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Assessment of the impact of e-learning of theoretical anesthesiology for medical students

Avaliação do impacto de ensino teórico de anestesiologia à distância para estudantes de medicina

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ABSTRACT

Introduction: Due to the high contamination rate and number of cases of the SARS-Cov-2, local authorities decreed the closure of universities and schools, which has forced these institutions to come up with innovative solutions for the continuation of their activities.

Objective: The aim of this study is to assess both the impact and level of satisfaction amongst undergraduate students of the online teaching of theoretical anesthesiology as an alternative method to the face-to-face teaching as the latter is currently impaired by the difficulties imposed by the pandemic.

Methodology: The teaching method chosen consisted of conducting online classes taught by a specialist using the Microsoft Teams platform. The level of knowledge of the participants was assessed through the application of questionnaires before and after each term of the course.

Results: A total of 812 questionnaires were completed, with a significant increase of 41.61% in the average of correct answers (3.94 vs 5.57; p <0.001).

Conclusion: The main focus of this study is that the e-learning of theoretical anesthesiology and its results showed considerable increase in the students' knowledge. Also, it was observed that the levels of satisfaction were higher than the expectation levels.

Keywords: Anesthesiology; Medical Education; eLearning; Covid-19.

RESUMO

Introdução: *Devido à alta taxa de contaminação do SARS-Cov-2 e ao surgimento de um grande número de casos, autoridades locais decretaram o fechamento de universidades e escolas, demandando a implementação de soluções inovadoras para a continuidade das atividades acadêmicas.*

Objetivo: *O objetivo do presente estudo é avaliar o impacto e nível de satisfação do modelo de ensino teórico à distância de anestesiologia em alunos de graduação como método alternativo ao ensino presencial em virtude das dificuldades impostas pela pandemia.*

Metodologia: *O método utilizado consistiu na realização de aulas online ministradas por professor especialista através da plataforma Microsoft Teams. O nível de conhecimento dos participantes foi avaliado por meio da aplicação de questionários antes e após cada módulo do curso.*

Resultados: *Um total de 812 questionários foram preenchidos, tendo sido constatado um aumento significativo de 41,61% na média de acertos geral (3,94 vs 5,57; p < 0,001).*

Conclusão: *O presente estudo trouxe o ensino teórico em anestesiologia à distância como foco principal e os seus resultados mostraram ganho de conhecimento considerável por parte dos participantes. Além disso, foram observados maiores níveis de satisfação em detrimento dos de expectativa.*

Palavras-chave: *Anestesiologia; Educação Médica; Ensino a Distância; Covid-19.*

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INTRODUCTION

The pandemic caused by the new coronavirus (SARS-CoV-2), has led to major social changes and also changes in the operations of various economic and commercial sectors of society[1]. Due to the high contamination rate of SARS-Cov-2 and its associated high number of cases, local authorities decreed the closure of universities and schools, which has forced these institutions to come up with innovative solutions for the continuation of their activities. Therefore, new technologies are being increasingly used by medical training centers and their students' performance with the use of these technologies point to an inevitable renewal in medical education[2].

In recent decades, technological advances have provided new ways of accessing knowledge. A wide variety of innovative teaching tools and devices are now available to optimize learning, making it possible to have classes and teaching support materials available online, which can be repeatedly used by the students. Another innovation is the application of exams and questionnaires through forms, which are also sent remotely. Lastly, it is also possible to have videoconferences in which the teacher can interact with students in real time[3]. E-Learning has proven to be fundamental and a successful strategy for medical schools in countries with limiting factors for face-to-face teaching, such as resources, as well as the availability of specialists and educators[4].

In 2015, the World Health Organization (WHO) released a report in which 33 studies analyzed the level of knowledge acquired by the students for both e-learning and traditional face-to-face teaching. The results showed that 11 (33%) of those studies included in the report demonstrated a significant gain in knowledge with e-learning, when compared to the traditional face-to-face method; 19 (58%) did not find a statistically significant difference between the two types of teaching; and 2 (6%) showed mixed results, with variations according to the knowledge indicator used[5].

