Reviewer's report

Title: Interactive whiteboard use in clinical reasoning sessions to teach diagnostic test ordering and interpretation to undergraduate medical students

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Reviewer: Denise Connor

Reviewer's report:

Overall, this is an interesting manuscript which is describing an important educational intervention that I think will be useful for other educators in the field of reasoning to learn about. I am impressed by the fact that you were able to randomize students to the two arms of your prospective study, and this feature is a definite strength of your work. I was also impressed by the detailed analysis that were undertaken, including comparing inter-rater reliability, along with your ability to report pre- and post-test scores as a concrete skill-based change seen in your students. Clearly a significant amount of work went into this project, and much can be learned from your study.

However, there are a number of areas that could be improved and clarified in order to ensure that readers of your work can follow the details of what you did in this complex intervention and study, as well as what the take away points should be from your work. In general, the manuscript would also benefit from further tightening and clarifying of some of the language used -- I have indicated some examples of areas that would benefit from different word choices or phrasing in the attached annotated manuscript. Some of the words you use were not common parlance in English and may be hard for some readers to follow. In addition, some of the phrasing would benefit from being tightened a bit further. My comments should be thought of as a starting point. I would suggest close review to consider other ways to enhance the readability of your paper.

I am uploading a pdf of your manuscript which I have annotated with some suggestions for potential line edits/clarifications, as well as additional questions for your team to consider. Note that these annotations are mainly in the form of 'sticky notes' on the pdf, which you can view when you click on each note. The notes are placed over the areas related to my comments.

Here are some key points that I would like to highlight:
# Limitations: Given the low response rates to your questionnaire, as well as the small % of total students who completed the post-test after your intervention, I have concerns about the biased nature of your sample. Students who opted to complete the questionnaire and who took the time to return to complete the post-assessment were likely different in some significant ways from students who did not. You will want to spend time in your discussion section discussing this important set of limitations and positing how it should impact our interpretation of your data. I imagine that students who followed through to do these steps may have been higher achieving students for example, which would impact your results.

# Study design issues: If I am understanding your design correctly, it seems that you were comparing students who were exposed to IWB + CRL (+ clinical mentorship) with students who received clinical mentorship alone. You briefly make the important point in your discussion that this means that you cannot truly make a comment regarding whether it was the IWB vs. the CRL which led to improvements, and I think that this is a very significant and important point, and should actually change the research question you are positing and attempting to answer. Given these comparison groups, your claims should be limited to an association of the combined IWB + CRL with improvements - as opposed to making claims that the study shows that IWB was a key tool that led to learning improvements. In fact, it is even possible that IWB detracted from the learning, and without a CRL only group, it is impossible to know. By stating this question and the association you are studying a bit more precisely, you will be giving readers a more accurate sense of what we can take away from your work.

# Pre and post tests: It is unclear to me whether students took the same exact test as pre- and post-, and whether any of the questions posited were linked with the cases done in the IWB + CRL curriculum. The content of the tests is important to describe briefly as it is important to know whether students simply learned and were able to repeat medical knowledge about specific tests/conditions which they discussed in the sessions themselves vs. whether they were able to apply their conceptual learning to new cases. Transfer of conceptual knowledge would be a higher level finding, but this could only be described if the test/content was different pre- post- and different from what was discussed in the CRL/IWB sessions.

# Analysis of white boards: You describe analyzing the paperboards after the CRL/IWB sessions. However, you do not describe what framework/approach you used for this analysis. Please see my comments on the attached manuscript, but essentially, it will be important to better understand your methods here in order to understand what we should take away from this component of your project. How was this done?
# Maturation factor is an important issue, which you point out - in other words, you are comparing much earlier medical students (in the questionnaire) with much more mature students. Since the questionnaire data is self-perception data, it would be helpful to explore whether the maturity/experience of the students answering the questionnaires would be expected to impact their answers, as opposed to their answers being linked with actual skill (as you point out self perception tends to fairly inaccurate with students often over estimating their skills when asked to self assess). It would be helpful to explore this idea a bit and suggest how it should impact our interpretation of your work. Since you are comparing students to themselves pre-/post-, maturation factor of students during the course itself is also relevant. Though, since you are comparing to your control group in this part of the study, this factor has less relevance for this part of your study.

# Your discussion of the impact of cognitive load, particularly of earlier learners, when it comes to the IWB is important. And, b/c you did not compare CRL alone to CRL + IWB, I don't think you can clearly state that the IWB was useful for all students and directly responsible for their learning improvements. As above, is it possible that IWB may actually have hindered learning, and results could have been superior with CRL alone?

# For readers in a different training system, you may want to find ways to describe what stage of learners you are working with in more universal language (i.e. what would be the equivalent learners of 3rd through 6th year learners in other training systems?).

# Questionnaires: Were your questionnaires validated or piloted in some way? Can you describe that process a bit further? Also may be helpful to attach your questionnaires as supplementary documents.

# Assessments: Were your assessments (pre-/post-) validated or piloted in some way? These seem like open answer questions - did your graders use a shared/validated rubric to grade these assessments? What objectives were your assessments aiming to test? May be helpful to provide your assessment as a supplementary document.

# Can you clarify the link between the validated objectives around test ordering and your findings. You mention this concept a few times in the manuscript, but it is not entirely clear to
me how you are showing this link. Is it based on performance of the assessment questions you chose, or does it relate to how the IWB’s were analyzed?

# Results: In general, it would be helpful to change some of the formatting/way you describe your results in the text. I found the comparisons a bit hard to follow here.

Are the methods appropriate and well described?
If not, please specify what is required in your comments to the authors.

No

Does the work include the necessary controls?
If not, please specify which controls are required in your comments to the authors.

No

Are the conclusions drawn adequately supported by the data shown?
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No

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