Author's response to reviews

Title: Teaching ultrasound in a curricular course according to certified EFSUMB standards during undergraduate medical education is feasible and beneficial A prospective study

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Author's response to reviews: see over
Re: Revision of Manuscript ID 1538060783837728

Teaching ultrasound in a curricular course according to certified ESUMB standards during undergraduate medical education is feasible and beneficial: A prospective study

Dear Professor Holzinger,

Thank you for your offer to reevaluate the revised version of our above manuscript. In the following, we have addressed each aspect of your letter and would like to comment on all reviewer concerns point-by-point. For convenience, the reviewers’ concerns were repeated. We are confident that we could address all issues to your satisfaction and want to thank the reviewers for their efforts to further improve our manuscript.

The changes we have made are highlighted by yellow colored text. Furthermore we have added the information on the name of the Ethics Committee that approved of the study in the section methods (page 10, 1st paragraph)

We would be happy to provide any additional information if needed.

Yours sincerely,

Hauke Sebastian Heinzow, M.D.
**Reviewer #1**

1. The authors should correct their background information “ultrasound...has not been systematically implemented as a curricular course in undergraduate medical teaching”. We have implemented a DEGUM-course in musculoskeletal ultrasound in the 2nd year undergraduate medical education using trained student-teachers with the same positive feedback (Knobe et al. 2012 BMC Medical Education).

**Reply:** We thank Reviewer #1 for this important information and for the valuable references on medical education in ultrasound. We have implemented the references into our manuscript. We have added the information on page 4, 3rd paragraph

2. This study is novel in that it examines the effect of teaching in ultrasound technique by DOPS. This should be put forward and I miss information of the development process of items and criteria. The detailed process of the DOPS exam is not clear.

**Reply:** According to your valuable suggestions, we have included the information on the detailed process of the DOPS on page 7 and 8:

We have used 7 different practice items in DOPS as shown in figure 5.

<table>
<thead>
<tr>
<th>Please grade the following areas using the scale below</th>
<th>Below expectation for completion (0)</th>
<th>Borderline expectation for completion (1)</th>
<th>Meets expectations for completion (2)</th>
<th>Above expectation for completion (3)</th>
<th>U/C*</th>
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<td>1.) Identification of organ structures by US</td>
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<td>2.) Investigation of organ structures by US</td>
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<td>3.) Measurement of organ structures and/or blood flow by US</td>
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<td>4.) Description of the procedure</td>
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<td>5.) Background information (and normal values)</td>
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<td>6.) Communication skills</td>
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<td>7.) Technical ability</td>
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</table>

* U/C: Please mark this if you have not observed the behavior and therefore feel unable to comment

The seven different practice items were graded by means of the guidelines published by Barton and colleagues (The validity and reliability of a Direct Observation of Procedural Skills assessment tool:}
assessing colonoscopic skills of senior endoscopists John Roger Barton et al.

0 Accepted standards not yet met, frequent errors uncorrected
1 Some standards not yet met, aspects to be improved, some errors uncorrected
2 Competent and safe throughout procedure, no uncorrected errors
3 Highly skilled performance
N/C Not calculable: item could not be assessed

DOPS assessors undertook the assessment for each organ themselves and afterwards an interactive workshop was held discussing point-by-point each item and comparing the individual gradings. Assessors then went on assessing the students. We cannot completely rule out that the assessors evaluated occasionally candidates who they had recently taught or trained during the course, thus leaving space for assessment bias. The DOPS gradings of each assessor were anonymously compared with data from other assessors and accessible for feedback. We have added the required information in the section “Methods”.

3. Figure 1 makes no contribution to the content of the study and should be deleted

Reply: We agree with Reviewer #1 and have deleted figure 1.

4. The phrase “new teaching method” should be replaced

Reply: We have changed the abovementioned phrase into “this teaching method” (page 2, 1st paragraph)

Reviewer #2

1. In the second paragraph authors state “So far ultrasound has only been incorporated into undergraduate medical student curricula only to a limited degree (3, 4) and has not been systematically implemented as a curricular course in undergraduate medical teaching.” Authors need to be more specific, if they are referring to medical student education in Germany. Several U.S. medical schools have graduated medical students who have participated in a four-year vertical curriculum in clinical ultrasound.

