First Implementation of a Point Of Care Ultrasound Course In Undergraduate Medical Students In Peru: Mixed Methods Study

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Abstract

Background: Point-of-care ultrasound (POCUS) is a study performed by any physician, as an adjunct to a physical examination, to identify the presence or absence of specific findings in medical pathologies. This skill is not yet taught in undergraduate medical studies in Peru.

Objective: This study aims to describe and evaluate the implementation of a point-of-care ultrasound (POCUS) course in undergraduate medical students.

Methods: Pre-experimental study. A theoretical and practical POCUS course was designed and implemented for fifth year medical students at the Universidad Peruana Cayetano Heredia, Lima Peru in late 2019 and early 2020. Prior knowledge was assessed through a pretest. At the end of the course, a posttest was administered to quantify learning achievement, and satisfaction was assessed with a survey.

Results: Twenty-six students (57.7% women) participated in the course, although only 19 took the posttest. The average scores in the pretest (at the beginning of the course), posttest, and pretest (at the end of the course) were 4.3, 12.2, and 18.5 points, respectively ($p < 0.001$). Only 15 students responded to the satisfaction survey, where more than 50% of them reported having fully acquired the skill of evaluating the inferior vena cava, bladder, free thoracic and abdominal fluid, and the right kidney. They also reported that they met 97.5% of their previous expectations.

Conclusions: A short theoretical-practical POCUS course for undergraduate medical students was able to achieve a significant improvement in the recognition of some abdominal and pelvic organs and anatomical structures using ultrasound.

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Original Paper

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Keywords:

pocus (point of care ultrasound); teaching in emergency medicine; emergency and trauma radiology;

medical student training; medical education curriculum;

Ultrasonography; Diagnostic Imaging; Curriculum; Short-Term Courses;

INTRODUCTION

Ultrasonography (US) is a noninvasive, portable, cost-effective, accurate, safe, efficient, and widely used clinical diagnostic tool [1], with few contraindications and adverse effects. Furthermore, ultrasound equipment is increasingly available to many physicians in the emergency and hospitalization departments of various hospitals in Peru and around the world.

Point-of-care US, or Point-of-care Ultrasonography (POCUS), unlike a routine diagnostic US study performed by radiologists and ultrasound technologists, answers a clinical question posed by surgeons [2], emergency physicians [3], family physicians [4], and, in general, by any physician who treats a patient's health problem using this procedure to solve it. POCUS is defined as a US study provided and performed by the patient's primary care physician, usually as an adjunct to the physical examination, to identify the presence or absence of a limited number of specific findings [5]. It has some synonyms such as clinical ultrasound, bedside US, or focused US [6].

As early as 2014, the American Academy of Emergency Medicine [7] stated that "*ultrasound should be integrated into the undergraduate medical education curriculum*". It even mentioned that there are numerous forms of introduction (teaching anatomy, physiology, physical examination and procedures) and learning modalities, with four that report the best results: learning on "live" models rather than on simulators; e-learning based on cases or self-directed "podcasts" rather than lecture-based presentations; peer-to-peer practice rather than practice with the student "alone," and a doctor-patient role-play model where they learn by participating as simulated patients [7]. However, to date, the skill of performing US studies is only taught in postgraduate programs and only in some medical specialties, and its teaching is not explicitly included in undergraduate programs at the main medical

schools in Peru [8]. In their pilot study, Syrpeda et al. [1] reported the teaching-learning of some skills and techniques for performing ultrasound in a small group of second-year medical students in practical sessions of 2 hours per week, promoting self-learning with minimal teaching guidance on the subject and achieving adequate levels of competence in obtaining and interpreting some ultrasound images.

Therefore, we believe it is necessary to introduce ultrasound teaching in the undergraduate medical programs at our universities. This will also improve the learning of certain subjects, such as anatomy and physiology, and certain skills and abilities, such as physical examination and diagnostic planning. Then, the objective of this research was to describe and evaluate the implementation of a POCUS course in a group of undergraduate medical students.

METHODS

A pre-experimental, quantitative, and qualitative study was conducted. Students enrolled in their fifth year of medical school at the Universidad Peruana Cayetano Heredia (UPCH) Faculty of Medicine in 2019 were included. The sample consisted of those who voluntarily agreed to take the course through an invitation sent via institutional e-mail. Students who started but did not fully complete the course, as well as those who had already received formal training in POCUS, were excluded.

