Author's response to reviews

Title: Enhanced virtual microscopy for collaborative education

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Version: 2 Date: 10 January 2011

Author's response to reviews: see over
We appreciate receiving the comments from the review of our manuscript. We have now responded to each of the issues raised by the reviewers as presented below and in the revised manuscript. These comments have certainly improved the manuscript and we appreciate the opportunity to return it to you for consideration of publication.

**Reviewer 1:**
Major essential revisions:
Point 1:
1. The “background” information given is relatively poor and adds nearly nothing new to that what is already known about virtual microscopy. Therefore, it should be reduced to about 15 lines. Just recently a nice review article was published by Paulsen et al. that gave really good background information. It would be enough to cite this and other articles. Moreover, the authors should be aware that there are also readers outside the US. Therefore, abbreviations like AAMC and the Howard Hughes Institute need much more explanation if used. It is absolutely not clear to this reviewer what the authors want to tell with the last two sentences of paragraph 1.

The background section has been shortened significantly and some of the supporting content has been moved to the discussion. In the interest of brevity in this section as well as to avoid any US-specific references, we eliminated the section on the AAMC-HHMI report. We already cite numerous reviews and reports in this section and have added additional ones to include the paper by the reviewer and others.

3. Also the statement “With the introduction of robust commercial systems, their use has become widespread throughout education“ is not correct. I agree that the number of medical schools that have established a VM offer increased dramatically during recent years, however, we are far away from a point where VM is widespread used throughout education at least if looking throughout the world. Most medical schools so far teach with conventional microscopes. Nevertheless, I absolutely agree with the authors that VM will be the future in teaching histology, histopathology and associated fields.

This is an excellent point and the language of this sentence has been softened to reflect the suggestion.
Point 2:
A. Analysis of how often, how long and when the system was frequented outside of the course periods. (This has partly been done).

This analysis was performed and is now included in the results section.

B. Analyses as to which specimens were particularly intensively used by the students.

This analysis is referenced in the results and the data are included in the new Table 1.

C. By “Tracking” (log-files) the portions of the pictures which have been particularly intensively viewed by the students specimens can be retraced in the respective or with other words what was of particular relevance to the student.

This analysis is referenced in the results and the data are included in the new Table 2.

C. Analysis of the extent to which histological specimens were being used in the framework of case presentations.

We unfortunately do not have access to these data as neither the faculty nor the students recorded or reported this type of use outside of the formal Histology curriculum.

D.Collection of evidence as to whether virtual microscopy may also be useful for other medical disciplines.

This is now mentioned in the background and additional references are included with supporting evidence.

Point 3: The paragraph about the examinations is less useful and should be omitted. Only two student years are compared and populations in two different years might be very different. It would have been much more effective to compare different populations of the same cohort in one year or in both years.

We agree that a “within cohort” comparison would have been ideal however the nature of the initial implementation and adoption by faculty did not permit this prospectively. We feel that the exam features of our system are unique and something that many readers are seeking, as pointed out by another reviewer. With this in mind, we have kept this paragraph and added clarification of the comparison.

Point 4: The discussion section is not a discussion section but more a hymn on the authors system. Not even one citation has been discussed in this section although there is already a bulk of literature. Therefore, this sections needs to be rewritten.
The discussion section has been heavily revised, including changes suggested below. Citations were added with supporting evidence.

**Reviewer 2:**
Minor essential revisions:
1. More info on impact of not teaching the manual skills of using a microscope. Citing others’ reflections on this matter would be sufficient.

This is now addressed in the Discussion section.

2. Also what kind of dependence is there on Google and what happens if their code changes or is pulled?

This is an excellent point and text about this was added to the ‘limitations’ paragraph in the discussion.

3. Several text edits:
   p4 "but rather the function" should be something like "but also the function"
   p5 "user preference and adoption" should be something like "user preference and their uptake of the system"
   p6 "just once and available" should be something like "just once and then made available"
   p8 "is as easily and broadly" should be something like "is as easy to use and broadly"
   p9 "can be collapse so" should be "can be collapsed so"

All of the suggested edits above are now reflected in the revised text.

4. p9 "the social curation of folksonomy" needs to be better explained

Additional explanation was added to this paragraph and a reference to a publication with much more detail is also now included.

5. p11 "far more efficiently" - please unpack and explain

As part of an expanded section on the exam capabilities, additional text was added to better describe these features.

6. p11 "We implemented the system ..." - please explain how the two were used together - at the same bench, alternating classes, separate cohorts?

