

Materials and methods

Course and population description

The teaching-learning module "Surgical Techniques and Therapeutic" (STT), updated in 2015 is part of the curricula at the Veterinary Medicine and Zootecnics School at the Universidad Autónoma Metropolitana, campus Xochimilco. The course is taught in the fourth year, in accordance with the curriculum, during what is called stage III: "Clinical-Medical Training II". To be admitted, it is necessary to have taken and passed "Systemic and Toxicological Diseases Clinic" as well as "Infectious and Parasitic Diseases and their Importance for Public Health". The course program consists of five learning units. The present study evaluated only the first part of the course program (20 %). The evaluation was carried out with the voluntary participation of 209 students of Veterinary Medicine and Zootechnics, enrolled for the first time in the STT module during the SARS-CoV-2 (COVID-19) pandemic.

Design of virtual sessions

During confinement, the Virtual Learning Environment (ENVIA in Spanish) platform of the Universidad Autónoma Metropolitana-Xochimilco was used four hours daily.

doi: 10.22201/fmvz.24486760e.2024.1167
Vol. 11 | 2024

The students participated asynchronously in four forums, where they had to express their informed opinion in writing in response to questions asked regarding the basic principles of surgery (BPS): incision, hemostasis, suturing, anesthesia, and delicate tissue handling. Additionally, they did three readings per topic. They also listened to five podcasts, one per each basic principle, with a duration of four minutes each one, in accordance with the concept of blended learning.[4] The teaching process was complemented with ten three-hour video conference synchronous sessions (Zoom Video Communications; San José, CA), where related concepts were clarified and audiovisual presentations were made in Power Point™. In addition, videos about the BPS were projected by the teachers in charge of such courses, according to the flipped classroom model.[5]

Questionnaire design and evaluation

The evaluation questionnaire was structured from the question bank for the ordinary final exam (global evaluation), related to the BPS. It consists of 100 items, numbered consecutively from 1 to 100. Ten multiple-choice items were selected, each with four response options, using a table of random numbers. The proportion of questions per area of knowledge was comprised of 10 % anesthesia, 20 % asepsis, 10 % hemostasis, 20 % delicate tissue handling, and 40 % suturing.

In order to evaluate the level of knowledge with which the students graduated from the STT course, a questionnaire was administered to them at the beginning (week 1) and at the end of the course (week 10), using the Google™ Forms platform. The passing grade for the questionnaire was 6 out of 10. Participation was voluntary. Only their institutional email address was required to link the initial and final questionnaires.

Statistical analysis

The analysis was carried out by means of the description of the results based on the frequency of correct answer items, their proportion, and the 95 % confidence interval. The scores of the questionnaires were analyzed to check their normality with the Jarque-Bera test ($P = 0.0003$), which indicates that the analyzed sample does not follow a normal distribution, so the scores of the initial questionnaire were compared with those of the final with the Wilcoxon signed rank test for paired samples, considering an alpha value of 0.05. The PAST (Paleontological Statistics) program was used.[6]

Results

The initial and final questionnaires were completed by 209 participants. The average rating of the initial questionnaire was 5 out of 10 (minimum 0, maximum 10), that of the final questionnaire was 8 out of 10 (minimum 2, maximum 10). The distribution of the scores obtained is shown in Figure 1. A W value of 19009 was obtained in the Wilcoxon signed rank test, with a value of $P < 0.0001$, which indicates a difference between the scores of both questionnaires. The results related to the individual correct answers are shown in Table 1, and the main erroneous answers are shown in Table 2.