Definitions

a. POCUS knowledge: This was measured with two assessments designed exclusively for this course, each with 10 questions. A pretest included five theoretical questions and five questions on ultrasound image analysis. A posttest included 10 questions, all for image analysis different from those used in the pretest. Each test had a minimum score of zero and a maximum of 20 (twenty).
b. Perception of achievement of skill in performing POCUS studies: The students were asked about

their perception of having achieved the ability to perform a POCUS study on a patient, and this was explored as a perceived percentage from 0% to 100%.

c. Satisfaction with the POCUS course: To evaluate the impact on educational training at level 1 of the Kirkpatrick model [9], a satisfaction survey was conducted at the end of the course that evaluated the perceived percentage of usefulness of the course and some of its characteristics.

Procedures and techniques

A three-week theoretical and practical course was designed from scratch to teach the skills of using US equipment to perform POCUS studies in adults, identifying some images of importance in the teaching and learning of medicine. The course was held between October 2019 and February 2020.

The theoretical part of the course was carried out exclusively through the individual reading of certain chapters of the ultrasound manual by García and Torres [10], gallbladder, common bile duct, liver, kidneys, bladder, abdominal aorta, portal vein, inferior vena cava and the eFAST (extended Focused Abdominal Sonography for Trauma) study. Explicit learning objectives were drafted and sent via e-mail to the students prior to the practical sessions (Annex 1 in Multimedia Appendix). To ensure the reading of the bibliography, they were given a virtual formative pretest on the learning objectives prior to each practice, whose score was not taken into account for this research.

The practical part was in-person and led by the principal investigator, an internist trained in POCUS and with more than 10 years of experience at the time performing general ultrasound studies then. Groups of three or four students were formed based on affinity chosen by the students. The practical sessions were carried out in 3 sessions of two hours each, during which the students performed ultrasounds based on what they had read the previous week. For these in-person practical sessions, each student alternated as "patients" (those who underwent the ultrasound) and "sonographers" (those who performed the ultrasound), similar to that reported by Syrpeda et al. [1] to learn normal images.

Each group consisted of exclusively female or male students.

The researcher first performed each ultrasound study on a volunteer student at the beginning of each session to demonstrate what would be done in practice to the other students. This also served as a role model for each student, so they could later perform the same actions and maneuvers as the researcher, locating all the structures that were the subject of study in each session. The roles of sonographer and patient alternated between each student. The researcher was at the student's side at all times and guided them in the use of the transducer or corrected certain maneuvers, if necessary. The student had to show and point to each organ to determine that the practice was performed adequately. Each group had four practice sessions throughout the course.

The US equipment used in the course was the SonoAceR3 model from the Samsung® brand, available in the internal medicine hospitalization ward 1-II of the Hospital Nacional Arzobispo Loayza (HNAL), and a 3.5 MHz convex type transducer and a 7.5 MHz linear type transducer were used, depending on the type of study performed. All course materials, notices and communications were distributed through the Edmodo virtual classroom [11], freely accessible on the web until 2022. In this classroom, there was an opportunity for question and answer forums in case of any questions students had about what they were reading.

To determine students' prior knowledge, an *ad hoc* pretest was designed with ten theoretical and image analysis questions, the answers to which were provided for development and/or justification (Annex 2 in Multimedia Appendix). Multiple-choice questions were not used to eliminate the possibility of guessing, in case the student did not know or recognized what they were observing in the image being asked. If the student did not know the answer, they left it blank or wrote "I don't know." The same pretest was also administered to the participating students to measure knowledge retention one week after completing the course.

To measure the achievement of learning objectives at the end of the course, a separate post-test was designed (Annex 3 in Multimedia Appendix) with ten short-answer questions. These questions only

assessed the analysis and recognition of ultrasound images and were completely different from those used in the initial pre-test. Both the pre-test and post-test were completed asynchronously by students online using Google Forms®. The same researcher graded all pre- and post-tests using a checklist. The maximum score for each test was 20 points.

Likewise, after completing the post-test, students were sent a satisfaction survey (Annex 4 in Multimedia Appendix) to complete through the SurveyMonkey® platform. This survey assessed their overall perception of the course's usefulness, and asked them to provide a score from 1 to 10, which was then stratified as follows: essential (9-10 points), very useful (6-8 points), not very useful (1-5 points), and not at all useful (0 points). Their perception of acquiring different US skills was also assessed, and they were asked to provide a score from 0% to 100%, which was stratified as follows: full capacity (100%), good capacity (51-99%), low capacity (1-50%), and no capacity (0%). Open opinions about the course were also requested, which are presented as written on the form.

