

Short Communication

Web-Based Obstetrical Ultrasound Curriculum Tested by Medical Students in Spain: A Pilot Study

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Abstract

Background: Medical education continues to face challenges particularly with the increased need for high quality accessible curricula delivered in a time effective manner. The purpose of the study was to assess feasibility and student learning with a web-based training program in ultrasound for limited obstetrics and gynecology. **Methods:** We created a six-module E-learning program (5 didactic modules and 1 biometry module) that contains quizzes and interactive labs, designed to complement an in-class lecture. Medical students were evaluated with a pre- and post-test. A web-based ultrasound curriculum was delivered to 27 fourth and fifth year Spanish medical students with English fluency at a university in Spain during a maternal-fetal medicine elective course from September 16–23, 2019. **Results:** Twenty-six students were able to demonstrate pre- and post-test score improvement following the web-based ultrasound education (median test score 160 pre vs. 290 post). A web-based ultrasound curriculum can be effective at increasing students' knowledge of ultrasound material, while saving in person instructional time for other materials. Students enrolled in this course demonstrated exemplary dedication to learning on their own time outside of the classroom. This opportunity freed up lecture time to cover other material. **Conclusions:** Web-based ultrasound curriculum provides a valid model in adapting remote education for medical training.

Keywords: E-learning; obstetrics and gynecology medical education; ultrasound curriculum; web-based curricula

1. Introduction

Traditionally, ultrasound training has occurred in clinical sessions with live patients and impacts almost every branch of medicine including internal medicine subspecialties (i.e., endocrine, gastrointestinal, renal), pediatrics, surgery, orthopedics, cardiovascular surgery, urology, ear, nose and throat (ENT), ophthalmology, family medicine, and obstetrics and gynecology. The competing pressures of service delivery, increase in quality standards, and limited access to patients especially during COVID, have hindered opportunities for this training. While ultrasonography is a key skill for obstetricians and gynecologists for comprehensive clinical assessments often in urgent conditions in labor and delivery and the emergency room, without a standard ultrasound curriculum across medical schools, there is variability in ultrasound skills that medical students bring to residency programs [1].

This variability in training continues in residency. Alrahmani *et al.* [2] reported from a survey from 93 obstetrics and gynecology (OB/GYN) programs, 23% of residents did not have any ultrasound-related didactics. Tolsgaard *et al.* [3] reported that trainees in OB/GYN have concerns regarding their confidence in performing ultrasound. Educators

are constantly challenged to find methods to effectively train residents and medical students over a longitudinal experience without sacrificing quality. New technologies and web-based sources have opened novel educational applications in medical practice [4].

To help solve this problem, we drew on previous success with one of the first comprehensive programs available for OB/GYN ultrasound training [5], and designed one that was web-based. It has a curriculum based on the learning guidelines set forth by the American Academy of Family Physicians and other governing bodies of OB/GYN education [6–9]. With five didactic modules and a sixth module in fetal biometry, it provides simulation training. We utilized this curriculum with Spanish medical students fluent in English to demonstrate student learning.

2. Material and Methods

2.1 Setting and Participants

Inclusion criteria were fourth- and fifth-year medical students fluent in English who voluntarily enrolled in a maternal-fetal medicine summer program at a university in Spain, September 16–23, 2019. Students who did not



Table 1. Pre-and post-test item analysis.

Question number	Pre-Test		Post-Test	
	Item difficulty index	Item discrimination index	Item difficulty index	Item discrimination index
1	0.03	0.67	0.86	0.27
2	0.01	0.30	0.45	0.10
3	0.03	0.74	1.00	0.00
4	0.02	0.44	0.97	0.07
5	0.01	0.37	0.97	0.07
6	0.02	0.44	0.97	-0.07
7	0.01	0.37	0.93	0.13
8	0.03	0.67	1.00	0.00
9	0.02	0.52	1.00	0.00
10	0.00	0.07	1.00	0.00
11	0.02	0.60	0.97	0.07
12	0.02	0.60	0.93	0.13
13	0.02	0.60	0.90	-0.08
14	0.01	0.22	0.97	0.07
15	0.01	0.22	0.97	0.07
16	0.02	0.52	0.97	0.07
17	0.00	0.07	0.97	0.07
18	0.02	0.44	0.76	0.47
19	0.02	0.44	0.97	0.07
20	0.03	0.81	0.83	0.33
21	0.02	0.44	0.97	0.07
22	0.01	0.30	0.97	0.07
23	0.03	0.74	0.97	0.07
24	0.02	0.59	1.00	0.00
25	0.02	0.52	1.00	0.00
26	0.03	0.67	1.00	0.00
27	0.03	0.81	1.00	0.00
28	0.03	0.67	1.00	0.00
29	0.01	0.37	1.00	0.00
30	0.02	0.52	1.00	0.00

complete the pre-or post-test and any students with prior ultrasound training or experience were excluded.

2.2 Interventions

The students were given access to the on-line course to complete in their free time. Modules 1–5 were didactic with ultrasound pictures to demonstrate the learning. Module 6 was a biometry module with images to measure simple crown rump length, femur length, biparietal diameter/head circumference (BPD/HC), and abdominal circumference (AC).

