Author's response to reviews

Title: Enhancing Student Learning of Research and Diagnostic Skills in Western Blotting and Muscular Dystrophy using an Adaptive Virtual Laboratory Environment

Authors:

Patsie Polly PhD (patsie.polly@unsw.edu.au)

Version: 2 Date: 18 July 2014

Author's response to reviews:

In response to the first round of review by referee Lewin:

Major Compulsory Revisions:
First, it appears that the version that was submitted is not the final version. There are multiple places with colored highlighting and words crossed out that implies that the authors did not go back and finalize the content and tidy up the manuscript.

Response/modification: The submitted version had changes highlighted for the purposes of easily directing the reviewers back to the issues they raised. We apologise for any distraction caused by this and have now submitted a tidied up version with all new modifications incorporated as suggested.

Next, the main point of the manuscript seems to be that using a vLab has advantages to using a wet lab. All of the quotes that are included in the results are about the positive aspects of the vLab. Unfortunately, the actual data collected does not support any superiority of the vLab over the wet lab. If the paper began with a purpose of collecting pilot data comparing the two, or of determining whether the vLab was equivalent to the wet lab, then there would be findings that would answer the question. In essence, they determined that it was equivalent. This is important to know, and shouldn't be hidden in the comments that seem to want to imply that it is better. So the statement of the study question and purpose of the study should be revised to reflect what was actually studied. If the real question was it is better, then the answer has to be no.

Response/modification: We have now modified the manuscript to reflect the evaluative nature of the study that shows the vLAB was no worse than and at least as useful as the real lab in teaching diagnosis of Muscular Dystrophy.

Additionally, the overall structure of the manuscript needs to be strengthened.
For example, there were several ideas to introduce in the introduction:

1. The importance of lab experiences to students’ learning of the muscular dystrophy disease processes and how they are diagnosed
2. The difficulties in running wet labs for large groups of students with limited resources and the possibility of the learners being distracted by the equipment in the wet lab and missing the important concepts it is meant to teach
3. The idea of virtual labs and how they have proven useful in the past along with the adaptive eLearning platform and its capabilities

These should be clearly introduced and discussed so that readers who are not familiar with these diseases and lab techniques have a basic understanding of what this is about and why it is important.

Response/modification: We have explicitly addressed all three above listed points in the introduction.

There are structural issues in the Methods section as well; for example there is a brief mention of the student survey without saying how many questions it had, what the Likert scale was like, and what the content was. The only hard data that was collected came from that survey, so the reader needs to know what was in it.

Response/modification: We have now provided the questionnaire in Appendix 1 and have referred to in the Evaluation-Questionnaire section of the Methods.

In Results, the whole beginning is really Methods, describing how the teaching/lab sessions were conducted.

Response/modification: We have now modified the Results section and agree with the suggestion to integrate the first part of this section into the Methods.

So, overall, the organization of this manuscript needs to be tightened up, and the purpose and findings made clear. It could likely be much shorter than it is as well, allowing the reader to more easily read the whole thing and get the main points, which I believe are that using vLabs is a reasonable way to teach the content in question, that it worked as well as using a wet lab, and shows promise in potentially improving the lab experience. It is also generalizable so that it could be used to teach other similar content.

Response/modification: We have now tightened up the manuscript and re-organised aspects of it.

In response to the third round of review by referee Dantas:

This is the third set of revisions that we have now addressed below in green. The below mentioned minor compulsory point raised in the second round of review
was also raised in the third round of review by Dantas. Modifications have been made within the document. We hope that we have now satisfied the issues raised.

Major Compulsory Revisions

1. The title of the article does not accurately reflect its content as the authors did not investigate whether the vLAB actually enhanced student learning of research and diagnostic skills.
Response/modification: The manuscript title has been re-written to reflect what is reported:
“Evaluation of an Adaptive Virtual Laboratory Environment on Student Skills Building when Learning Muscular Dystrophy Diagnosis using Western Blotting”.