Statistical analysis plan

A descriptive analysis was performed by obtaining the absolute and relative frequencies of the qualitative and quantitative variables. The scores obtained in the pretest and posttest were subjected to calculation of means with standard deviation and then compared using the Student t test. To evaluate the differences between pretest and posttest, the Wilcoxon test for related samples was used. A p value ≤ 0.05 was considered significant. Some questions that required opinions are shown verbatim in quotation marks, but opinions that were repeated or only related to the specific content of the course were not included. Excel 2021 for Windows® was used for tabulation and descriptive analysis of the data.

Ethical aspects of the study

Students authorized their participation by responding positively to the course via e-mail and by signing an informed consent form. The students' privacy and comfort were respected by using an office with adequate ventilation and lighting, consisting only of the students in groups of two, three, or four people and the researcher. A stretcher and bedding were used to cover the body parts not subjected to ultrasound examination. No harm was caused to any of the study participants, as this is an educational intervention.

This study was conducted after receiving approval from the Integrated Research, Science, and Technology Management Unit of the Faculties of Medicine, Dentistry, and Nursing, and from the Institutional Research Ethics Committee of the Universidad Peruana Cayetano Heredia (CIEI-UPCH), under certificate 480-20-19 of August 27, 2019.

RESULTS

Quantitative Results

An invitation to participate in the study was sent to 81 students, 34 enrolled, but only 26 (57.7% women) started and completed the course. The mean (SD) age of these students was 22.2 (0.8) years. The 26 students took the pretest before the start of the course, with a mean (SD) score of 4.3 (2.2) points out of a maximum of 20, but only 19 (73%) students took the posttest at the end of the course. In the latter, the mean (SD) score was 12.2 (3.3) points, but the average score they obtained when taking the same initial pretest again was 18.5 (1.6) points. The differences between these last two scores and those of the pretest at the beginning of the course were statistically significant (Table 1).

Table 1: Pretest and posttest notes from medical students, Universidad Peruana Cayetano Heredia, October 2019 - February 2020 (n=19).

Student	Pretest score basal	Pretest score at the end of the course [a]	Posttest score [b]
E1	5	17	13.5
E2	5	18.5	13.5
E3	3	20	12.5
E4	4.5	15	7.5
E5	6.5	16	12
E6	4	19	18
E7	6.5	20	15.5
E8	7.5	16	11.5
E9	4.5	19	16.7
E10	0	18	7.5
E11	5.5	19.5	10.5
E12	3	20	10
E13	7	19.5	13
E14	9	18.5	10.5
E15	4	19	12.7
E16	4.5	20	18
E17	2.5	17	9.5
E18	7.5	19	7
E19	2	20	12
Mean qualification (SD)	4.8 (2.2)	18.5 (1.6)	12.2 (3.3)

(a) $P < .001$ compared to the baseline pretest
(b) $P < .001$ compared to the baseline pretest

Qualitative Results

The course satisfaction survey was completed by only 15 students (57.7% response rate), who reported that they met 97.5% of their prior expectations (range: 90-100%). Regarding their perception of acquiring the skills taught in the course, more than 50% of students reported that, upon completing the course, they had fully acquired four skills: assessing the size of the inferior vena cava, the volume and characteristics of the bladder, detecting free thoracic and abdominal fluid, and assessing the size and characteristics of the right kidney. The remaining skills obtained lower percentages (Table 2).

Table 2: Perception of acquisition of the skills taught in the course reported by medical students, Universidad Peruana Cayetano Heredia, October 2019 - February 2020 (n=15)**.**

Perceived ability to evaluate each item	None or Little		Good		Complete		Total	
	n	%	n	%	n	%	n	%
Size of the inferior vena cava in the study of a patient with hypotension	1	6.7	4	26.7	10	66.7	15	100
Bladder volume and characteristics	1	6.7	5	33.3	9	60.0	15	100
Free thoracic fluid	1	6.7	6	40.0	8	53.3	15	100
Free abdominal fluid	0	0.0	7	46.7	8	53.3	15	100
Size and characteristics of the right kidney	0	0.0	7	46.7	8	53.3	15	100
Pelvic free fluid	1	6.7	7	46.7	7	46.7	15	100
Free pericardial fluid	1	6.7	7	46.7	7	46.7	15	100
Size and characteristics of the left kidney	0	0.0	8	53.3	7	46.7	15	100
Portal vein size	1	6.7	7	46.7	7	46.7	15	100
Size and characteristics of the abdominal aorta	1	6.7	7	46.7	7	46.7	15	100
Size and characteristics of the spleen	0	0.0	10	66.7	5	33.3	15	100
Size of the common bile duct	2	13.3	8	53.3	5	33.3	15	100
Size and characteristics of the gallbladder	1	6.7	9	60.0	5	33.3	15	100
Size and characteristics of the liver	1	6.7	10	66.7	4	26.7	15	100

