

The Use of Digital Microscope in Oral Pathology Teaching

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Abstract

Oral Pathology course has always been synonym with practical learning using microscope to identify histological features in order to diagnose. However, many students had expressed their difficulty in learning this subject when using light microscope (LM). The study was to evaluate the effectiveness of digital microscope (DM) as a teaching aid in Oral Pathology. 53 students of 4th year Dentistry at Dental Faculty, Universiti Kebangsaan Malaysia (UKM) were required to view 20 pathological cases, both under LM and DM and diagnose them. Questionnaires on their preference microscope were evaluated. There were 92% response rate to the survey. 87% students preferred DM over LM. 92% students agreed that DM positively improved their learning and had sufficient resolution to allow identification and magnification of the slides viewed. 95% students agreed that DM was effective for the course purpose. For the diagnosis exercise, all participants managed to answer correctly using DM compared to LM. Therefore, it was shown that the students' favored DM more than LM. Thus, indicating that this should certainly be integrated as a teaching tool to enhance the learning process within the dental curriculum in the future.

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Introduction

Virtual microscope was introduced in 1997 by the Computer Science Department at University of Maryland and The Pathology Department at Johns Hopkins Hospital, Baltimore, Maryland.¹ Virtual microscope is obtained by scanning specimen slides under high resolution (can be up to 40x objective), making them amenable to be analyzed and interpreted via the computer.² Virtual microscope has allowed for analysis of automated images using specific algorithms. It also allows the ability to edit specific region within a slide, which has shown to have a great impact in research development and also student's participation in classes. Virtual microscope has eliminated the need to support large expensive microscope laboratories.

However, the term 'virtual' as stated is somewhat confusing and is agreed as mentioned by Rojo *et al.* 2006, when they wrote "Because the digital image is not less real than the one provided by the optical microscope, we believe that the term virtual is not an accurate term and we prefer the term digital microscopy." Recent studies have shown that digital microscope is gaining popularity in multiple medical and dental school as teaching aid.²

Identification of specimen via light microscope is part of curriculum during oral pathology classes. However, most students dislike using light microscope as they find it difficult to manipulate this equipment and to appreciate the histological features on the glass slide. The idea of converting the glass slide into the digital slide brings a new revolution in dental education especially in oral pathology subject. Traditionally, LM requires large space for installation and placement compared to DM. In term of financial value, application of DM can help institutions to save space for storage of a large quantity of LM in order to accommodate with the number of student in the class. Furthermore, DM allows the slides digitally scanned at high resolution and all the data to be

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saved in the computer. This can prevent specimen loss due to breakage or misplace, as well as abridge slide analysis for research.³ DM still has no statistically significant influence on academic performances among the student. Most of the researchers only assessed student perception when using DM compared to LM by using questionnaire to evaluate the result.² In our study, we compared student's performance in identifying oral pathology cases when using LM and DM.

Methods

Ethical approval was obtained from Research Ethics Committee Universiti Kebangsaan Malaysia (RECUKM); UKM PPI/111/8/JEP-2017-668. Convenient sampling of 53, 4th year students of Dental Faculty of The National University of Malaysia (UKM) was done. Informed consent was obtained from all the subjects. All students had undergone Oral Pathology lecture series according to the curriculum.

Digital slide preparation

Ten selected cases of histology slides were scanned using Precipoint M8 microscope scanner and the images were uploaded in the computer using OlyVIA viewer software. This software enables remote access to slide image server by LAN/www. It provides high speed image transfer via LAN/WAN and also high image quality. The OlyVIASWeb viewer is also compatible with MAC software and can be viewed as .vsi files using this software. Annotations and text are also available for students to mark on the images as they are studying.

Making diagnosis using DM and LM

Students were briefed on instructions the usage of the LM and the DM software. Afterwards, they viewed the slides and diagnosed 10 pathological cases each both under LM and DM of these lesions.

Student perception

At the end of the session, students were asked to complete a questionnaire to evaluate their perception on LM and DM. The questionnaire was adapted from Zachary RM and Bruno CJ² and conducted in online form. It

consist of nine questions, each with three possible answers: agree, undecided, disagree.

DM/LM Diagnosis Exercise

Diagnosis exercise done to compare the effectiveness of DM and LM. Fifty-two students were selected for the LM session while only 51 students were included for the DM session. The remaining students were excluded due to color blindness.

Results

Forty-nine students out of 53 students responded to the questionnaire contributing to 92% of response rate to the survey. From the respondents, 87% stated they preferred the use of DM over the use of LM. However, only 2% reported a preference for the LM, while 10% were undecided. Ninety-two percent of students agreed that DM positively improved their learning and had sufficient resolution to allow identification and magnification of the slides viewed. When asked which navigation was easier, 94% of the sample agreed that DM was easier. Ninety-five percent also agreed that DM was effective for the course purpose. DM brought more fun compared to LM as stated by 80% of the sample and 92% also agreed that DM software allowed for better collaboration with other participants.