2.3 Outcomes Measured

Prior to engaging in the web-based curriculum, each learner (student) and his/her results were recorded as a pre-test. **Supplementary File 1** provides these pre-test questions. Included in each of the 5 didactic modules was a post-test that required a pass rate of 7 out of 10 questions (70%) **Supplementary File 2** provides the post-test questions. Each test was 30 questions with a possible score of

300. These post-tests were scored, including number of attempts to pass each module and raw percentage of correct scores. This allowed study staff to assess effects of education on student performance. Interactive measurements (real time measurement of static images) of fetal biometry in module 6 provided simulations to develop basic skill in ultrasound performance and interpretation. This hands-on experience was invaluable for students to practice and improve their skills. Number of attempts to achieve the proper measurements were saved and compared amongst the students. After completing the on-line course, a final post-test was administered for a final evaluation.

2.4 Analysis of the Outcomes

All Student data were de-identified and scores were stored electronically in the database on the website including test scores in the 5 didactic modules, the fetal biometry testing in module 6, the pre-test data, and post-test data and then downloaded after completion of the training program for analysis.

2.5 IRB Statement

The research is classified as exempt by the IRB.

3. Results

Twenty-seven students participated in this study. Twenty-six students (96.3%; 26/27) were able to demonstrate test score improvement. Each test was 30 questions with a possible score of 300. The post-test scores indicated increased knowledge about limited ultrasound. The Wilcoxon signed rank test shows that the observed difference between both measurements was significant, $Z = -4.46$, $p < 0.01$. The median pre-test score was 160 whereas the median post-test score was 290. Thus, we can reject the null hypothesis that the educational material did not improve test scores and we may assume that the educational program increased knowledge of ultrasound material.

Item difficulty was defined as the proportion of test takers who marked an answer correctly, with more difficult items being answered correctly less frequently than those items that are answered incorrectly. The closer the value was to one, the less difficult the question. All questions on the pre-test were difficult for the students, with most having a value below 0.3 (see Table 1). The discrimination index was above 0.2 for all questions with the exception of questions 10 and 17, indicating that students who scored well on the pre-test answered more difficult questions correctly than people who scored poorly on the pre-test, indicating that the questions were able to discriminate between high and low-performing students. For the post-test, most questions had a difficulty index above 0.8, meaning that after completing the course questions on the material were easier (see Table 1). This was an expected result as we used a criterion-referenced test. Many of the discrimination indices were between 0.0 and 0.3, which is consistent with our use of a criterion reference model.

4. Discussion

Students enrolled in this course had positive learning outcomes and demonstrated the ability to manage their time to complete the modules in the assigned period. This study demonstrated the ability to provide easily accessible web-based ultrasound training for Spanish medical students fluent in English. This E-learning curriculum is a viable option for those who would like to use E-learning in conjunction with in-seat lectures to meet recent curriculum needs for medical students to have exposure to ultrasound training as required by the supervising medical student organizations.

Limitations of the intervention include the small number of participants with limited data for interpretation and possible language barrier issues with using Spanish medical students even though the students were all fluent in English. While we observed improvements in knowledge and skills with these students, a pilot study like this requires context to ascertain the efficacy of web-based education. Dietrich *et*

al. [4] reported that pre- and post-test with ultrasound simulation have shown to be important for improving knowledge, motivation, and skill retention [10,11].

5. Conclusions

Results of this intervention model confirm E-learning for ultrasound in limited obstetric can provide medical students a tool to take control of their education while allowing educators to shift their in-class curriculum to topics that need more attention. If our students are to meet the guidelines set forth by our governing bodies, we must continue to provide dynamic and time effective means of delivering the necessary materials. Due to the already widespread utilization of remote learning in other fields, this training could be expanded to include more in-depth exposure in obstetrical ultrasounds to medical students and residents in other medical disciplines, as well as augmenting the educational efforts to other future medical professionals (i.e., sonography students, nurses) who need to be familiar with ultrasound.

Availability of Data and Materials

Data for this study are stored on a secured server per the study protocol. The authors do not wish to share study data due to confidentiality that could be breached when working with small numbers.

Author Contributions

WW, MD, LT and BCC conceptualized and designed the research study. MCA, AMCD and AVH acquired data. LT and DJS analyzed and interpreted data, WW and LT wrote the manuscript DJS and BCC revised for intellectual content. All authors contributed to editorial changes in the manuscript. All authors read and approved the final manuscript.

Ethics Approval and Consent to Participate

The CAMC/West Virginia University Institutional Review Board determined this project as exempt from review and provided an outcome of Non-Human Subjects Research.

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Conflict of Interest

Dr. Byron Calhoun sponsored the web-based course the students utilized in the ultrasound study but received no financial remuneration from anyone involved in the study.

On behalf of the rest of the authors, the corresponding author states that there is no conflict of interest.

Supplementary Material

Supplementary material associated with this article can be found, in the online version, at <https://doi.org/10.31083/j.ceog5002031>.

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