Likewise, students considered the different aspects of the course to be very useful, especially the methodology, the practices and the instructor (Table 3). Among the best aspects that students found in the course, they highlighted aspects such as: putting theory into practice, learning how to use the US equipment and having few students per group (Table 4). Opinions of improvement were mainly related to more practice time and performing ultrasounds on real patients with pathologies (Table 5).

Table 3: Perception of the usefulness of the course and its materials reported by medical students, Universidad Peruana Cayetano Heredia, October 2019 - February 2020 (n=15)**.**

Perceived usefulness of…	Not very useful		Very useful		Essential	
	n	%	n	%	n	%
Course teacher	0	0.0	0	0.0	15	100.0
Practice with the	0	0.0	0	0.0	15	100.0

ultrasound scanner						
Course methodology	0	0.0	1	6.7	14	93.3
Learning objectives	0	0.0	2	13.3	13	86.7
Course manual	0	0.0	2	13.3	13	86.7
Course pretest	0	0.0	3	20.0	12	80.0
Course posttest	1	6.7	3	20.0	11	73.3
Virtual classroom	1	6.7	3	20.0	11	73.3
Course time	1	6.7	5	33.3	9	60.0

Table 4: Textual responses to the question: "Describe the best thing about the ultrasound course you took." from some medical students, Universidad Peruana Cayetano Heredia, October 2019 - February 2020.

Student [a]	Opinions
E1	"Learning how to use the machine, performing ultrasounds with my classmates, and seeing my organs."
E2	"Using the ultrasound machine for the first time in my career, patiently and in a small group, gave me enough confidence to do the practice well."
E3	"The content of the information is very accurate."
E4	"Precise time for practice"
E5	"To practice among ourselves and be able to see what's normal."
E7	"Put into practice what we had theoretically read"
E8	"Learning to perform focused questions"
E10	"Each chapter had specific objectives to accomplish"
E11	"The teacher who always strives to ensure we effectively learn the basic concepts necessary for our careers, in addition to conveying knowledge well and seeking alternative learning methods, such as using a virtual classroom"
E11	"To practice with the ultrasound machine among students allowed us to learn what an ultrasound machine looks like and how to use it, as well as to recognize anatomically normal, disease-free structures"
E13	"Put into practice what you learned from the manual"
E14	"Few students in each learning session"
E14	"Do the practice based on clinical cases"

(a) Some students wrote more than one different opinion. Others didn't write any opinions at all.

Table 5: Textual responses to the question: "Describe suggestions you consider to improve learning in the ultrasound course you took" from some medical students, Universidad Peruana Cayetano Heredia, October 2019 - February 2020.

Student [a]	Suggestions for improvement
E1	"More topics"
E2	"When we couldn't find a position for the ultrasound during practice, sometimes the doctor would help us guide the ultrasound, but even then, I often felt like I didn't know where it was pointing. It would have also helped to hear an anatomical reference or a verbal tip on how to locate it at that moment to remind me where to look."
E2	"Shorten the time between practices. A consistent week-to-week rhythm of these practices would seem ideal to consolidate knowledge and practice with the ultrasound"
E2	"See cases of pathologies"
E3	"More practice time"
E4	"Clinical cases in each practice, including echocardiographic studies"
E5	"It would be possible to see pathologies in real patients using ultrasound"
E7	"Having the opportunity to perform ultrasound on real patients"
E7	"Conduct more sessions on other uses of ultrasound"
E8	"Perhaps we could also practice it on a patient with a pathology related to the corresponding topic"
E9	"I think one more session would be beneficial so as not to cover so many topics in the second session"
E11	"With regard to the learning objectives, perhaps it would have been more appropriate to also mention that we review topics such as cases of biliary colic, hypotensive patients, or some cases that were seen in the pretest, because although we should have that knowledge from our previous years, it would have been important to mention them so that students could review and have an idea of how to relate the ultrasound manual to clinical aspects"
E11	"Although the central theme of the course is learning how to use ultrasound and asking focused questions, it would have been more interesting to have given us more examples so that we could ask more focused questions, because otherwise the course would only focus on learning ultrasound, but not POCUS, which would involve seeing patients or identifying pathological findings"
E11	"Time will always be a difficulty that is not necessarily the fault of the students or the teacher"

E12	"I wish I could have more days to practice"
E14	"Maybe I can practice with a patient with a certain pathology after having practiced"
E15	"I would like to be able to practice on patients with pathology"

(a) Some students wrote more than one different suggestion. Others didn't write any opinions at all.