Additional information was added here to clarify the initial introduction of the VM system.

7. And finally the screenshot: although the histology is clear the interface is rather small - please redo at a lower screen resolution to make the interface clearer

The screenshot has been reformatted at a lower resolution. We also now include two additional screenshots illustrating other aspects of the system.
Reviewer 3:
1. The authors imply that only enrolled students and faculty can tag and vote, but don’t specifically state that other users (general public) will not be able to logon to the system. There should probably be a statement that the tagging feature and some materials (lab materials) can only be used by students and faculty members.

A note clarifying this fact was added to the Dissemination section.

Minor essential revisions
1. Throughout the paper, ‘searchable’ is listed as ‘search-able’. Searchable is a standard word and should be the preferred term. Minor issue not for publication

This change was made.

2. Background. Paragraph 1, third line from the bottom: Change cellar to cellular.

This change was made.

3. Implementation. Page 9 line 3: change collapse to collapsed. Minor issue not for publication

This change was made.

4. Discussion, second paragraph, first line: microscope should be microscopes. Minor issue not for publication

This change was made.

Major essential revisions
5. Implementation. Page 9 second full paragraph: Use of ‘folksonomy’ seems non-standard and should probably be avoided – general readers may not be familiar with the term. Consider replacing with a more standard term or definition. In addition, this sentence is poorly structured.

This section was revised and both additional text and a reference was added.

6. Results. Regarding comparison of exam scores, were the exams identical? Same questions and slides used for both? Same format? If the exams were not identical, how does this impact the comparison of scores?

We added clarification to the sentence in the results section indicating that the exams were identical.

7. Discussion. Paragraph 1. The authors state that VM was met with ‘enthusiastic’ adoption – what are they basing this on? They didn’t show any data relating to student enthusiasm and did not reference any previously published reports.
We agree with this observation and have removed that from the first line of the discussion.

8. Discussion. Paragraph 1. The authors state that VM has not had any negative impact on practical exam performance – this statement should be softened a bit since they only did a single comparison of one exam. Same thing for the conclusion statement regarding student performance and for the abstract. At best, the authors can conclude there was no major difference in a single comparison of similar (identical??) tests administered before and after adoption of VM, a finding that is similar to other studies.

We agree and have used the suggested language in the relevant sections.

9. Discussion. Regarding the discussion on the change in the structure of laboratory sessions – none of this is presented in the implementation or results sections, although it was mentioned as being planned in the background. If this is included in the discussion, some sort of description of the changed to the lab structure should be in the implementation section and observational or descriptive data should be included in the results, or the authors need to state that the data wasn’t shown/captured.

The ‘Pilot’, results and discussion sections were revised to clarify the methodology and results.

Discretionary revisions

10. Implementation. How is security maintained when administering exams on laptops via a web-based application? Or are exams ‘open-web’ and ‘open-hard drive’? This is not the focus of the paper, but is an issue of general interest. This isn’t critical to include for publication.

This topic was given a new subheading (Practical Examinations) and additional clarification was added to address the reviewer’s query.

11. Results. It would have been nice to include student survey data showing preference for the system or to document ease of use. It would also have been good if the authors could have found a way to include data showing some sort of benefit from the greater collaboration students engaged in either by some sort of outcome assessment or by survey. This isn’t critical to include for publication.

We certainly agree and hope to do this in the future using a prospective design.

12. Discussion. Paragraph 2, student usage data – do the authors have any previous usage data from when the course was taught using glass slides to compare with? Can they show that students actually spend more time viewing slides because of digital access? When taught using glass slides, were students restricted to certain hours of access to the slides/microscopes? If any of this can be included, it will help build the cases that students study more or spend more time viewing slides because of digital access. This is a minor suggestion and is not critical to include for publication.

We unfortunately have no data from the use of physical microscopes. The ability to monitor and quantify student usage of the VM is one of its advantages.
13. Discussion. It is too bad that the authors were unable to include student and faculty survey data which could have supported student and faculty preference for the system and also could have supported increased student usage (over glass slides) as well as increased student collaboration both in and out of the lab. This would have enhanced the paper but is not critical for publication of the study.

We certainly agree and did not anticipate that the success of the system would so quickly translate into the course directors moving completely to the VM and removing our opportunity to do that comparative survey in a controlled fashion.

We sincerely hope that these revisions and responses will clarify and strengthen the manuscript to allow final acceptance. We look forward to your comments.

Respectfully,

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