doi: 10.22201/fmvz.24486760e.2024.1167
Vol. 11 2024

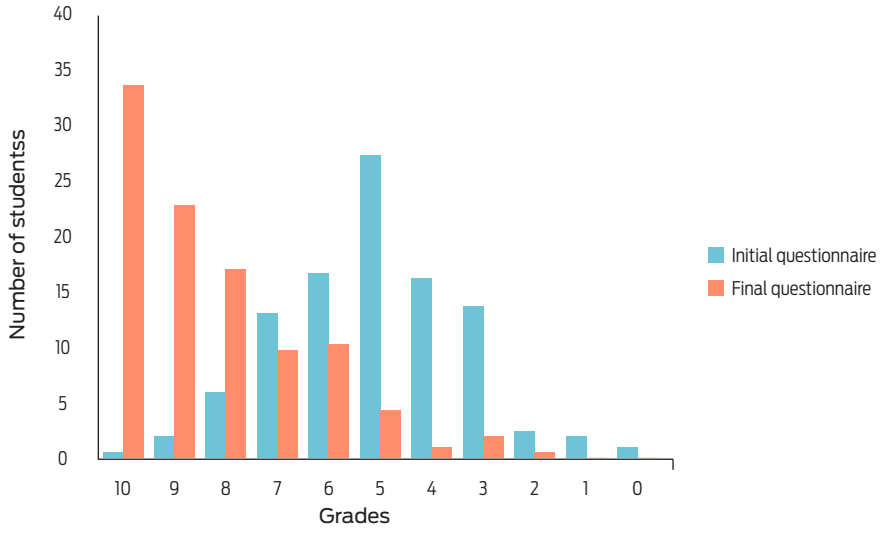

Figure 1. Distribution of the scores of the initial and final questionnaires.

Table 1. Correct answers to the questions

Question	Correct answer	Initial questionnaire (n= 209) % 95 % CI	Final questionnaire (n= 209) % 95 % CI	Wilcoxon's test
Where is antisepsis performed?	Skin of surgical patient	(179) 85.65 % 80.15–90.10 %	(207) 99 % 98.14–100 %	P < 0.007 W = 609
Where is sterilization performed?	Operating room staff gowns	(99) 47.37 % 40.44–54.37 %	(207) 99 % 98.14–100 %	P < 0.0001 W = 4550
Anesthetic that binds to N-methyl-D-aspartate receptors.	Ketamine	(116) 56.04 % 48.99–62.91 %	(207) 99 % 98.14–100 %	P < 0.0001 W = 3831.5
Fundamental procedure that contributes to a complication-free recovery.	Delicate tissue handling	(85) 40.67 % 33.95–47.66 %	(164) 78.47 % 72.27–83.8 %	P < 0.0001 W = 6266
Instrument used in the delicate handling of tissues.	Allis forceps	(107) 51.20 % 44.21–58.15 %	(207) 99 % 98.14–100 %	P < 0.0001 W = 3610
Instrument used in hemostasis.	Kelly forceps	(155) 74.16 % 67.67–79.95 %	(207) 99 % 98.14–100 %	P < 0.0001 W = 1696
Suture material of natural origin, absorbable, multifilament.	Catgut	(97) 46.41 % 39.50–53.42 %	(148) 70.81 % 64.14–76.88 %	P < 0.0001 W = 3626
The following are interrupted (simple) less suture patterns.	Schmidem	(87) 42.03 % 35.22–49.07 %	(207) 99 % 98.14–100 %	P < 0.0001 W = 5600
The following are less invaginating suture patterns.	Reverdin	(72) 34.78 % 28.31–41.69 %	(207) 99 % 98.14–100%	P < 0.0001 W = 8687.5
Suture pattern for primary closure of the linea alba.	Reverdin	(60) 28.99 % 22.91–35.68 %	(150) 71.77 % 65.15–77.76 %	P < 0.0001 W = 7560

(n): number of participants
%: proportion of participants with the result.
95% CI: 95% confidence interval.

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Vol. 11 | 2024

Table 2. Most frequent wrong answers to the questions

Questions	Initial questionnaire n = 209	Final questionnaire n = 209	Considered actions
Where is antisepsis performed?	Operating room table n = 15 7.18 %	–	None
Where is sterilization performed?	Operating room table n = 84 40.19 %	–	None
Anesthetic that binds to N-methyl-D-aspartate receptors	Propofol n = 48 23.19 %	–	None
Essential procedure that contributes to a complication-free recovery	Antisepsis n = 57 27.27 %	Antisepsis n = 21 10.04 %	Reinforce the concept of delicate tissue handling
Instrument used in the delicate handling of tissues	Halsted forceps n = 45 21.53 %	–	None
Instruments used in hemostasis	Allis Forceps n = 29 13.88 %	–	None
Suture material of natural origin, absorbable, multifilament	Silk n = 58 27.75 %	Silk n = 34 16.26 %	Reinforce related knowledge with the types of sutures
The following are interrupted (simple) suture patterns less	Sarnoff stitches Ad n = 53 25.60 %	–	None
The following are less invaginating suture patterns	Cushing n = 73 35.27 %	–	None
Suture pattern for primary closure of the linea alba	Conell n = 85 41.06 %	Sarnoff n = 28 13.39 %	Reinforce concepts related to the mechanical functions and uses of suture patterns