DISCUSSION

Principal Findings

Although by 2023, 18 of 53 (31%) medical schools in the European Union [12] and, by 2020, 56 of 122 (56%) undergraduate medical schools in North America and other countries included POCUS instruction in their curricula, only 3 were from South America, specifically Brazil [13]. The theoretical and practical course that was the subject of our study was conducted between October 2019 and January 2020, at a time when there was little or no experience with the use of POCUS as a learning methodology in undergraduate medical studies in Peru [8]. Its design and subsequent application in a group of volunteer students before entering their pre-professional internships in hospitals showed favorable results, both in learning how to use ultrasound equipment and in knowledge of theoretical aspects and recognition of normal images in ultrasound studies, in some aspects of human medicine. This was reflected in the results of the post-course evaluation, which showed significant differences with those of the pre-course evaluation, indicating adequate acquisition of the knowledge and skills taught.

Our course was created from scratch following the six Kern steps described by Rivera Mercado et al. [14], using the previous information we obtained on the learning needs on the subject in medical students in 2018 [8]. The contents and learning objectives of our course partially coincide with those used in a medical school in a rural area of Idaho, United States in 2022 [15], and, although the latter was implemented in first-year medical students and had a longer duration than ours, it also demonstrated a significant increase in POCUS knowledge in them. Meanwhile, in 2023, POCUS was

taught from the first to the sixth year of medical school and was mandatory in some institutions in the European Union. In some of them it was even carried out longitudinally for several years, although in others it was transversal teaching in subjects such as anatomy, cardiology, gastroenterology or pulmonology [12].

Comparison With Prior Work

In our study, the majority of students perceived that they had fully acquired skills in assessing the inferior vena cava and bladder, as well as in detecting pleural and ascitic fluid, and the right kidney, after taking our course. A 2023 study from Saudi Arabia similarly reported that most final-year medical students perceived that they had acquired adequate skills in detecting free abdominal fluid, hepatomegaly, deep vein thrombosis, and thyroid masses, but at least 31.5% of them had received some prior POCUS training at their faculty [16]. Meanwhile, in 2021 and 2022, another theoretical and practical course for second-year medical students also reported full acquisition of skills in assessing the liver and right kidney, Morrison space, the subxiphoid and long parasternal views of the heart, and the pleural line in Indianapolis, USA [17]. However, in the latter study, almost 40% of students also had some prior experience with POCUS. In our study, all students reported that they started their ultrasound training from scratch, although as students who were completing their fifth year of studies, they may have been able to use their prior knowledge of anatomy and physiology to improve their learning.

On the other hand, a study conducted in Germany at the same time as ours also demonstrated a significant improvement in learning after a POCUS course, focusing on the liver, gallbladder, spleen, kidney, pancreas, urinary bladder, and spaces to evaluate free fluid or pleural effusion, but also on the thyroid and vascular structures, in fourth and fifth year medical students [18]. On the other hand, good learning in the evaluation of the spleen, right kidney, and urinary bladder was also observed in

another study, which was even conducted with instructors who were peer students with experience in ultrasound, and these skills could be maintained for up to 4 months after instruction of only one day of theory and one day of practice at different times [19].

Student expectations for our course were met in over 97% of cases, likely due to the predominance of hands-on practice and small-group teaching, which is consistent with other similar studies [15,20,21]. The main objectives of this course were even captured by two students, who stated: "*Practice with the ultrasound system among students allowed us to learn what an ultrasound system looks like and how to use it, and also to recognize anatomically normal, disease-free structures*" and "*Using the ultrasound system for the first time in my career with patience and in a small group of people gave me enough confidence to do the practice properly*". This improvement in the safety of ultrasound use has also been reported by other authors in Germany, Canada, and Poland, even with only one day of POCUS instruction [22-24].