Few studies have been carried out to prove the effectiveness of online teaching of practical skills and medical procedures in medical schools. However, the effectiveness of theoretical teaching through e-learning has been previously demonstrated[6,7]. In order to establish a more effective approach to teaching anesthesiology to residents, a group of researchers proposed that face-to-face classes should be solely interactive, with dynamic discussions of clinical cases[8]. To do so, the students would have to acquire a previously established knowledge, which would then be consolidated in the classroom. In this context, e-learning may prove to be a means of providing adequate theoretical content to students, so that they can optimize their use in their practical and face-to-face activities.

One of the main missions of academic medical centers is to train qualified medical professionals, able to diagnose conditions, prescribe medications and take appropriate measures for their patients. In these centers, specialized professionals are responsible for the transmission of knowledge to the students. However, being an expert is not the only qualification necessary for teaching to be carried out efficiently; it is essential that the teachers have didactic competence and know how to use tools capable of contributing to greater student learning[9].

In addition, the impact of e-learning is also present economically-wise. A previous research found that the blended learning approach costs about 24% less than face-to-face teaching, without considering any transition costs[10]. The existence of several studies that prove the effectiveness of distance learning and its optimization in learning, considering the current situation related to the COVID-19 pandemic, contributes to the development of new teaching strategies.

The aim of this study is to assess both the impact and level of satisfaction amongst undergraduate medical students of the online teaching of theoretical anesthesiology as an alternative method to face-to-face teaching due to the difficulties imposed by the COVID-19 pandemic.

METHODOLOGY

This is an observational, cross-sectional study, approved by the Research Ethics Committee of Universidade Federal de Sergipe (UFS). Student selection was carried out by voluntary enrollment through the Integrated System of Management and Academic Activities (SIGAA, *Sistema Integrado de Gestão e Atividades Acadêmicas*) belonging to UFS. Sixty-one students enrolled in the medical program at the Federal University of Sergipe, in the Aracaju campus (Urban) and in the Lagarto campus (Rural), who enrolled in the extracurricular, non-mandatory project "E-learning of Theoretical Anesthesiology" were included in the research. Participation in this research was voluntary and the participant had full autonomy to decide to withdraw their participation at any time, without any consequences.

The method consisted of conducting online classes, taught by a specialist using the Microsoft Teams platform (Microsoft Corp, Redmond, WA), in which the following topics were covered in 8 modules: surgical anesthetic risk and pre-anesthetic assessment (module 1), basic life support in cardiorespiratory arrest (module 2), advanced life support in cardiorespiratory arrest (module 3), anesthesia inhalation systems (module 4), ventilatory assistance (module 5), venous and inhalation anesthetics (module 6), neuromuscular blockers in anesthesiology (module 7) and neuraxial blocks (module 8). Each topic was taught in two subsequent classes, with a one-

week interval, so that the topics could be discussed in subgroups supervised by monitors who are part of the course coordination.

The Informed Consent Form (ICF) and the expectation questionnaire about the e-learning course were answered through the Google Forms platform (Google LLC, Mountain View, CA). At the end of the course, the satisfaction questionnaire was sent and answered by the students through the same platform. The personal assessment questionnaire was adapted from a previously applied questionnaire found in the literature[11]. The following items were graded by students on a scale from 1 (very low expectations / very dissatisfied) to 7 (very high expectations / very satisfied): course design, coordination, faculty and tutors, program schedule, available materials, work methodology, evaluation system, support services and technological infrastructure.

Each topic was discussed in two classes, the first being the theoretical content covered in an expository way and the other, discussions of clinical cases with stimulated interaction among the participants. The students were subdivided into six subgroups that had support from a monitor. Each subgroup held a virtual meeting between each module's classes to discuss and answer questions about the clinical cases to be discussed in the upcoming class. The evaluation of the impact of the classes took place through questionnaires with 10 questions. The pre-test questionnaire was made available 20 minutes before the first class of each module, aiming to assess the participants' previous level of knowledge. After the end of the module, the questionnaire was reapplied, aiming to assess whether there was significant progress in performance after the performed intervention.

The categorical variables were described by means of absolute frequency and relative percentage. Continuous variables were described using means, standard deviations, maximum and minimum values. The hypothesis of adherence of continuous variables to the normal intra-group distribution was tested using the Shapiro-Wilks test, which was not confirmed. Hence, the Wilcoxon test (two groups) was used to check the hypothesis of equality of central tendency measures. The adopted level of significance was 5% and the software "Statistical Package for the Social Sciences" - SPSS 22.0 was used for the statistical analysis.

