Peer-Teaching of Basic Ultrasound Skills using a Flipped Classroom Concept – Experience from Hannover, Germany

Sabine Schneidewind*, Hannover Medical School, Hannover, Germany
Gerald Stiller
Marianne Behrends
Volker Paulmann
Volkhard Fischer
Andrej Potthoff

Background: Performing abdominal ultrasound constitutes an essential physician skill. Even young doctors are expected to handle an ultrasound machine correctly and to perform a basic abdominal ultrasound. Nevertheless, most medical undergraduate curricula lack ultrasound classes. Teaching ultrasound usually takes place in electives allowing only limited numbers of participants.

Summary of Work: We developed a peer-teaching tutorial that enables its participants to practice abdominal ultrasound on their own. It is based on a flipped classroom concept in which participants are asked to study a handout on ultrasound setting as well as watch a movie of a best practice example of abdominal ultrasound before class. The video consists of an introduction explaining the function of the essential buttons followed by the actual examination shown on a split-screen with the patient’s abdomen to the right, the ultrasound picture and the buttons that are being used to the left.

Summary of Results: The tutorial takes place twice a month and is always fully booked. During the two two-hour tutorial sessions, participants master “knobology” as well as finding and measuring the organs under supervision of the trained student tutors. Preliminary data show that most participants do have ultrasound experience, but that they lack knowledge about image optimization. Students change their ultrasound technique after having participated and feel more confident in finding and measuring the abdominal organs and finding the aortic branches.

Discussion: The fact that students show deficits in image optimization emphasizes the need for a structured introduction before free practice. Teaching ultrasound requires many facilitators. We show that this can be successfully done with student tutors.

Conclusion: Engaging student tutors in basic abdominal ultrasound can reconcile the gap between students' need for ultrasound classes and availability of physician teachers.

Take Home Messages: Teaching basic abdominal ultrasound skills using a flipped classroom concept assures that participants focus on practicing during the tutorial session.

Ultrasound-facilitated anatomy teaching and learning outcomes

Irene Ma*, University of Calgary Cumming School of Medicine, Calgary, Canada
Heather Jamnickczy
Mike Paget
Kevin McLaughlin
Sylvain Coderre

Background: Ultrasound is increasingly used as a teaching tool in medical education and is well-liked by learners. Although teaching ultrasound has been shown to improve ultrasound skills and knowledge, its impact on non-ultrasound related learning outcomes is unknown. Using the framework of cognitive load theory, this study seeks to evaluate the relationship between cognitive load associated with using ultrasound and actual learning outcomes in anatomy.

Summary of Work: Consenting first year medical students (n=161) underwent ultrasound-guided anatomy training laboratories. Relationship between reported cognitive load on using ultrasound and learning outcomes was evaluated using linear regression analyses. Anatomy examination scores between two years of students who were taught with ultrasound (n=318) were compared with historical controls (two years of students who were not taught with ultrasound; n=348).

Summary of Results: Weighted factor scores on cognitive load were not significantly associated with examination scores, although the higher the cognitive load on image interpretation, the lower the scores [F(1,135)=0.28, beta= -0.22, p=0.61]. Cohorts exposed to ultrasound-guided anatomy training had significantly higher scores than historical controls (82.4% +/- 8.6% vs 78.8% +/- 8.5%, Cohen’s d = 0.41, p<0.001).

Discussion: The incorporation of ultrasound as a teaching tool for anatomy is associated with improved learning outcomes in anatomy. Although a detrimental effect of high cognitive load on learning outcomes is not shown in our study, the direction of this relationship suggests that educators should exercise caution in introducing tools that may impose a high cognitive load on learners.

Conclusion: Using ultrasound to teach anatomy does not negatively impact learning and may improve learning outcomes.

Take Home Messages: We recommend the use of ultrasound as an educational tool for anatomy but careful attention should be paid to cognitive load considerations in designing ultrasound-facilitated teaching interventions for novice learners.
#9FF03 (134446)
Flipped Classroom: A Valid Approach to Teaching Bedside Ultrasound Concepts to Undergraduate Medical Students

Sara Nikolic*, Faculty of Medicine, University of Maribor, Maribor, Slovenia
Una Mrsic
Jan Hansel
Gregor Prosen

Background: We implemented the flipped classroom model in Ultrafest, a single-day intensive hands-on ultrasound course for undergraduate medical students, to investigate its validity for teaching basic theoretical ultrasound concepts.

Summary of Work: Students attending Ultrafest (n=134) were provided with video lectures a month in advance to study basic ultrasound concepts. The seven selected videos were recorded by University of California Irvine and lasted 4 hours altogether. Theoretical knowledge was tested on the day of the event by a pre-test consisting of 15 single best answer multiple-choice questions of mixed format (recall questions, clinical vignettes with pictures). Ultrafest was concluded by students completing a 5-point Likert scale questionnaire.