Discussion

Many higher education institutions use blended learning, where students learn through supervised face-to-face instruction on campus as well as online activities. Of the different blended learning models, the use of the flipped classroom approach has become increasingly widespread. Virtual learning encourages diverse experiences using information and communication technologies, which are familiar to contemporary students. This way, teachers can facilitate the achievement of learning objectives effectively through the appropriate selection of the activities to be developed.[4,7]

In the present analysis, the students acquired the essential knowledge of the basic principles of surgery using virtual learning methodologies. This was verified by performing an evaluation before starting the course, in which they obtained a non-passing grade (5 points), and a second, at the end of the course, where they obtained an average passing grade (8 points). The results agree with a study carried out in Pakistan, in which students were evaluated with an instrument related to surgical clinical education and who were taught using both virtual and face-to-face

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Vol. 11 2024

learning. They obtained significantly better results compared to those who only attended with face-to-face classes.[4]

In a similar situation in which an online surgical education video platform was developed during the COVID-19 It was concluded, it was concluded that the use of this platform students to improve their knowledge, since they obtained a significantly higher score, higher in the weekly exams, compared to that obtained by reading conventional textbooks.[8] Recently, another study reports that by using the flipped classroom model, undergraduate surgery students achieved improved scores on pre-class questionnaires. Aditionally, 89.5 % of the participants preferred the flipped classroom format to a traditional class format.[9]

In a further study, an optional, asynchronous, week-long online virtual course was implemented for undergraduate medical students. A total of 86 third- and fourth-year students voluntarily enrolled in the course, regardless of their prior experience in surgical skills. During this, topics such as the identification of surgical instruments, knot tying, and suturing were dealt with. Ten teachers with no prior experience in online classes provided feedback on the acquired knowledge.

The results showed that the students were pleased with the technical skills they had acquired and that their self-confidence had also increased. Most participants acknowledged that the online format was effective for basic surgical skills instruction. This was due in part to timely feedback and performance evaluation, which contributed to building a solid educational foundation in the students.[10]

Surgical practice requires surgeons to acquire knowledge of the fundamental principles of surgery. Internet access offers advantages for the development and learning in surgical disciplines, whether through textual content, images, or videos. As surgical procedures evolve, the training of future surgeons must also adapt and improve. Therefore, more comprehensive online training can enhance the development of these skills.[11]

Conclusions

The need to transform teaching strategies in veterinary surgical education has been identified and a new design that takes advantage of online platforms for blended learning and video conferencing for asynchronous teaching has been adopted. This combination with synchronous teaching has proven effective in enhancing students' self-study of the basic principles of surgery. Therefore, the implementation of this mixed methodology in regular courses is suggested as a way to improve face-to-face teaching and maximize educational effectiveness in the field of veterinary medicine.

doi: 10.22201/fmvz.24486760e.2024.1167
Vol. 11 | 2024

Data availability

The original datasets used in this research and if applicable, supporting information files, are deposited and available for download at the SciELO Dataverse repository.

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This work did not require financing.

Conflicts of interest

The authors declare that they have no conflict of interest.

Author contributions

Conceptualization: JJ Pérez-Rivero.
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Research: JA Herrera-Barragán, A Lozada-Gallegos, E Rendón-Franco
Methodology: JA Herrera-Barragán, A Lozada-Gallegos.
Writing-original draft: JA Herrera-Barragán, A Lozada-Gallegos.
Writing-review and editing: JJ Pérez-Rivero, E Rendón-Franco.

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Vol. 11 | 2024

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