One of the challenges faced during the research was that of encouraging students to stay in the course until the end, since some had family and friends affected by COVID-19, a delicate and difficult-to-handle situation. Another obstacle was the partial return of face-to-face classes, which made most of the students end up with a busy schedule, which we inferred to have been one of the factors responsible for the reduction in the number of questionnaires answered in the second half of the course. In addition, it should be noted that all preventive measures against SARS-COV 2 infection were taken, with no meetings or face-to-face classes taking place during the course.

RESULTS

Participants' profile

In general, 61 undergraduate medical students accepted to participate in the study and answered the questionnaires, with an overall response rate of 83.2% (8120 responses out of 9760 possible ones). Student participation was similar in terms of gender, with 52.46% female and 47.54% male participants. Most were aged between 20 and 25 years old (91.80%) and were in the fourth year of the undergraduate medical school (62.29%). Less than 20% of the participants were graduating from a rural campus and only 32.79% of students said they had chosen anesthesiology for their medical residency. Among the possible reasons for choosing to take a course with a distance learning methodology, the development and consolidation of knowledge was the criterion most often chosen by the participants (91.80%), followed by the development of skills for professional application (80,33%) and the space flexibility due to the lack of displacement (75.41%). The selection criteria that were least cited by the participants included curiosity about the operation of distance learning (24.59%), conciliation with professional life (26,23%) and conciliation with personal and family life (22.95%). Table 1 summarizes the social and demographic characteristics of the participants.

Questionnaires and learnership

Of the 61 participants, only 36 answered all 16 questionnaires related to the 8 modules of the course. All questionnaires applied after the classes in the respective module showed a significant increase ($p<0.05$) in the average of correct answers when compared to the answers obtained before the classes, as shown in Table 2 and in Graph 1. After adding the questionnaires applied before and after meeting with the students, 812 were filled out of a total of 976; there was a significant increase of 41.61% in the average of correct answers (3.94 vs. 5.57; $p <0.001$). When considering only the responses of the participants who completed all the questionnaires, it was observed that there was no difference in the increase of the average between the different modules of the course ($p >0.05$).

Expectation and satisfaction indexes

Table 3 and Graph 2 compare the responses of the participants regarding their expectations in relation to the course with the levels of satisfaction obtained at the end of the course. Out of the 61 participating students, 86.88% answered the quality assessment questionnaires. Only in variables 3

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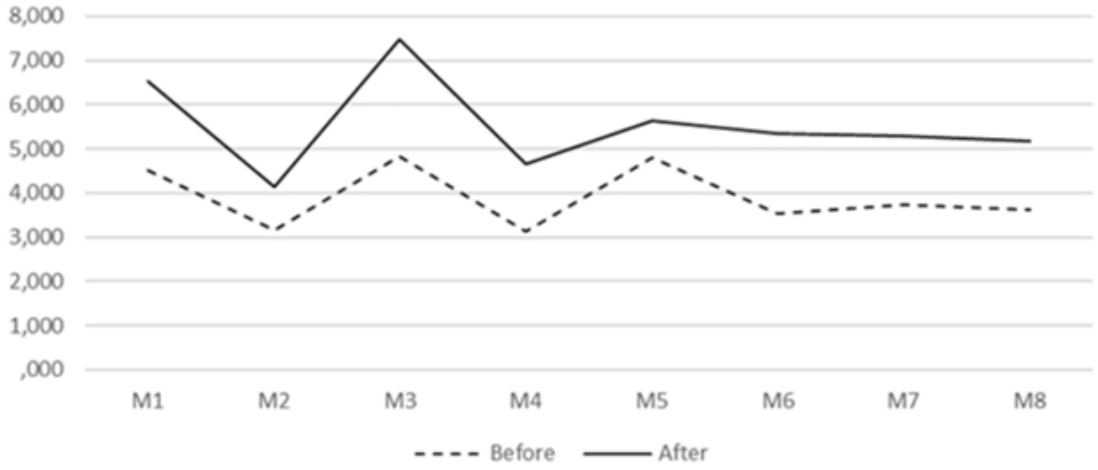
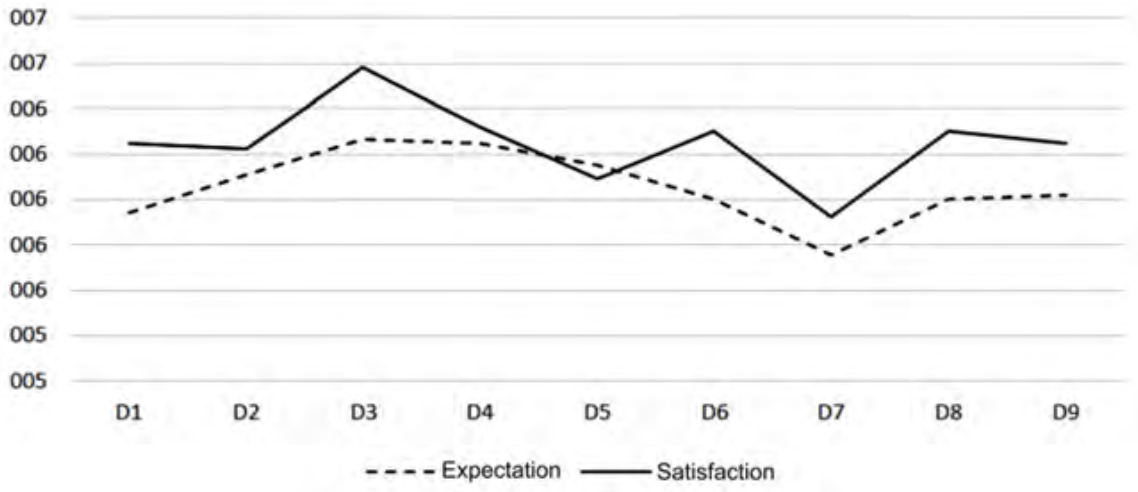
and 6, which analyzed the students and the methodology, respectively, there was a significant increase in satisfaction rates in relation to expectations (6.26 vs 6.58; 6.00 vs 6.30; p <0.05). Upon analyzing the variables individually, there was no significant decrease in the levels of satisfaction in relation to the expectations created before the beginning of the course. In general, satisfaction levels significantly exceeded the expectation levels (6.25 vs 6.05; p <0.001).