Summary of Results: There was a statistically significant difference between pre-test results of students who reviewed 0-4 videos (mean score 11.86, n=21) and students who reviewed 5-7 videos (mean score 14.05, n=113) (p<0.0001). On the post-event survey students agreed that video lectures were appropriate for achieving learning outcomes (4.81), considered them useful for further studies and clinical practice (4.82) and mostly preferred video lectures to classic lectures (4.24).

Discussion: Students who reviewed more video lectures beforehand performed better on the pre-test. According to student feedback video lectures in a flipped classroom context cannot completely replace classic lectures. Our study was limited by uneven research groups due to opportunity sampling.

Conclusion: The flipped classroom approach utilizing video lectures is a valid modality for teaching theoretical ultrasound concepts to undergraduate medical students and students see it as a welcome augmentation to classic lectures.

Take Home Messages: The flipped classroom is a time-saving approach that offers a valuable tool for educators even in basic point-of-care ultrasound education at the undergraduate level.

#9FF04 (134950)
Collaborative Ultrasound Objective Structural Practical Examination (OSPE) in Gross Anatomy

Wojciech Pawlina*, Mayo Clinic, Rochester, MN, USA
Tony R. Blankers (Mayo Medical School, Mayo Clinic, Rochester, MN, USA)
Nirusha Lachman (Department of Anatomy, Mayo Clinic, Rochester, MN, USA)
Anjali Bhagra (Department of General Internal Medicine, Mayo Clinic, Rochester, MN, USA)

Background: Use of ultrasound as a diagnostic tool is fast becoming an expectation in clinical practice. Learning anatomy through ultrasound is a standard practice for many anatomy courses in the United States. However, very few if any offer formal assessment of students' ultrasound skills and anatomical knowledge at the same time.

Summary of Work: Throughout the anatomy course at Mayo Medical School, first-year medical students were provided with both didactic briefing sessions and hands-on training on ultrasound basics, image interpretation and scanning techniques. The ultrasound content was integrated with the overall course material. As part of the final practical examination, students were expected to complete a collaborative team-based, hands-on ultrasound skills assessment. During this collaborative OSPE, students in four-person teams were expected to (1) setup the ultrasound machine, then (2) obtain, (3) orient, and (4) label an assigned image on a live model.

Summary of Results: Teams were graded using the rubric scale for each of the four components and given an overall score as a team. Each student was given a unique role within the exercise corresponding to the four tasks. The average OSPE score was 72% (±21%). Students were the best at labeling the obtained images - 100% correct score. The most challenging task to achieve was the selection of the correct ultrasound probe and set up of the machine - 40% (±51%) correct score. The OSPE scores were included as part of the final laboratory practical grade.

Discussion: The entire OSPE was performed in the classroom at 4 stations with 4 live models. Rotating through all 4 stations, students obtained, oriented and labeled 4 different structures. Collaborative OSPE was organized and supervised by near-peer teachers, who were trained third-year medical students working as teaching assistants (TAs) in the course. In final course evaluation, students were very positive regarding their collaborative ultrasound OSPE experience.

Conclusion: Collaborative OSPE assessment demonstrated an effective method to evaluate ultrasound skills in a preclinical anatomy course.

Take Home Messages: Collaborative OSPE can be successfully used to assess ultrasound skills and anatomy knowledge learned in the anatomy course.
Ultrasonic in the Undergraduate Medical Curriculum. A pilot project to introduce ultrasound skills to medical students to facilitate peer-led delivery of an ultrasound-assisted physiology session

Thomas Simpson*, King’s College London, London, UK
Daniel Curley
Asya Costa
Liju Ahmed

Background: The use of bedside ultrasound in increasing in the UK. Cheaper machines and a wider appreciation of the safety and diagnostic benefits of ultrasound in common clinical scenarios and procedures have led to a growing call for postgraduate ultrasound training, a need which is difficult to meet. The solution may be teaching ultrasound in the undergraduate medical curriculum, both as a skill to be learned but also as an adjunct to the teaching of subjects such as physiology, where real-time visualisation of live structures could form a powerful learning tool.

Summary of Work: We performed a pilot project where a cohort of medical students trained in the basic skills of ultrasonography, provided the faculty for a peer-led lesson, linked to concurrent curriculum learning on cardiac anatomy and physiology, delivered to the entire first-year cohort.

Summary of Results: Feedback from 255 students was extremely positive. Students were keen on more teaching of this nature, and felt that integrating ultrasound into their teaching would help their learning. Thematic analysis of free-text feedback demonstrated a variety of mechanisms that were felt to make the sessions a success. Follow-up feedback is currently being sought on perceived long-term benefits.