However, there were still areas for improvement in our course, such as the ability to perform ultrasound studies on patients with pathologies and, specially, to have more hands-on time with the US equipment, as reported in other studies [22,23]. All of the suggestions for improvement could be achieved in the future by having more teachers trained in POCUS and US equipment, if its teaching can be implemented in undergraduate programs and funding and logistical support can be obtained. In fact, in other countries, the use of peer-to-peer teaching as POCUS instructors has been proposed [19,21,25], as well as low- and high-fidelity simulation strategies, with several advantages of each, which could even complement each other to contribute to or develop other skills, such as developing empathy, communication, teamwork, among others [26]. The most important thing, regardless of the length of this course or its future voluntary or mandatory implementation in the medical program, is that after learning these skills, each student continues to use POCUS in every area of the rest of their undergraduate program and their future career.

Limitations

We group the *limitations* of our study into 2 types. First, related to the development of the course itself, as the number of students who completed the course was lower than initially expected when the call was realised. This could be due to the fact that they were taking regular university courses they had to pass at that time and were unable to participate or complete the entire course. Other students had to travel abroad at the end of 2019, despite initially enrolling. Another limitation was that the students voluntarily enrolled in the POCUS course, which could have positively influenced the learning of new concepts as they were highly motivated to learn. The second type of limitation is related to the assessment methods. On the one hand, learning was measured with image recognition and knowledge tests shortly after the course was completed. A post-assessment assessment several months after the course ended was not possible due to circumstances arising from the COVID-19 pandemic. In current times, post-practice assessments may be necessary, as skills and knowledge learned in the course may be forgotten if they are not continued. Furthermore, there was neither the time nor resources to design and implement practical assessments to determine the acquisition of operational skills in using ultrasound equipment and transducer management to obtain images of the organs to be evaluated. Further research may also include third level assessments of the Miller pyramid, such as objective structured clinical evaluations (OSCE), which are performed in other countries to enable students to "show how" they perform the ultrasound study [27]. Rubrics may even be used to review video clips of the same students performing an ultrasound examination, with subsequent feedback [15] or direct observation of procedural skills [22,26].

Some interesting aspects of the implemented POCUS course

Among the *positive aspects* of our research is that real patients were not required for the practices; instead, students were able to perform the US studies on each other. This may have created a more comfortable learning environment than in a hospital setting or in a healthcare facility's office with

real patients. Furthermore, although many medical schools in other countries include POCUS from the first year of the degree in anatomy, physiology, or physical examination courses [13], our study was conducted prior to students' pre-professional practices, when they had already taken medical clinical courses. This may have positively influenced the learning of POCUS skills by utilizing some prior knowledge of anatomy and physiology. However, over time, it could be implemented earlier in the degree program when some of the barriers already described, such as the lack of trained faculty, lack of space in the current curriculum, or lack of ultrasound equipment, can be overcome [13]. Another positive and different aspect of our study worth mentioning is that, unlike almost all studies on POCUS teaching in medical undergraduate programs, we conducted assessments with short-answer, open-ended, or expanded-choice questions. By not using multiple-choice questions in our course assessments, we reduced the possibility of students guessing the answer by "recognizing" the correct answer rather than recalling or generating it, or of using exam strategies to "rule out incorrect alternatives" without requiring in-depth knowledge of the subject [28]. Several authors have described and demonstrated that short-answer questions have similar reliability and discrimination as multiple-choice questions [28-30]. A final positive point was that we assessed ultrasound image interpretation more than theoretical aspects of the subject, which is required for proficiency in medical ultrasound and which had been included by other authors [20,26]. This could indicate that students have effectively mastered the acquisition modality of some ultrasound images.

Conclusions

Our theoretical and practical POCUS course, conducted in small groups with fifth-year medical students, demonstrated significant improvement in the recognition of some organs and anatomical structures using ultrasound. Furthermore, the students who participated in the course found the skill of performing POCUS very useful in identifying and interpreting some normal abdominal and pelvic

anatomy findings using ultrasound. Therefore, we suggest that it can be progressively implemented in undergraduate medical programs in Peru, as it already exists in other countries.

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Conflicts of Interest

None reported.

Ethical approval

This study received ethical approval from the Integrated Research, Science, and Technology Management Unit of the Faculties of Medicine, Dentistry, and Nursing, and from the Institutional Research Ethics Committee of the Universidad Peruana Cayetano Heredia (CIEI-UPCH), under certificate 480-20-19 of August 27, 2019.

Abbreviations

POCUS: Point-of-care ultrasound

Multimedia Appendix

Course design and tests.

PDF File , 1.9 KB

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Supplementary Files

Multimedia Appendixes

Course design and tests.
URL: http://asset.jmir.pub/assets/d5e252f39341fe7243837478cff2da19.pdf