Graph 1. Comparison between the averages of tests performed before and after each module



Source: Research Data 2020

Graph 2. Graph illustrating the averages related to the students' expectation and satisfaction levels



Source: Research Data 2020

Table 1. Distribution of the students according to personal and sociodemographic variables

Variable	N	%
Sex		
Male	29	47.54
Female	32	52.46
Age range		
20-22	28	45.90
23-25	28	45.90
>25	5	8.20

Continues...

Table 1. Continuation

Variable	N	%
Semester		
6	1	1.64
7	23	37.70
8	15	24.59
9	15	24.59
10	5	8.20
11	2	3.28
Campus		
Urban	51	83.61
Rural	10	16.39
Considering anesthesiology as an option for residency		
Yes	20	32.79
No	41	67.21
Reasons why students choose to take the e-learning course		
Space flexibility	46	75.41
Time flexibility	37	60.66
Fitting with professional life	16	26.23
Knowledge development/consolidation	56	91.80
Developing skills to ally professionally	49	80.33
Appreciation and interest in the specialty	32	52.46
Fitting with personal/family life	14	22.95
Personal improvement	21	34.43
Profissional improvement	39	63.93
Expectations of advantagens in e-learning	20	32.79
Impossibility to attend in person	22	36.07
Cost reduction	22	36.07
Participation in a different learning experience	38	62.30
Curiosity about the operation of the e-learning	15	24.59
Autonomy in learning	34	55.74
Extra curricular certificate	34	55.74

Source: Research Data, 2020. Subtitles: N - absolute frequency. % - relative frequency.

Table 2. Comparison between the results of tests performed before and after each module

Modules		Mean Score		After: Before	P-value
		Before	After		
Module 1	N	61	61		
	Minimum	1	9		
	Maximum	2	10		
	Mean	4.50	6.54	1.45	<0.001
	Std. Deviation	1.66	1.94		

Continues...