Discussion: Our pilot project has shown a possible solution to introducing ultrasound to the whole undergraduate curriculum of our medical school, through the development of a student faculty.

Conclusion: Ultrasound will increasingly form part of our clinical work. A place for it to be taught as both a skill and a way of understanding physiology, anatomy and pathology is during the undergraduate curriculum. We have demonstrated the feasibility of this approach without needing a large, expert faculty.

Take Home Messages: Teaching ultrasound to medical students is feasible and may provide a route to introducing ultrasound across the curriculum of undergraduate medicine, allowing the graduation of doctors skilled in the use of ultrasound.

Lessons learned from teaching ultrasound: defining specific motor-cognitive skills required for training, assessment and quality assurance of ultrasound training

Dimitri Parra*, The Hospital for Sick Children. University of Toronto, Toronto, Canada

Background: Ultrasound is an imaging modality on high demand in health care organizations. Multiple specialties and disciplines perform and teach ultrasound. This has resulted in a variety of different approaches of how to teach this imaging modality.

Summary of Work: We retrospectively reviewed our experience in the past three years performing interdisciplinary workshops of ultrasound guided vascular access and ultrasound teaching in elective rotations in our interventional radiology unit. The trainees included from medical students up to staff physicians. By observation we isolated and defined motor cognitive skills that were perceived as important for training and assessment of ultrasound.

Summary of Results: The specific motor-cognitive skills identified were: a) Dominant hand transducer control; b) Image creation/optimization; c) Non-dominant hand control of keyboard; d) Normal anatomy visualization; e) Abnormal finding identification; f) Hands coordination for procedure performance.

Discussion: We have isolated six specific cognitive motor skills required to effectively train and assess ultrasound skills. We are going to pilot a teaching approach based on these skills in our ultrasound guided vascular access workshop in the 2016 calendar year.

Conclusion: We provide our experience defining specific cognitive motor skills that we believe are required to design, implement and assess ultrasound training programs. Testing is underway to assess if this approach is effective.

Take Home Messages: Ultrasound teaching programs need to define and train competencies based on certain motor cognitive skills to reach acceptable quality standards.
Background: Ultrasound is widely used by physicians today. Therefore, the need for ultrasound education is evident. Ultrasound training in undergraduate medical students has been increasingly incorporated but the teaching methods vary among medical schools. The effective teaching model was proposed by adding hands-on ultrasound experience proctored by radiologists on live patients in the last clinical year.

Summary of Work: A two-week radiology elective course was offered for sixth year medical students at Burapha University hospital. The elective students were provided ultrasound experience on live patient in real-life clinical settings. All sixth year students then completed a 25-ultrasound image quiz, and a questionnaire at the end of the academic year. The ultrasound test scores were compared between elective students and non-elective students. The students’ background characteristics were determined by a grade point average and the ultrasound experience was determined by the number of scans. These were collected, and analyzed for the relationship with the ultrasound test scores.

Summary of Results: Fourteen medical students participated in the elective course. The ultrasound test scores in the elective group was significantly higher than in the non-elective group (p = 0.013). The students’ background characteristics and ultrasound experience have no significant relationship with the ultrasound test scores.

Discussion: In only 2-weeks of training, radiology elective students show significant higher US test scores than non-elective students, regardless of their background performances or previous US experience. This study suggests that the training had substantial impact on US knowledge with background independence.

Conclusion: Adding hands-on ultrasound experience using live patients proctored by radiologists for final year medical students, in the space of two weeks, is an effective ultrasound learning model for undergraduate medical students. This model should be considered in the curricular design.

Take Home Messages: US training in undergraduate medical education has been proved to be useful. Direct hands-on US experience on positive live patients is a valuable part of a student’s medical education.
#9FF09 (133604)
Current condition and future perspective of diagnostic imaging education in undergraduate education: results of questionnaire survey to worldwide.

Kunihiko Fukuda*, The Jikei University School of Medicine, Tokyo, Japan
Ruri Ashida (The Jikei University School of Medicine, Tokyo, Japan)
Mariko Nakamura (The Jikei University School of Medicine, Tokyo, Japan)
Joseph Ledsam (University College London, London, UK)

**Background:** Despite increasing dependence on diagnostic imaging (DI) in clinical medicine, there has been little discussion about the importance of undergraduate DI education. The purpose of this research was to investigate the current condition of undergraduate DI education and gain insights into its future.

**Summary of Work:** A questionnaire survey was sent to forty-two radiologists, all of whom are presidents of radiological societies. The responses were collected and analysed to investigate current and potential future directions for undergraduate DI education.