Reply: We thank Reviewer 2 for this important advice. Following your comments we have added the information on medical schools having implemented a curriculum in clinical ultrasound on page 4, 3rd paragraph
References:
7. Ivanusic J, Cowie B, Barrington M. Undergraduate student perceptions of the use of ultrasonograph

2. Second paragraph-Authors state “The quality of sonographic findings is due to legibility of the image plane as compared to other imaging modalities that work with standardized planes, dependant on the investigator's technical skills.” This sentence need to be rephrased.

Reply: We have rephrased the abovementioned sentence: Compared to other imaging modalities that work with standardized planes, sonographic findings are mainly dependant on the investigator’s technical skills (page 4, 2nd paragraph)

3. Authors state “In groups of five, students worked on high-end ultrasound devices (Hitachi EUB 5500 HV). Availability of high-end ultrasound systems may not be possible at other institutions, limiting the generalizability.
**Reply:** We thank Reviewer #2 for this important comment.

We are aware that establishing an ultrasound course requires capital expenditures that cannot always be held available. Anyhow, we suggest that a structured ultrasound course is also possible with other ultrasound devices and that it should not influence the positive feedback of a course. We have added a comment on the limited generalizability of our course model in the section “Conclusion” (page 16, 2nd paragraph).

4. **Authors state** “During each lecture, live-demonstration of interesting sonographic findings on patients was performed after written or oral informed consent had been obtained from the patients. Moreover, ultrasound scanning techniques were efficiently presented during lectures.” The details of the curriculum are lacking. This affects the external validity of the study. Based on the information provided by authors, it would be difficult to replicate this curriculum at other medical schools.

**Reply:** As our implemented course consists of lectures and hands-on time, live-demonstration of interesting sonographic findings on patients was performed in the lecture theatre using a Hitachi EUB 6500 device. The sonographic findings were then discussed with the students in the lecture theatre. Moreover, during each lecture ultrasound scanning techniques were demonstrated in the lecture theatre. Students could then practice the demonstrated techniques during the hands-on practice time of the course. We have added information of the course model and curricular content in the section “Methods” (page 6, 2nd paragraph and page 7 1st and 3rd paragraph)

5. **Did investigators use human models?**

**Reply:** Only human models were used in the course

6. **Any simulation equipment used for teaching?**

**Reply:** No simulation equipment was used for teaching

7. **Did the investigators use clips, still images, interactive presentations?**

**Reply:** We used video clips, still images as well as interactive presentations during the lectures of the course. We have added this information in the section “Methods” under “Course model and curricular content” (page 6, 3rd paragraph and page 7, 1st paragraph). In addition, we have added figure 1 and 2 giving an overview of the curricular content and learning modules.
8. Were the investigators involved in assessment of students? This could have introduced some bias.

Reply: Yes, one of the investigator (D.D.) was involved in lecturing, teaching and DOPS assessment of students, thus a certain methodological bias cannot be ruled out. We thank Reviewer 2 for this important comment and have added the information in the section “Methods” (page 8, 1st paragraph).

9. What components of scanning skills were assessed? Holding the probe, adjusting gain, depth, focal zones, performing any dynamic maneuvers?

Reply: Grading of scanning skills was based on selecting the appropriate ultrasound probe, holding the probe, adjusting gain, depth and focal zones. These points are compromised in DOPS item 7. DOPS item 2 and 3 assessed dynamic maneuvers as measuring the portal flow and adequate scanning of an organ (page 8, 3rd paragraph; please also see figure 5).

10. Please present confidence intervals for percentages.

Reply: We have added confidence intervals for percentages in our manuscript (page 11 and page 12).

11. Any technical difficulties encountered by students while performing the ultrasound examinations?

Reply: Technical abilities/skills were assessed during DOPS assessment at the end of the term.

12. Authors state “The measurement of organs (1,69; 95%-CI 1,62-1,76), description of procedure (1,84; 95%-CI 1,77-1,99) and the giving of background information (1,79; 95%-CI 1,66-1,91) met our expectations” What is giving the background information?

Reply: Background information included e.g. normal values of the common bile duct, portal vein flow, normal volumetry values of thyroid gland. As all DOPS assessment are combined with a simulated clinical case example naming of related information are also considered as background information (page 8, 2nd paragraph, line 14-19).

13. The discussion section is too long and can be condensed. The discussion should compare and contrast the results with those of other studies that have previously
been published. The discussion section should focus on interesting findings of this study and put them into context, including a brief discussion of the prior studies.

**Reply:** We have modified the discussion section as requested and tried to outline interesting findings of our study.

14. Too many references. Can delete at least 10 references.

**Reply:** We have added the suggested references as previously proposed by the reviewers and have tried to delete redundant information.