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Table 2. Continuation

Modules		Mean Score		After: Before	P-value
		Before	After		
Module 2	N	59	59		
	Minimum	1	1		
	Maximum	7	8		
	Mean	3.16	4.15	1.31	0.001
	Std. Deviation	1.29	1.94		
Module 3	N	57	57		
	Minimum	1	10		
	Maximum	1	10		
	Mean	4.82	7.49	1.55	<0.001
	Std. Deviation	2.12	2.13		
Module 4	N	54	54		
	Minimum	1	1		
	Maximum	6	9		
	Mean	3.13	4.67	1.49	<0.001
	Std. Deviation	1.37	2.18		
Module 5	N	48	48		
	Minimum	1	2		
	Maximum	8	9		
	Mean	4.81	5.64	1.17	0.006
	Std. Deviation	1.39	2.09		
Module 6	N	46	46		
	Minimum	0	0		
	Maximum	7	g		
	Mean	3.54	5.35	1.51	<0.001
	Std. Deviation	1.54	2.28		
Module 7	N	45	45		
	Minimum	0	1		
	Maximum	7	10		
	Mean	3.73	5.29	1.42	<0.001
	Std. Deviation	1.51	2.46		
Module 8	N	36	36		
	Minimum	1	1		
	Maximum	7	8		
	Mean	3.61	5.17	1.43	<0.001
	Std. Deviation	1.69	1.76		
General	N	406	406		
	Minimum	0	0		
	Maximum	10	10		
	Mean	3.94	5.57	1.41	<0.001
	Std. Deviation	1.72	2.31		

Abbreviations: Std. Deviation - Standard Deviation. N - Number of tests performed. Wilcoxon's test.

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Table 3. Comparison between the levels of expectation and satisfaction of students regarding the e-learning course

Variables		Mean Score		Expectation: Satisfaction	P-value
		Expectation	Satisfaction		
Design	N	53	53	1.05	0.057
	Minimum	4	3		
	Maximum	7	7		
	Mean	5.94	6.24		
	Std. Deviation	0.95	0.94		
Coordination	N	53	53	1.02	0.418
	Minimum	4	4		
	Maximum	7	7		
	Mean	6.11	6.23		
	Std. Deviation	0.89	0.93		
Teacher and tutors	N	53	53	1.05	0.024
	Minimum	3	3		
	Maximum	7	7		
	Mean	6.26	6.58		
	Std. Deviation	0.96	0.82		
Program schedule	N	53	53	1.01	0.66
	Minimum	4	2		
	Maximum	7	7		
	Mean	6.24	6.32		
	Std. Deviation	0.83	1.01		
Materials	N	53	53	0.99	0.661
	Minimum	4	4		
	Maximum	7	7		
	Mean	6.15	6.09		
	Std. Deviation	0.82	1.00		
Methodology	N	53	53	1.05	0.039
	Minimum	4	3		
	Maximum	7	7		
	Mean	6.00	6.30		
	Std. Deviation	0.83	0.89		
Evaluation system	N	53	53	1.03	0.346
	Minimum	4	3		
	Maximum	7	7		
	Mean	5.75	5.92		
	Std. Deviation	1.00	1.09		
Support services	N	53	53	1.05	0.094
	Minimum	4	3		
	Maimum	7	7		
	Mean	6.00	6.30		
	Std. Deviation	0.98	0.99		

Continues...

Table 3. Continuation

Variables		Mean Score		Expectation: Satisfaction	P-value
		Expectation	Satisfaction		
Technological infrastructure	N	53	53	1.04	0.185
	Minimum	4	3		
	Maximum	7	7		
	Mean	6.02	6.24		
	Std. Deviation	0.86	0.94		
General	N	477	477	1.03	<0.001
	Minimum	3	2		
	Maximum	7	7		
	Mean	6.06	6.25		
	Std. Deviation	0.92	0.97		

Abbreviations: Std. Deviation - Standard Deviation. N - Number of responses. Wilcoxon's test.

DISCUSSION

As of February 2021, more than 2 million COVID-19 deaths have been recorded worldwide, with 110 million confirmed cases[12]. Even with the development of vaccines, several countries, including Brazil, have faced difficulties in acquiring and distributing the necessary doses to vaccinate the entire population[13]. In this scenario, several academic institutions persisted with an exclusively remote or hybrid teaching methodology, the latter consisting of face-to-face practical classes and theoretical classes conducted online[14]. To measure the applicability of this system, it is necessary to jointly assess the level of satisfaction and, consequently, adherence, as well as the impact on the participants' theoretical knowledge.

The students' adherence to the alternative teaching method and activities related to its methodology can be considered high, with an overall participation of 83.2%, represented by the answers obtained through questionnaires applied weekly. Of the 61 students enrolled in the course, 59.02% answered all questionnaires. Previous studies using questionnaires to assess knowledge acquisition during distance learning have shown a response rate between 41.18% and 65.3%[4,7,15].

