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Research Article

Implementing Ultrasound Education: An Active Learning Programme (Skills Labs) for Midwifery Students

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Abstract

Background: Since 2011, in Italy, midwives have been allowed to use Point-of-Care-Ultrasound as a tool for maternal and fetal monitoring. This skill can only be acquired through training. **Aim:** This pilot study aimed to implement a learning program for developing practical skills required for ultrasound in the third trimester of pregnancy using a field-based laboratory teaching approach. Additionally, the study aimed to evaluate the effectiveness of the teaching methodology. **Methods:** The approved experimental study was conducted at a university in northern Italy between July 2023 and June 2024.The initiative involved thirty-seven second- and third-year students (Group A) and fourteen first-year students (Group B). In addition to standard coursework, Group A participated in a two-hour session, which entailed viewing instructional video tutorials and creating a checklist. Subsequently, each student in Group A performed five scans on pregnant women. The study sample (83 women) included singleton pregnancies in the third trimester. Learning progress was evaluated using the prepared checklist. Group B students were assigned to perform ultrasound scans, without having participated in the training session. This study used the validated Student Satisfaction and Self-confidence in Learning Scale to assess the effectiveness of the teaching methodology. **Findings:** The findings indicated that the project was efficacious. Group A students demonstrated a high level of satisfaction. **Conclusion:** Consequently, there is a strong case for incorporating this initiative into the core curriculum of the three-year midwifery degree program.

The researchers propose a follow-up one year after to ascertain the long-term retention of the acquired skills.

Keywords: Midwifery; Education; Point of Care Ultrasound (PoCUS); Hands-on skills practicum

Background

Obstetric ultrasound is an important diagnostic tool. Point of Care Ultrasound (PoCUS) is an ultrasound examination that complements obstetric and gynaecological consultations. This non-invasive imaging technology enables the accurate assessment of the normal progression of pregnancy and labour.

In compliance with current regulations, [1-4] starting in 2011,5 in Italy midwives have gained the autonomy to perform Point of Care Ultrasound [6,7]. This is an important development because performing PoCUS is a basic skill that, when combined with other obstetrical skills, allows for the autonomous follow-up of low-risk pregnancies throughout their development.

PoCUS is not a substitute for prenatal or diagnostic ultrasound [7]. Therefore, if a more comprehensive ultrasound examination is deemed necessary, the initial ultrasound will be followed by a

more detailed examination, performed by a gynaecologist.

This approach enables us to provide women with the most effective care, informed by scientific evidence, while ensuring the quality and timeliness of care. It also allows us to reduce waiting times for those who require access to specialist care.

The acquisition of this specialized skill necessitates an appropriate postgraduate education and training program. Currently, this is possible through specific training in only a few training centres in Italy.

Nevertheless, the acquisition of fundamental competencies may start during the training provided for the bachelor's degree in obstetrics.

Clinical training on real patients is a valid method to improve skills; ultrasound is safe for both the fetus and the mother when used in obstetrics.

At present, there is no established, evidence-based ultrasound training program for midwives [8]. Shaw-Battista et al. [9] developed an ultrasound course focused on clinical applications with pregnant volunteers.

The primary goal of this pilot study was to develop an educational program to implement the technical and practical skills required for obstetric ultrasound in the third trimester of pregnancy by introducing the subject to students to encourage them to seek postgraduate training; secondarily the study sought to assess the efficacy of the teaching methodology used.

Material and Methods

The case-control study included thirty-seven midwifery students at the University of Genoa (Group A), comprising twenty-one second-year students and sixteen third-year students. The control group (Group B) consisted of fourteen first-year students. The Ethics Committee approved the study which was conducted between July 2023 and June 2024 (XXX - Resolution No. XXX of XXX).

In addition to the standard 12-hour theoretical "obstetric and gynaecologic ultrasound" course, Group A participated in an additional two-hour session prior to the clinical training course. All participants attended an equal theoretical presentation in person on the methodology and practice of ultrasound10, which included viewing three instructional video tutorials to implement skills on basic ultrasound performance.

The objective of the study was to introduce the subject to students and encourage them to pursue postgraduate training. Consequently, a certificate was not provided at the conclusion of the activity.

The initial video, obtained at no cost from an online course, demonstrated the proper utilization of the transabdominal probe. The subsequent two videos were created by the investigators. The first video elucidated the assessment of fetal position and presentation, as well as the visualization of fetal heart rate (FHR). The second video elucidated the measurement of amniotic fluid by identifying the maximum vertical pocket (MVP).

Subsequently, the students engaged in a collaborative exercise in small groups of five, with the objective of developing a checklist for the performance of obstetric ultrasound scans during the third trimester of pregnancy. The objective of the checklist was to investigate the three parameters previously mentioned. Subsequently, the checklists created by each group were compared with the experimenter-validated checklist, which was then provided to all students.

Following the completion of the two-hour theoretical exercise, students were divided into pairs for a practical exercise. During the training session at the San Martino Polyclinic Hospital obstetric clinic, each student had to perform five ultrasound scans on female volunteers in the third trimester of pregnancy.