**Summary of Results:** Twenty-one radiologists responded; Europe 7, North-America 5, Asia 5, and other areas 4. Classroom-style lecture is performed in 17. E-learning materials are used in 11. DI-related research is performed in 13. Nineteen responded that DI-related research should be introduced into curriculum. DI-OSE is performed in 9. Nineteen responded that DI-OSE should be performed in the future.

**Discussion:** In order to facilitate self-learning and flipped classrooms, we should develop attractive e-learning material. DI-related research can be an attractive curriculum for future doctors, with proposed topics including pure-DI, radiation safety, and imaging-related medical economics. Through DI-OSEs students can learn safe and effective practice in DI, which may lead to DI-related safety improvements and reduced medical expenditure.

**Conclusion:** Although DI-related research is a small theme, there is interest in providing undergraduate research opportunities in DI, DI/social economics and safety in medical imaging. It is expected that through introduction of DI-OSEs future doctors will choose more effective imaging algorithms, care more about patient safety and show interest in medical economics.

**Take Home Messages:** DI-related research during undergraduate education is recommended. Introduction of the DI-OSE is expected, and cooperation between radiologists and medical education faculties is necessary to achieve this.

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#9FF10 (132942)
An educational course for the achievement of confidence on basic Focused Assessment with Sonography in Trauma (FAST): Evaluation of a small group workshop in Thai medical student

Thawatchai Tullavardhana*, Department of Surgery, Faculty of Medicine, Srinakharinwirot University, Onghharak, Nakhon Nayok, Thailand

**Background:** Trauma has become a leading cause of death in developing country as Thailand. After graduating from the institute, the medical students have to work in emergency department of community hospital. Our goals were to improve the confidence of the student on Focused Assessment with Sonography in Trauma (FAST).

**Summary of Work:** The one-day small group-training course was organized at Faculty of Medicine, Srinakharinwirot University. Twenty-five participants affiliated in the small group workshop; the participants have divided up into 3 groups (7-8 participants/group). The training program initiates with 1-h lecture by an instructor and spent 6-h in hands-on practice session. The participants complete a questionnaire in the confidence of basic knowledge on equipment use, ability to illustrate 4 standard views and decision-making in FAST; based on a 5-point Likert scale. The scores between pre-and post-workshop was compared by paired t test statistical analysis.

**Summary of Results:** The small workshops demonstrate a significant improvement of the confidence in basic skill and decision-making in trauma patient on the basis of FAST result. The mean overall score of pre-and post-workshop were 24.9 and 37.6 respectively (p < 0.001).

**Discussion:** FAST is an initial diagnosis tool for abdominal trauma, which is helpful for planning for optimal management. The training model has been developed such as a simulator. However, the limitation was consisted of the cost of the simulators, the needs of technical maintenance and software upgrades. Our results verify the effectiveness of small group workshop as an excellent training model for practice in FAST, which was suitable for socioeconomic of developing countries.

**Conclusion:** The small group workshop is an effective model of training for better performance in FAST.

**Take Home Messages:** Small group hand-on workshop is a valuable education method for achieving an experience to the students even in the limited resources situation.
Learning through visualization and feedback: integrating ultrasound in physical examination improves confidence

Adrian Yee*, UBC, Victoria, Canada
Steve Chang
Jim Salzman
Christine Simmon
Pete Tonseth
Joshua Williams

Background: Portable ultrasound technology is becoming a standard part of undergraduate medical curriculum. We piloted a program integrating ultrasound technology with the traditional teaching of the head and neck anatomy and physical examination.

Summary of Work: The pilot study was conducted by the undergraduate medical program at UBC. One-hundred and thirty students participated in the pilot. Participants received a lecture about the operation and clinical application. This was followed by a hands-on workshop with tutor demonstrations using ultrasound to visualize anatomical structures of head and neck.

Summary of Results: Ninety-two participants completed the survey and eighty-six participants indicated that the pilot supported and complemented learning in clinical skills. Hands-on experience, one-on-one interaction with tutors, and visualization of the anatomy with interpretation of images were perceived to be factors in improving confidence in physical examination and clinical reasoning skills.

Discussion: Our pilot confirmed medical studies value the use of ultrasound in clinical skills and anatomy. One possible explanation for our results is that teaching ultrasound requires direct one-on-one feedback and visualization, both of which are key factors in improving clinical skills learning.

Conclusion: Our pilot confirmed the feasibility of integrating portable ultrasound technology into the physical examination curriculum. Medical students have a positive perception about using ultrasound to improve learning in physical examination. Further research is needed to identify whether direct observation and/or visualization are the reasons.

Take Home Messages: Integrating portable ultrasound technology into clinical skills teaching may have multiple benefits.