Students' attendance can be linked to different variables. Low level of involvement, demotivation, limited flexibility, high levels of anxiety and stress, lack of self-discipline and poor interactions between students and facilitators can limit the learning and motivation process, reflecting the degree of participation throughout the project[16]. However, even with these factors, this study suggests that it is possible to have good student adherence and participation in distance learning conducted online.

When assessing the participants' improvement regarding the theoretical content approached through the e-learning method, a significant increase of 41.37% was found in the average of correct answers. A prospective study, in which an online course consisting of six sessions on Evidence-Based Medicine given to 84 students, was assessed by means of questionnaires before and after the completion of the exams showed similar results. Amongst the participants involved in the course, 48 answered both questionnaires and there was an increase of 57.14% in the average of the post-course questionnaire ($p < 0.001$)[7]. The methodological similarity between the present study and the aforementioned ones, as well as the equivalence in the good results obtained, allows the inference of the good effectiveness of the method. In Ethiopia, the teaching of anesthesiology by distance learning to residents was evaluated and obtained a significant increase in the overall average after the methodological intervention performed (54.5% vs 83.6%)[4]. This result is in line with that obtained in this study, and the content covered in both studies may have been responsible for this statistical similarity.

A longitudinal study, conducted in Brazil, sought to assess the increase in knowledge of residents of gynecology and obstetrics after taking an online course on sexuality during pregnancy. Tests were applied before and after the course and an increase of 36.36% ($p < 0.0001$) in the average of the participants was observed[15]. Thus, with the statistical similarity obtained between different studies with a similar methodology, it seems that the e-learning methodology for the teaching of theoretical medical content is effective.

When comparing these results to the traditional teaching method, medical students at King Abdulaziz University, in

Jeddah, Saudi Arabia, assessed that e-learning was able to replace classical learning on campus during the Covid-19 pandemic[17]. The uniform learning corroborates the success of this method and it can be satisfactorily added to the traditional form of teaching for medical students. When compared to each other, there was no difference between the increases in the averages of the different modules, suggesting that the proposed methodology took place uniformly throughout the course.

Regarding the participants' acceptance, the expectation questionnaire about the course applied before the start of classes had a general average of 6.05, out of a maximum of 7, and the satisfaction levels exceeded the expectation levels, obtaining an average of 6.25. In a study carried out in Jordan, the general satisfaction rate in medical distance education was 26.8%, it was also observed that this rate was significantly higher in students with previous experience in distance education during medical training and with the instructor's experiences and interactions[14].

In Colombia, aiming to increase the knowledge of pediatricians and pediatric residents on rheumatological disorders in children, a hybrid course was held, with four online modules and two face-to-face meetings. Of the 41 participants in the course, 90.24% completed all online modules and 80.48% attended the final face-to-face session, with 94% of the participants reporting they felt an increase in medical knowledge and skill after the course, whereas 88% said they were satisfied with the teaching strategy used[18]. The significant increase in the level of knowledge and the high levels of satisfaction, corresponding to that found in the present study, contribute to the definition of e-learning as an effective method for medical teaching, which can be used as a complementary tool for the optimization of the current model, with exclusively in-person classes.

CONCLUSION

The present study had distance theoretical anesthesiology teaching as its main focus and its results showed considerable knowledge gain on the part of the participants and good acceptance of the used method, corroborating other studies carried out around the world. Finally, this research was not intended to show the superiority of one method over another but rather to be used as a model to demonstrate the effectiveness of the use of different technologies to support the training of future doctors, even in periods of time when it is impossible to have regular face-to-face meetings, such as during the COVID-19 pandemic.