As this was a pilot study, it was decided that only five ultrasound scans would be performed on the students, with the intention of increasing this number in subsequent studies.

The recruitment of pregnant participants was conducted at the obstetrics clinic, with a sample of 83 women meeting the inclusion criteria of having a single fetus and being in their third trimester of pregnancy (gestational ages ranging from 28+3 weeks to 41+3 weeks). All participants provided written informed consent to participate in the study.

During the practical exercises, each pair of student trainees was supervised by senior residents in obstetrics and senior midwives. The progress in performing the ultrasound scan was evaluated using a prepared checklist, comparing the parameters obtained by the student with those obtained by the gynaecologist.

To assess the effectiveness of the teaching methodology employed, at the end of the practical activity, each student anonymously completed the validated *Student Satisfaction and Self-confidence in Learning Scale questionnaire* [11]. The questionnaire was validated for the simulation technique; it was decided to adapt it to the method used, i.e., hands-on activity.

The questionnaire consists of thirteen items evaluated on a 5-point Likert scale ranging from 'Strongly disagree' to 'Strongly agree'.

The control group was not required to attend the two-hour theoretical lecture; however, they were tasked with performing an ultrasound on pregnant women in their third trimester to evaluate the three parameters of the study. The performance of each student

was evaluated using the same checklist used by the study group (Group A).

Results

The results were subjected to statistical analysis using the open-source software JASP. 185 ultrasound scans were performed as defined, i.e., five ultrasound scans per student in Group A. All fetuses were longitudinal, with 97.3% (180 out of 185 fetuses) in the cephalic position and 2.7% (5 out of 185 fetuses) in breech position. The fetal heart rate was visualized in all ultrasound examinations performed. However, the maximum pocket was not measured in four ultrasound examinations (2.2%) by the students due to maternal fat.

A comparison of the performance of the two groups of students of Group A (as shown in Table 1) revealed that third-year students had higher non-performance rates for the identification of the four amniotic fluid pockets, the selection of the MPV and its measurement (2.7% not executed vs 0%); on the other hand, they were more successful in visualizing the FHR (91.9% adequate execution vs 86.7%) and identifying the four amniotic fluid pockets (87.8% adequate execution vs 76.5%).

Table 1 Comparison of ultrasound services of second- and third-year students.

Items	second-year students			third-year students		
	A	I	U	A	I	U
Visualize FHR	86.7%	13.3%	0.0%	91.9%	8.1%	0.0%
Identifying the 4 amniotic fluid pockets	76.5%	23.5%	0.0%	87.8%	9.5%	2.7%
Select MVP	85.7%	14.3%	0.0%	81.1%	16.2%	2.7%
Measuring the MPV	81.6%	18.4%	0.0%	77.0%	20.3%	2.7%

Table 1: Comparison of adequate (A), inadequate (I), and unperformed (U) ultrasound services of second- and third-year students.

The control group had performed 70 ultrasound scans. All the sample were able to turn on the ultrasound and to identify the fetal head; however, they were unable to diagnose the fetal presentation.

Furthermore, 85.7% of the control group randomly identified the fetal heart, although they had utilized inappropriate scan plans.

A comparison of the results obtained from Group A and Group B revealed that the entirety of the control group was unable to identify the four amniotic fluid pockets and consequently failed to select and measure the maximum pocket of amniotic fluid (Table 2).

Table 2 The results of the ultrasound services provided to students in the control group (Group B).

Items	Control group students		
	A	I	U
Visualize FHR	0.0%	85.7%	14.2%
Identifying the 4 amniotic fluid pockets	0.0%	28.5%	71.4%
Select MVP	0.0%	0.0%	100%
Measuring the MPV	0.0%	0.0%	100%

Table 2: The results of the adequate (A), inadequate (I), and unperformed (U) ultrasound services provided to students in the control group are presented herewith.

The questionnaires were analysed by comparing the responses of twenty-one second-year students (representing 56.76% of the sample) and sixteen third-year students (representing 43.24% of the total).

The first section of the questionnaire, consisting of five questions, investigated student satisfaction with the teaching method used and the materials provided. According to Table 3 a significant proportion of students found that the teaching methods used were helpful and effective (100% of second-year students vs. 81.25% of third-year students); moreover, the teaching methods used by the tutors were suitable for their learning.

Table 3 Answers to the first section of the questionnaire: Satisfaction with current learning.

Satisfaction with Current Learning	second-year students					third-year students				
	SD	**D**	**UN**	**A**	**SA**	**SD**	**D**	**UN**	**A**	**SA**
1. The teaching methods used in this laboratory were helpful and effective.	0.00%	0.00%	0.00%	0.00%	100.00%	0.00%	0.00%	0.00%	18.75%	81.25%
2. The laboratory provided me with a variety of learning materials and activities topromote my learning the medical surgical curriculum.	0.00%	0.00%	0.00%	33.33%	66.67%	0.00%	0.00%	6.25%	43.75%	50.00%
3. I enjoyed how my instructor taught the laboratory.	0.00%	0.00%	0.00%	19.05%	80.95%	0.00%	0.00%	0.00%	12.50%	87.50%
4. The teaching materials used in this laboratory were motivating and helped meto learn.	0.00%	0.00%	0.00%	23.81%	76.19%	0.00%	0.00%	0.00%	31.25%	68.75%
5. The way my instructor(s) taught the laboratory was suitable to the way I learn.	0.00%	0.00%	0.00%	0.00%	100.00%	0.00%	0.00%	0.00%	18.75%	81.25%

Table 3: Answers to the first section of the questionnaire with Likert scale (SD Strongly disagree, D Disagree, UN Undecided, A Agree, SA Strongly agree); comparison between second- and third-year students.

