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USAGE OF INTERACTIVE VIRTUAL REALITY TECHNOLOGY IN PRE-CLINICAL MEDICAL CURRICULUM DELIVERY

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Abstract

Teaching pathology in graduate entry medical education is predominantly through didactic lectures. Other innovative forms of imparting pathology education, such as learning through virtual microscopy, is necessary in the advancing trend of the medical curriculum. With increasing number of disease processes, some medical universities are now using more state-of-the-art technology driven software. The ultimate goal of the study was to provide options for students and teachers to use virtual microscope learning modules corresponding to key topics in pathology. Through the pathology sessions in years 1 and 2 in the graduate entry medical curriculum, we developed a series of virtual microscopy sessions. A total of nine pre-clinical

modules consisting of 224 respondents were done. The students were invited to take part in an evaluation exercise consisting of basic survey questions. The anonymous data were analyzed qualitatively. A significant number of students responded positively for three important themes: (1) the virtual microscope sessions positively influenced more enthusiasm in learning pathology (84%), (2) both VM and a clinicopathological discussion in the form of case study were necessary to achieve those skills (76%), and (3) the VM sessions led to a sense of personal development as a student (71%). An interactive discussion with the students revealed that they were interested and quite enthusiastic to gain knowledge by this module, which depicted the picture, gross & microscopic with some salient text notes, and they felt that this would also be useful for them in tackling the exams, and in future, during their clinical exposure.

Keywords

Virtual, Pathology, Microscope, Curriculum, Medical

1. Introduction

Compared to didactic lectures, teaching the skill of pathology through other forms of instruction is often lacking in medical education. Other innovative forms of imparting pathology education, such as learning through virtual microscopy, is necessary in the advancing trend of the medical curriculum (Dee & Meyerholz, 2007). For ages, traditional teaching in medical education, especially in Pathology, has always relied on tissue slides of various diseases which are studied under the microscope. With increasing number of disease processes, and various pathology changes presented by many disease variants, especially in the study of cancers and infections, some medical universities are now using more state-of-the-art technology driven software to the knowledge hungry student of the 21st century, not only for medical students but also for dentistry and veterinary science students (Mills et al, 2007; Farah & Maybury, 2009).

Keeping this in mind, Perdana University Graduate School of Medicine, Malaysia, uses Mscope, an interactive virtual microscope, extensively for histology & pathology teaching. This provides online access to an expanding digital archive of high resolution scanned images of many common and important diseases, infections and cancers of human tissue sections, prepared over several years using many different staining methods. These images have been annotated by trained pathology faculty to highlight key learning points; students can access this using a personal user account. Online evaluations with formative feedback, case atlases, course materials

and media library enable students to test their understanding of pathology, compare normal and abnormal tissue, and the link between structure and function.

This interactive computer-based technology offers the full range of traditional microscope functionality to the medical students to access from outside university premises, such as from their homes, thereby serving as an enhanced curriculum delivery for distance learning and self-directed learning. The use of virtual microscopes has transformed traditional teaching methods by removing the reliance on physical space, equipment, and specimens to a model that is solely dependent upon computer-internet access. This rich database is enhanced with clinical presentations, laboratory data, comprehensive morphology interpretations, and diagnoses (Brachtel & Yagi, 2011).

MScope's hematology section has a huge collection of diseases and cancers of the blood, and imparts an understanding of blood cell morphology and identification for hematology training, representing a variety of diseases, common, rare and unique (Sims et al, 2009). Glass microscope slides are fragile, fade over time, and are extremely difficult to duplicate because they have been created from actual patient samples. Hence, by digitizing the slide sets, this resource is preserved and can be accessed online by more students.

2. Objectives

To organize better computer based virtual microscopy educative sessions for students in learning pathology. To encourage the students to utilize the virtual microscopy facility. To enhance small group interactive sessions. The ultimate goal of the study was to provide options for students and teachers to use virtual microscope learning modules corresponding to key topics in pathology.