AUTHORS' CONTRIBUTION

Fabrício Dias Antunes: creator of the project and the course, taught the theoretical classes and directly supervised all stages of the process. Ricardo Euzébio Ribeiro Silva, Renan Santos Cavalcanti, Pablo Amércio Silva Lima, Iago Henrique Gomes Silva de Jesus, Wesley Gonçalves Nascimento Pereira and Mayra Souza Chagas: course coordinators responsible for managing one of the subgroups, preparing the questions, analyzing the results and writing of the article.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

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REFERENCES

1. Almarzooq ZI, Lopes M, Kochar A. Virtual Learning During the COVID-19 Pandemic: A Disruptive Technology in Graduate Medical Education. J Am Coll Cardiol. 2020 May 26;75(20):2635–8.
2. Kanneganti A, Sia C-H, Ashokka B, Ooi SBS. Continuing medical education during a pandemic: an academic institution's experience. Postgrad Med J. 2020 Jul;96(1137):384–6.
3. Bello G, Pennisi MA, Maviglia R, Maggiore SM, Bocci MG, Montini L, et al. Online vs live methods for teaching difficult airway management to anesthesiology residents. Intensive Care Med. 2005 Apr;31(4):547–52.
4. Patel KB, Dooley M, Abate A, Moll V. Distributed Learning: Revitalizing Anesthesiology Training in Resource-Limited Ethiopia. Front Public Health [Internet]. 2017 [cited 2021 Mar 19];5. Available from: https://www.frontiersin.org/articles/10.3389/fpubh.2017.00059/full
5. WHO | eLearning for undergraduate health professional education [Internet]. WHO. World Health Organization; [cited 2021 Mar 19]. Available from: https://www.who.int/hrh/documents/elearning_hwf/en/
6. E -learning during Covid 19 Pandemic. [Internet]. 2020 [cited 2021 Mar 19]. Availabe from: https://www.researchsquare.com
7. Sabouni A, Bdaiwi Y, Janoudi SL, Namous LO, Turk T, Alkhatib M, et al. Multiple strategy peer-taught evidence-based medicine course in a poor resource setting. BMC Med Educ. 2017 May 4;17(1):82-82.
8. Martinelli SM, Chen F, DiLorenzo AN, Mayer DC, Fairbanks S, Moran K, et al. Results of a Flipped Classroom Teaching Approach in Anesthesiology Residents. J Grad Med Educ. 2017 Aug;9(4):485–90.
9. Lombarts KMJMH, Bucx MJL, Arah OA. Development of a System for the Evaluation of the Teaching Qualities of Anesthesiology Faculty. Anesthesiology. 2009 Oct 1º;111(4):709–16.
10. Maloney S, Nicklen P, Rivers G, Foo J, Ooi YY, Reeves S, et al. A Cost-Effectiveness Analysis of Blended Versus Face-to-Face Delivery of Evidence-Based Medicine to Medical Students. J Med Internet Res. 2015 Jul 21;17(7):e182.
11. Lemos S, Pedro N. Expectativas e satisfação dos estudantes em cursos em E-learning no ensino pós-graduado. ETD - Educ Temática Digit. 2013 Mar 28;15(1):107–26.
12. Dong E, Du H, Gardner L. An interactive web-based dashboard to track COVID-19 in real time. Lancet Infect Dis. 2020 May;20(5):533-4.
13. Mills MC, Salisbury D. The challenges of distributing COVID-19 vaccinations. EClinicalMedicine [Internet]. 2021 Jan 1º [cited 2021 Mar 19];31. Available from: https://www.thelancet.com/journals/eclinm/article/PIIS2589-5370(20)30418-1/abstract.
14. Al-Balas M, Al-Balas HI, Jaber HM, Obeidat K, Al-Balas H, Aborajooh EA, et al. Distance learning in clinical medical education amid COVID-19 pandemic in Jordan: current situation, challenges, and perspectives. BMC Med Educ. 2020 Oct 2;20(1):341.

15. Vieira TCSB, Nakamura MU, Silva I, Torloni MR, Ribeiro MC, Souza E. Distance Education Course about Sexuality for Obstetrics and Gynecology Residents. Rev. Bras. Ginecol. Obstet. 2017 Dec;39(12):670-675.

16. Regmi K, Jones L. A systematic review of the factors – enablers and barriers – affecting e-learning in health sciences education. BMC Med Educ. 2020 Mar 30;20(1):91.

17. Ibrahim NK, Al Raddadi R, AlDarmasi M, Al Ghamdi A, Gaddoury M, AlBar HM, et al. Medical students' acceptance and perceptions of e-learning during the Covid-19 closure time in King Abdulaziz University, Jeddah. J Infect Public Health. 2021;17–23.

18. Pino S, Mora C, Diaz A, Guarnizo P, Jaimes D. Improving skills in pediatric rheumatology in Colombia: a combined educational strategy supported by ILAR. Clin Rheumatol. 2017 Jul 1º;36(7):1631–5.