2. In the abstract, under the methods sub-section, the first sentence states that The vLAB “was implemented and evaluated to assess its impact on understanding technical research skills and diagnostic skills”. The student evaluation conducted did not actually investigate the impact on understanding.
Response/modification: This sentence has now been re-written to reflect what is reported:

3. In the discussion, 3rd paragraph, 1st sentence, authors stated that “Students rated the vLAB as being most helpful as a way of learning about Western Blotting and interpreting diagnostic outcomes, when compared to the real lab in 2011”. However, the data shown in figure 5 shows no significant differences in “improved understanding” between the vLAB and the real lab and thus does not support this statement in regards to the learning.
Response/modification: This sentence has now been re-written to reflect what is reported.

4. In the discussion. 4th paragraph, last sentence, the authors state that the vLAB had an impact on learning but this was not assessed in this study.
Response/modification: This sentence has now been re-written to reflect what is reported.

Minor Compulsory Revisions

2nd round: 7. Methods section, Evaluation Questionnaires: Since they used a cross-over design for the students to complete the vLAB and real lab, can the authors please clarify exactly when the evaluation questionnaires were given to the students. The authors currently state that “These questionnaires were provided to all students upon completion of the vLAB and used Likert scale questions to allow students to draw comparisons of their understanding, confidence and learning of technical and diagnostic skills in the vLAB versus the real lab environments.” How did the students that completed the vLAB first make
such comparisons before even completing the real lab? Did the students complete a questionnaire after the vLAB and then another one after the real lab?

3rd round: 5. Methods section, Evaluation Questionnaires: Since they used a cross-over design for the students to complete the vLAB and real lab, can the authors please clarify exactly when the evaluation questionnaires were given to the students. The authors currently state that “These questionnaires were provided to all students upon completion of the vLAB and used Likert scale questions to allow students to draw comparisons of their understanding, confidence and learning of technical and diagnostic skills in the vLAB versus the real lab environments.” How did the students that completed the vLAB first make such comparisons before even completing the real lab? Did the students complete a questionnaire after the vLAB and then another one after the real lab?

Response/Modification: Questionnaires were completed at the completion of the practical class. We also surveyed the usefulness of doing the vLAB first vs second (see attached Appendix 1). The effects we observed indicated that regardless of the order of doing each lab, students found both real-life and vLAB experiences useful, with the vLAB probably most useful in preparing for their real-life LAB experience (data not shown in manuscript). This suggested that both modes when used in a blended manner probably have the best value for student learning. It is likely that students may have been exposed to real-life Western blotting in courses offered in semester 1 of Yr3.

6. In the discussion, both paragraphs discuss the diagnostics outcomes for 2011. This is repetitive and should be combined.

Response/Modification: These paragraphs have now been combined re-written to reflect what is reported, with new discussion on 2012 and 2013 data.

7. In the discussion, the authors should discuss possibilities why the student’s view of the diagnostic skills only improved in 2011. Interestingly, it seems that the percentage of students that agreed for the vLAB was consistent throughout the 3 years but it was the percentage for the real experiment that increased. Were there any changes in the way that the real experiment was conducted and taught in the last 2 years?

Response/Modification: More discussion included on the observed effects in 2011 vs 2012 and 2013 data as suggested in the above mentioned comment 7.

In response to the second round of review by referee Dantas:

While the authors have addressed some of my previous concerns, there are still some important issues that need to be addressed as discussed below.

There is a new set of revisions that we have now addressed in red. There are points raised in this second review were also raised in the first. We have indicated this in speech comments within the document. We hope that we have now satisfied the issues raised.
Major Compulsory Revisions

1. There are still some claims that the vLAB improved student learning in some way even though the authors have not provided any data to show this. For example:
   • Discussion section; 3rd paragraph: “building skills for analysing protein expression changes that cause muscular dystrophy was achieved”
     Response: This sentence has now been removed as qualitative feedback was the reason for this interpretation.
   • Conclusion; “The vLAB appeared to have positive impact on student understanding”
     Response: This point was also raised in the first review. This sentence has been re-written to remove all assertions.