We had classified the questionnaire into 3 parts which are part 1: student's perception (Question 1 and 2), part 2: easy to manipulate (Question 4, 5, 6 and 7) and part 3: attractive teaching experience (Question 3, 8 and 9). Based on the graph (Figure 1, 2 and 3), 87% student preferred DM compared to LM. More than 92% of student claimed the DM was easier to manipulate and more than 80% having fun while using DM during oral pathology classes.

For the LM session, 50 students managed to answer the correct diagnosis of lesions and scored more than 50%. However, 2 students failed and scored less than 50%. The average marks for LM was 77%. For the DM session, all participants managed to answer correctly the diagnosis and scored more than 50%. The average mark was 93% ±9. To compare between DM and LM, Mann Whitney U-test was used to analyze with $P < 0.05$.

QUESTION
1. I preferred the digital microscope to the light microscope
2. I preferred the light microscope compare to digital microscope
3. Using of the digital microscope enhanced my learning of the material
4. The maneuverable images studied with the digital microscope were of sufficient resolution to allow identification of the required organs, tissues and cells
5. The digital microscope had sufficient magnification potential to allow me to examine the tissues and cells in great detail
6. Navigation of the images with the digital microscope viewer was easier than that of the glass slide
7. The software viewing technology used in the digital microscope was effective with the purpose of this course
8. Using the digital microscope was more fun than using the light microscope
9. The digital microscope software allowed for greater collaboration with other student

Table 1. Survey Questions Adapted from Zachary *et al.* 2013.

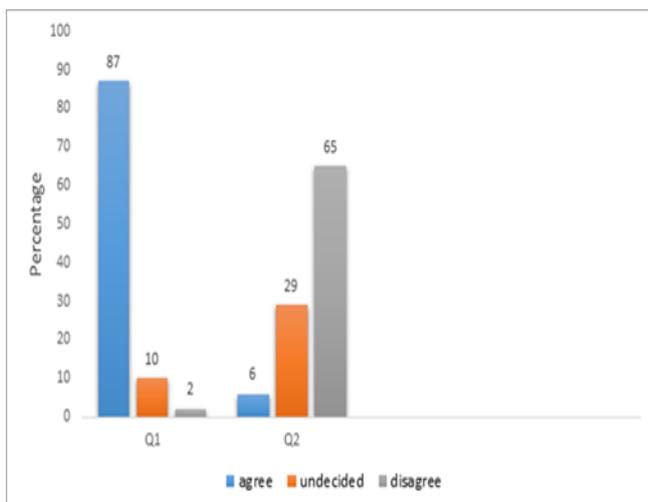


Figure 1. Student's Perception Towards Digital Microscope and Light Microscope.

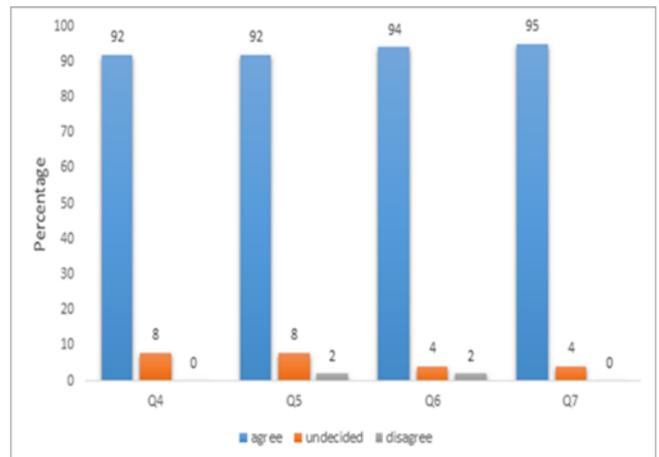


Figure 2. Ease of Manipulation with Digital Microscope.

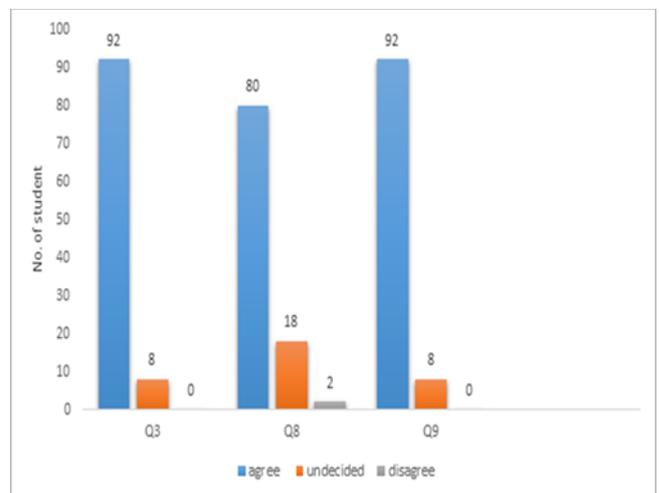


Figure 3. Attractive Learning Experience with Digital Microscope.