3. Design

Through the pathology sessions in years 1 and 2 in the graduate entry medical curriculum, we developed a series of virtual microscopy sessions. This provides online access to an expanding digital archive of high resolution scanned images of many common and important diseases, infections and cancers of human tissue sections, prepared over several years using many different staining methods (Figure 1, 2, 3). These images have been annotated by trained pathology faculty to highlight key learning points; students can access this using a personal user

account. The system includes several features to annotate slides with markers that act as visual signposts placed on the slide itself and with descriptions. The lecturer can add information to every slide in the following categories: source tissue/organ type, stain, preparation, section type, scan level, and diagnosis. All of these data are searchable so that faculty and students can quickly find all slides of a given tissue type or stain for example. The system also has a feature where the lecturer can attach links to other slides and students can easily see a different example of the same tissue or structure. Our VM also permits students and faculty to add random text tags to any slide. This approach allows the entire educational community at our school to add additional searchable terms, create ad hoc or informal collections of slides, or to organize slides in unanticipated ways.

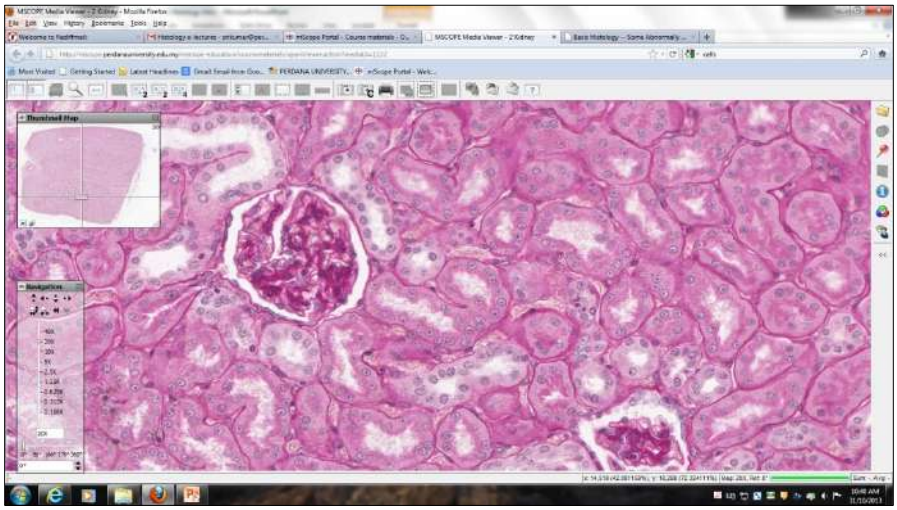

Figure 1: *Snapshots of the MScope during a Virtual Microscopy Session on Renal Pathology*

Figure 2: *Snapshot of the MScope showing the Case Discussion Topics during a Virtual Microscopy Session on Basic Histopathology*

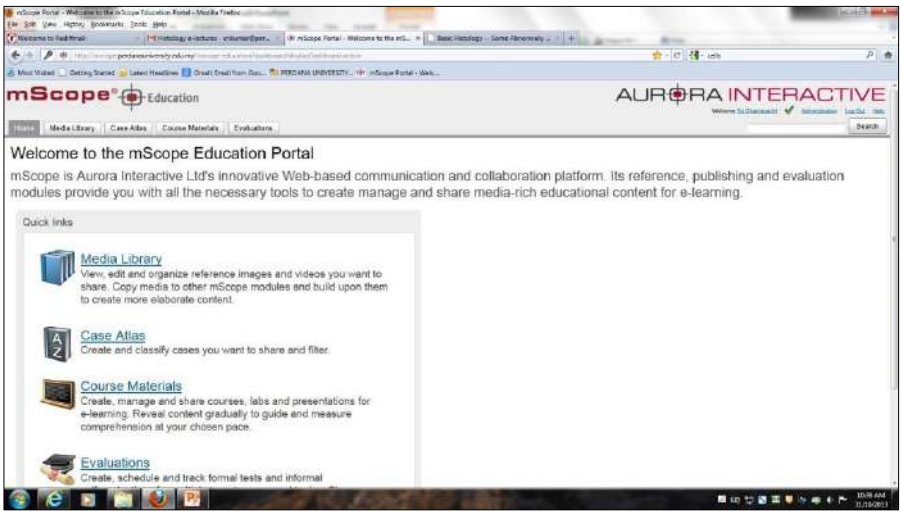

Figure 3: *Snapshot of the MScope showing the main menu after login which each student is able to view*

Online evaluations with formative feedback, case atlases, course materials and media library enable students to test their understanding of pathology, compare normal and abnormal tissue, and the link between structure and function. The sessions involved facilitating by lecturers. To evaluate the course's effect on the student's skills, we performed a qualitative evaluation of the students.