2. There are still some errors in interpretation of the data which showed no significant differences. For example:
   Results section:
   • Student understanding sub-heading, 5th paragraph: “Improvements in student confidence were also evident: “It was better than the real life version.”; and “Gave more confidence on how to do it hands on” (Fig. 5).” Figure 5 does not show that student confidence was significantly higher in the vLAB compared to the real lab.
     Response: Reference to figure 5 has now been removed and the stem sentence leading into student comments has been modified as significance was not attained for this parameter.
   In the first paragraph of this section, the sentence was revised in the first round of review and has now been re-written to remove any indication that data may be trending towards significance or indicating that quantitative data may show effects for student confidence.
   • Learning of Research Technical skills by students sub-heading, 1st paragraph: “Student feedback indicated that engagement with the vLAB allowed for learning of research technical skills, which were otherwise harder to learn in a real lab environment (Fig. 5).”
     Response: This has now been re-written to refer to the qualitative data and not quantitative data presented in figure 5. The reference to figure 5 has now been removed.
   Discussion section:
   • In the discussion, the authors ignore the fact that the improvement in diagnostic skills occurred in only 1 year. They should state that whenever they discuss the improvement in diagnostic skills.
Response: We have now revised the text such that only the diagnostic data from 2011 is referred to.

- 4th paragraph: “The evaluation questionnaire data revealed that the vLAB also had the effect of students’ acquisition of technical and diagnostic skills...”
Response: This has now been re-written to refer to 2011 data

- 5th paragraph: “teaching the link between technical skills and diagnostic skills in disease was achieved.”. How does the data show that?
Response: This statement is now removed as the data does not show this direct effect.

Conclusion section:

- 1st paragraph: “The vLAB had a positive impact on student learning, including improved student understanding and diagnostic skills.”
Response: This statement has now been re-written and is also related to point 1, raised above.

3. The authors need to re-write the above sections of the article and remove all references to differences in the questionnaire data other than the statistically significant difference for “Improved Diagnostic skills” for one year.
Response: All references to questionnaire data that is not for the significant data reported in 2011 is now removed.

4. In general, the authors should avoid stating that there are “trends” in the results if there are no significant differences. It would also be useful to have the p values for the data that they claim there are trends in. If these p values are not close to significance, then the authors cannot state that there is a trend in the data.
Response: All interpretations using ‘trends’ are now removed throughout the document.

5. Instead of discussing “trends” in the data where there are no significant differences, the authors should concentrate more on the discussion of the positive aspect that the evaluation questionnaire data for the vLAB was comparable to that of the real lab. Thus, students perceived that the vLAB was as useful as the real lab in the areas evaluated.
Response: We have now concentrated on the positive aspects of the evaluation data as suggested.

6. Discussion section; 3rd paragraph: “Student feedback demonstrated that they
enjoyed being able to use the vLAB to prepare for real lab ‘hands on experience’ and generally enjoyed the interactivity and immediate feedback that the vLAB provided at each step.” Was that feedback provided via comments or from questions with Likert scales? If it was the latter, then the data should be included.

Response: This data was via student comments not quantitative data.

Minor Compulsory Revisions

7. Methods section, Evaluation Questionnaires: Since they used a cross-over design for the students to complete the vLAB and real lab, can the authors please clarify exactly when the evaluation questionnaires were given to the students. The authors currently state that “These questionnaires were provided to all students upon completion of the vLAB and used Likert scale questions to allow students to draw comparisons of their understanding, confidence and learning of technical and diagnostic skills in the vLAB versus the real lab environments.” How did the students that completed the vLAB first make such comparisons before even completing the real lab? Did the students complete a questionnaire after the vLAB and then another one after the real lab?

Response: Questionnaires were completed after the vLAB. We also surveyed the usefulness of doing the vLAB first vs second. The effects we observed indicated that regardless of the order of doing each lab, students found both real-life and vLAB experiences useful, with the vLAB probably most useful in preparing for their real-life LAB experience (data not shown in manuscript). This suggested that both modes when used in a blended manner probably have the best value for student learning. It is likely that students may have been exposed to real-life Western blotting in courses offered in semester 1 of Yr3.

8. There are some instances where spaces are missing. For example, Results section, 2nd paragraph; “within the vLAB (Figs. 1 and 2). Embedded”

Response: These edits are now made.

9. Results section, 3rd paragraph: There is no need to include reference 20 when referring to the vLAB in the current study.

Response: Reference 20 is now removed.

10. Discussion section, 6th paragraph: An “of” is missing for “a perceived improvement in some aspects understanding.

Response: ‘of’ is now inserted into the sentence.