Reviewer's report

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

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Reviewer: Linda Lewin

Reviewer's report:

This manuscript is timely and interesting; using learning technology to enhance educational activities and potentially conserve valuable resources is the way education needs to go. Using a virtual laboratory to teach something that was previously taught in a wet lab seems like an excellent idea. Having said that, this manuscript needs a great deal of reorganizing and refocusing to make it useful to others.

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.

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.

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.

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.

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

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.

**Level of interest:** An article of limited interest

**Quality of written English:** Needs some language corrections before being published

**Statistical review:** No, the manuscript does not need to be seen by a statistician.

**Declaration of competing interests:**

I declare that I have no competing interests.