4. Methods

A total of nine pre-clinical modules consisting of 224 respondents were done. The students were invited to take part in an evaluation exercise consisting of basic survey questions

(questionnaire as in table 1). Question areas included the most memorable experience, the course's influence on the student-student and teacher-student relationship, and usefulness during pre-clinical years of graduate medical school, and skills, which would help them in clinical years. The anonymous data were analyzed qualitatively.

Table 1: *Questionnaire provided at the end of each module*
Feedback on MScope Virtual Microscopy

Please tick (✓) where most appropriate.	**1**	**2**	**3**	**4**	**5**	**6**
1. Understanding Pathology images and interpretation is a difficult task						
2. I am able to understand Pathology images by means of lectures, VM sessions and independent reading						
3. Pathology image identification and description need a facilitator						
4. I found the MScope content clear and useful						
5. I found the material presented in MScope engaging						
6. Learning Pathology images by MScope is better than reading text books						
7. I found navigation through the MScope content easy						
8. The details provided were found to be useful to understand the images						
9. The drop pins on the images were useful to understand the different areas of the image						
10. MScope helps me improve my understanding of pathology						
11. MScope will help me improve my performance in exams						
12. It was easy to access MScope on moodle portal						
13. I would like to see collaborative learning with other students in an online discussion forum						
14. In addition to MScope shown in the sessions, I also access MScope while studying at home						
15. The images were of good clarity						
16. I would like this activity to be implemented in all semesters						

Comments (if any)

……
……
……

Scoring guide

1= strongly disagree; 2= disagree; 3= somewhat disagree; 4= somewhat agree;

5= agree; 6=strongly agree

5. Results

A significant number of students responded positively for three important themes: (1) the virtual microscope sessions positively influenced more enthusiasm in learning pathology (84%), (2) both VM and a clinicopathological discussion in the form of case study were necessary to achieve those skills (76%), and (3) the VM sessions led to a sense of personal development as a student (71%). Other parameters, such as the course's influence on the student-student and teacher-student relationship, usefulness during pre-clinical years of medical school, and skills which would help them in clinical years, were all rated above 80%. In addition, students responded that the training in observation and description skills they learned were unique. Annova was used as the standard statistical parameter to validate the results ($p<0.05$)

The use of the VM system reduced the amount of time the lecturer spent teaching the module, but did not reduce the number of laboratory sessions or the number of required faculty. Due to the efficiencies and workflow of the VM system, laboratory sessions were reduced from three hours to two hours without reducing the number of slides taught in each session. The laboratory duration reduced the overall facilitating time by 26%, saving 40 hours per year in faculty time and freeing up an additional 40 hours of laboratory space for other courses.

Though we did not formally assess the workflow changes that enabled the reduction in laboratory session duration, reports from faculty credited the continuous access to all specimens and the students not having to share slide boxes and wait before they could use a given slide. Student performance on the end of module exam was compared from one year prior to, and one year after the transition from microscopes to the VM. Their performances were better in the USMLE part 1, which contains picture based vignettes in pathology component.

6. Discussion

This interactive computer-based technology offers the full range of traditional microscope functionality to the medical students to access from outside university premises, such as from their homes, thereby serving as an enhanced curriculum delivery for distance learning and self-directed learning (Weaker & Herbert, 2007). The use of virtual microscopes has transformed traditional teaching methods by removing the reliance on physical space, equipment, and specimens to a model that is solely dependent upon computer-internet access (Mark & Holloway, 2011). This rich database is enhanced with clinical presentations, laboratory data, comprehensive morphology interpretations, and diagnoses (Camparo et al, 2012).

An interactive discussion with the students revealed that they were interested and quite enthusiastic to gain knowledge by this module, which depicted the picture, gross & microscopic with some salient text notes, and they felt that this would also be useful for them in tackling the exams, and in future, during their clinical exposure.