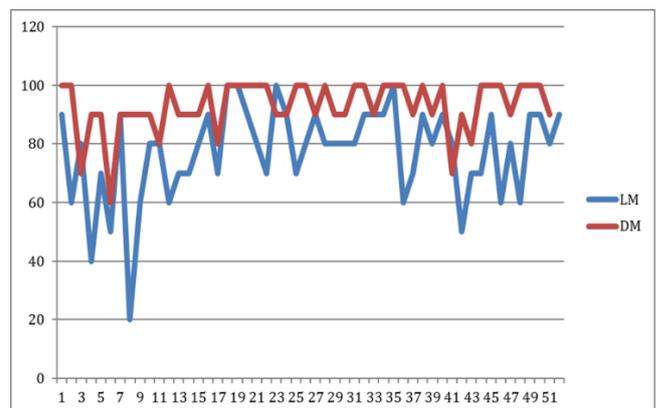


Figure 4. Student's Assessment Performance using LM (Blue Line) And DM (Red Line). The Passing Mark Is 50% for the Assessment.

Discussion

In this study, the aim was to evaluate the effectiveness of DM as a teaching aid in oral pathology. From the results, majority of students preferred DM over LM adding up to a total of 87%. This is comparable to studies done by Zachary *et al.*², Hao YU *et al.*⁴, Farah *et al.*⁵ and D. J Brierley *et al.*⁶, as all respondents gave the inclination of preference towards DM. It is important to obtain student's feedback on the learning resources in the educational services and this study showed that majority of the students prefer DM.⁷ Amongst advantages of DM that we observed was that there was no longer the need to redirect and refocus the image on the conventional microscope in order to view illustrations as in the textbook.⁶ Everything was made easy by using the mouse and clicks of the buttons at the tip of your fingers to maneuver the images. Thus, moving towards a paperless environment where technology is used to combine data for educational training.⁸ It was also found that students were more alert and engaged when using DM compared to LM as 80% agreed that it was more fun to utilize.

Besides that, the biggest impact was that the images can be viewed by more than one person at any time, as the software also allows for group chats and discussions. The interactive learning using DM may change the lecturer role from sole knowledge provider to a moderator by converting conventional discussion in the classroom using LM to online forums with DM that is more engaging for the students.⁹ These allow the students to have more understanding and be more confident in learning oral pathology as they are viewing the same images as the lecturers and tutors.¹⁰ This in hand also eliminates the need to have multiple microscopes to compensate for the amount of students in each class every year which is not very cost-effective. Some of the students who participated in the workshop also expressed that they found more interactive way of learning this particular subject as to being alone with the LM and not knowing what they were looking at. Most agreed that this facility helped them to appreciate it more and being able to correlate it in the clinical settings.

DM also eliminates the need for slide maintenance as over time, the hematoxylin and eosin (H&E) staining are prone to fade or they

can be accidentally broken.² The ability of DM to maintain image quality, speed and efficacy also serves as a major benefit.¹⁰ Furthermore, the ability to provide a bank of standardized images¹¹ and annotate directly on the images¹² could serve as a start to technology advancements in learning pathology. With the use of this software, students or teaching staffs will also be able to access and view the slide images at their own time allocation thus making learning not restricted to office hour's only.¹²

Even with many beneficial outcomes there were also some setbacks, one being that the lecturers and tutors need to be well versed in the software in order to manipulate the DM.² However, we did have a technician on standby to assist in any hiccups along the workshop. Also DM requires quite some time to completely scan an image and the larger the specimen the longer time it takes to complete. Furthermore, only one image can be scanned at one time. Besides that, DM would also have its financial drawbacks such as it require high bandwidths and large digital storage plus backup modalities.¹³

Amongst our objective was also to assess students' performance in identifying oral pathology cases when using LM and DM. Although some research suggested conversion to DM had no statistically significant effect on academic performance.¹⁴ However, a study done by Raja S¹⁵, suggest that there is a significant effect on students' academic performance. Our study also supports this outcome as we have evidence that it does have a significant impact on improvement of the students' academics. This is shown by where all the students who participated in the DM diagnosis exercise were able to get correct diagnosis and score marks of more than 50%. While for LM, 2 students failed to get marks more than 50%. If it were to be implemented permanently into the dental curriculum, surely students will be well versed in this particular subject. Thus it would be possible to curb the failure rate amongst students in the future. The DM can improve the students' knowledge of Oral Pathology course through this interactive learning and may also increase the lecturer satisfaction in teaching this course.¹⁶

Even with promising results, our study did have its limitations, including that we did not assess the quality and quantity of previous LM exposure. Some students did not respond to the questionnaire. Furthermore, the questions asked

in the survey was closed ended ones and did not give freedom for students to elaborate their opinions.

Conclusion

During this technological era, DM is becoming more recognized in multiple fields, including dentistry. From our study it was found that the students' favored DM more than LM, indicating that this could be integrated as a teaching tool to enhance the learning process within the dental curriculum in the future. We also propose further long term monitoring of the efficacy of this teaching modality.

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