Furthermore, teaching materials were found to be stimulating and helpful for learning by 76.19% of second-year students and 68.75% of third-year students. The second section of the questionnaire analysed self-confidence and acquired skills, as shown in Table 4.

Table 4 Answers to the second section of the questionnaire: Self-confidence in learning.

Self-confidence in Learning	second-year students					third-year students				
	SD	**D**	**UN**	**A**	**SA**	**SD**	**D**	**UN**	**A**	**SA**
6. I am confident that I am mastering the content of the laboratory activity that my instructors presented to me.	0.00%	0.00%	23.81%	57.14%	19.05%	0.00%	0.00%	18.75%	81.25%	0.00%
7. I am confident that this laboratory covered critical content necessary for themastery of ultrasound skills.	0.00%	0.00%	0.00%	23.81%	76.19%	0.00%	0.00%	0.00%	68.75%	31.25%
8. I am confident that I am developing the skills and obtaining the required knowledge from this workshop to perform necessary tasks in a clinical setting	0.00%	0.00%	4.76%	61.90%	33.33%	0.00%	0.00%	25.00%	75.00%	0.00%
9. My instructors used helpful resources to teach the laboratory.	0.00%	0.00%	0.00%	9.52%	90.48%	0.00%	0.00%	0.00%	25.00%	75.00%

10. It is my responsibility as the student to learn what I need to know from this hands-on activity.	0.00%	0.00%	4.76%	9.52%	85.71%	0.00%	0.00%	0.00%	18.75%	81.25%
11. I know how to get help when I do not understand the concepts coveredin the hands-on practicum.	0.00%	0.00%	0.00%	38.10%	61.90%	0.00%	0.00%	0.00%	31.25%	68.75%
12. I know how to use hands-on activities to learn critical aspects of these skills.	0.00%	0.00%	4.76%	71.43%	23.81%	0.00%	0.00%	6.25%	37.50%	56.25%
13. It is the instructor's responsibility to tell me what I need to learn of the activity content during class time.	0.00%	0.00%	0.00%	28.57%	71.43%	0.00%	0.00%	0.00%	43.75%	56.25%

Table 4: Answers to the second section of the questionnaire with Likert scale (SD Strongly disagree, D Disagree, UN Undecided, A Agree, SA Strongly agree); comparison between second- and third-year students.

None of the third-year students felt completely prepared to master the ultrasound technique, and one-fifth of the students expressed uncertainty about their abilities (23.81% of second-year students and 18.75% of third-year students). Only 33.33% of the second-year students strongly agreed that they had developed the required skills. A high percentage of students are aware that they are responsible for their own education (85.71% of second-year students vs. 81.25% of third-year students). The students in the control group did not complete the satisfaction survey, as they did not engage with the learning program.

Discussion

In addition to the didactic validity of the method, the study demonstrated through the analysis of the data from the student satisfaction questionnaire that despite some differences in satisfaction levels between second- and third-year students, the method used for the implementation of ultrasound skills was appreciated and considered effective by all the students.

The hands-on activity was appreciated by the students as fundamental to their learning, as also noted by Shaw-Battista et al.

The group activity results indicate that second-year students had a better understanding of the technique than third-year students. Additionally, the third-year students expressed dissatisfaction with the provided material. These aspects are hypothesized to be due to the inclusion of theoretical ultrasound lessons in the second-year curriculum.

Although the study produced positive results, the researchers suggest that an evaluation after one year is necessary to determine whether the skills acquired through the training are maintained over time. Therefore, the effectiveness of incorporating this teaching methodology into the students' curriculum could be evaluated.

Additionally, future research could offer the laboratory to students in two successive years in a multicentre manner across multiple university clusters.

Research on the implementation of basic and advanced ultrasound skills could contribute to the professional growth of the entire profession in the future.

The students' answers to questions regarding their perceived level of competence and self-confidence were indecisive. It is unclear whether this is due to personal characteristics or the workshop's methodology. An additional limitation was the numerically small sample of students.

Conclusion

In conclusion, the present study revealed that the teaching effectiveness of the laboratory program is greater for second-year students; therefore, we propose implementing training in midwifery degree course to stabilize the project created for this pilot study.

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Acknowledgements are not applicable.

An Ethical Statement

CER Comitato Etico Regione Liguria - Resolution No. 1151 of 19/07/2023

All participants provided written informed consent to participate in the study.

Declarations

The authors have no conflicts of interest to disclose.

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