Overwhelmingly, students wanted virtual microscopy sessions available for study and review during the modules, before exams and also remote access from home. Students identified many advantageous features, which included winning the first place in a national level Pathology quiz.

The Virtual Microscope MScope allow medical students to access pathology microscope slides through an online database for distance learning and enhanced curriculum delivery (Dick, 2000). The Virtual Microscope MScope database offers a high quality resolution of 100X oil immersion, which is necessary for the proper examination of blood cells. The use of virtual microscopes can transform traditional teaching methods by removing the reliance on physical space, equipment, and specimens to a model that is solely dependent upon computer-internet access. This rich database is enhanced with patient clinical presentations, laboratory data, comprehensive slide interpretations, and diagnoses.

6.1 Benefits of MScope

6.1.1 Less expensive - the cost is less than that of replicating, creating, and storing glass slide sets.

6.1.2 High quality - the digitized slides have a high resolution of 100X oil immersion. Glass slides are fragile, can be easily broken or damaged, and can fade (Harris et al, 2001).

6.1.3 Convenient - slide sets can be accessed through an online database, anywhere, anytime. No longer dependent on availability of space, equipment, or specimens (Neel et al, 2007).

6.1.4 Access - increases availability of hematology slide sets to students, even while outside campus

7. Conclusion

Our virtual microscope system has been an effective solution to the challenges facing traditional histopathology laboratories and the novel needs of our revised curriculum. The use of a web-based system empowered learners to have greater control over their content and work together in collaborative groups. The VM system saved faculty time and enhanced student performance during their exams.

After having used virtual microscopy in our University for 3 years since its inception, it is evident that VM technology is effective for the new generation pathology education in undergraduate medical teaching, and may be suitably implemented in other student centered pedagogic models, including integrated and problem-based learning curricula and in traditional education system.

Research Limitation: The limitations in this study included the short period which resulted in a smaller student number sample; the lack of previous similar works, as this is a new kind of technological innovation; and the qualitative aspects of student responses. However, we take this as a pioneering study in Malaysia in field of virtual imaging, and hope that this research work serves as a shining example for further similar kind of further research in the future.

References

Brachtel E, Yagi Y (2012). Digital imaging in pathology--current applications and challenges. Biophotonics. 5(4):327-35.

Camparo P, Egevad L, Algaba F, Berney DM, Boccon-Gibod L, Compérat E, Evans AJ, Grobholz R, Kristiansen G, Langner C, Lopez-Beltran A, Montironi R,Oliveira P, Vainer B, Varma M (2012). Utility of whole slide imaging and virtual microscopy in prostate pathology. APMIS. 120(4):298-304.

Dee FR, Meyerholz DK (2007). Teaching medical pathology in the twenty-first century: virtual microscopy applications. J Vet Med Educ.;34(4):431-6.

Dick FR (2000): Web-Based Virtual Microscope Laboratories. Pathology Education, 25(2):58-62.

Farah CS, Maybury TS (2009): The e-evolution of microscopy in dental education. J Dent Educ, 73:942-949.

Harris T, Leaven T, Heidger P, Kreiter C, Duncan J, Dick F (2001). Comparison of a virtual microscope laboratory to a regular microscope laboratory for teaching histology. Anat Rec, 265:10-14.

Mills PC, Bradley AP, Woodall PF, Wildermoth M (2007). Teaching histology to first-year veterinary science students using virtual microscopy and traditional microscopy: a comparison of student responses. J Vet Med Educ.;34(2):177-82.

Marc M Triola, William J Holloway (2011). Enhanced virtual microscopy for collaborative Education BMC Medical Education, 11(4):18-24

Neel JA, Grindem CB, Bristol DG (2007). Introduction and evaluation of virtual microscopy in teaching veterinary cytopathology. J Vet Med Educ, 34:437-444.

Sims MH, Mendis-Handagama C, Moore RN (2007). Virtual microscopy in a veterinary curriculum. J Vet Med Educ, 34:416-422.

Weaker FJ, Herbert DC (2009). Transition of a dental histology course from light to virtual microscopy. J Dent Educ 2009, 73:1213-1221.