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Brief Communication

Comparing the use of virtual and conventional light microscopy in practical sessions: Virtual reality in Tabuk University

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Abstract

Virtual microscopy has an established role in medical practice and education across all medical disciplines. It provides economical and pedagogical advantages, albeit with some shortcomings.

We randomly assigned two groups of second-year medical students from the University of Tabuk in KSA to use either conventional light or virtual microscopy practical sessions. The students' perceptions were assessed by written and practical exams. Students in the virtual microscopy group performed better than those in the light microscopy group in both practical and written exams, as reflected by their more-uniform performance and less-scattered grades. The virtual microscopy group had the advantage of optional online off-campus access to study materials, which they spent an average of 2.5 h reviewing. Virtual microscopy is a valid educational tool that can augment conventional microscopy in pathology practical sessions, and its application is convenient for both students and staff.

Keywords: KSA; Light microscopy; Pathology; Practical sessions; Virtual microscopy

Introduction

Light microscopy practical sessions are a fundamental tool in medical and biological education. Long before the availability of colour-printed textbooks and the advent of PCs and portable electronic devices, the best method by which students learned about histological, biological and pathological entities was by viewing specimens through light microscopes.

Students' conventional light microscope (LM) usage skills and etiquette are poor, and they need time to master LM. Unfortunately, they do not receive adequate exposure to LM before medical school, and the time dedicated to basic medical-science practical sessions in integrated training systems is insufficient (typically 4 h per module).

Virtual microscopy is defined in Wikipedia as *"a method of posting microscope images on, and transmitting them over, computer networks"*.[1]

The University of Cairo considered launching the first digital pathology unit in the Middle East and started building an undergraduate and post-graduate digital archive in 2003.[2]

The justification behind using virtual microscopes is both economical and pedagogical.

Virtual slides became an integral part of telepathology practice, both for consultation and educational purposes, including the potential usage of whole-mount slides.[3]

Virtual microscopic technologies entail a platform composed of hardware and its accompanying software. The concept is simple, albeit technically advanced: a high-resolution camera takes several pictures of tissue slides, and with the aid of a massive processing power, hundreds of pictures are collaged to a single image of enormous size, reaching 5–20 gigabytes. The process involves pre- and post-image processing, compression, transmission and visualization.[4]

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Currently, these robust scanning virtual microscopes are small and do not need a dedicated location in a lab. The price of these machines dropped dramatically for basic models, and universities do not need to purchase their own, as they can rent access to online databases, or they can send their own slides for scanning by other universities.

The software is designed to render a simple mirror of reality. It provides on-screen slide annotation and measurement along with basic magnification buttons (×4, ×10, ×40 and ×100) (Picture 1). The web-based archive can be accessed off-campus at the students' convenience, as long as the student has internet access.[5]

Vendors often exhaust the tissue sections for the sake of profit, and multiple levels are attained, many of which are neither ideal nor uniform.

Materials and Methods

We randomly assigned two groups of students (20 students in each group) from the second-year at the University of Tabuk in KSA in the Faculty of Medicine. These students have the same average level of knowledge and skills.

The learning objectives for the practical sessions are chosen from the syllabus for second-year students, which covers the general pathology section of the Abnormal Human Morphology module.

The first group participated in a classic light microscopy session (LM), and the second group participated in a virtual microscopy session (VM). The space, study material content, and number of tutors were matched.

The two groups answered 10 short multiple choice questions (MCQs), followed by a 5-question objective structured practical examination (OSPE) one week later after the sessions.

In the stem of the MCQs, we provided students with clinical case scenarios with snapshots from histopathological slides from the VM database for both groups. The time allowed for the MCQs exam was 15 min.

The OSPE consisted of 5 stations that were allowed 90 s each for 9 min of total time, including one rest station. The format consisted of either LM or VM slides for the LM and the VM groups, respectively, and the questions were to provide histological description and diagnosis.

The MCQs and the OSPE were invigilated by 6 staff members, and the students were spread out 2 m apart during the exams.

Students' apprehension of knowledge and skills via LM and VM was compared through a t-test.

Student exposure time to off-campus study materials in the VM was assessed through a feedback questionnaire, and lab-time access in the LM groups was assessed through staff observations.

The data were analysed statistically with the aid of SPSS and Microsoft Excel software.

Results

Twenty students were assigned to each group. In the conventional LM group, the average scores for the written exam and the OSPE were 78 and 76, respectively, and the average written and OSPE scores for the VM group were 88 and 90, respectively.

The range of the scores for the LM group was 33 and 28 for the MCQs and OSPE, and the range was 15 for both in the VM group. The minimum score for the MCQs was 59 for the LM group and 79 for the VM group, and the maximum score was 92 and 94, respectively; the OSPE minimum score for the LM group was 60, and that for the VM group was 81; the maximum scores were 88 and 96, respectively.

The dispersion of the scores for the conventional light microscopy sessions was 2–3 times the standard deviation of the virtual microscopy group (Table 1).

Correlation and cross-tabulation between the LM and VM groups showed statistically significant differences between the students' performances in both MCQs and OSPE ($P = 0.000$) in favour of VM.

The VM group spent an average of 2.5 h off campus reviewing study materials; two students did not access the VM materials, and one student maximally spent 5 h reviewing the VM materials (Figure 1).

Discussion

This is the first study regarding the utilization of the VM in pathology and basic-science education in Saudi Arabian universities. Launching a new teaching methodology requires testing the methodology's validity and learning outcomes. This pilot study evaluated the acceptance of the VM and its learning outcomes compared with the conventional LM.

The students' performances in our study in the VM group were better than those of the conventional LM group.

Tutors appreciate more interest and enthusiasm during the sessions in the VM groups than in the LM groups.

In a study in Germany, students appreciated the *"Whole Slide Imaging functionality, points of interest, auxiliary informational texts, and annotations"*.[6]

A research group from the US found superior performance by VM students in a haematology course.[7] Research from China found VM *"to be an effective and efficient educational strategy"*.[8] Another study from China showed only statistically significant differences in the case analysis and the identification of structure in favour of VM, but performance in MCQs and short assay questions was negligible.[9]

The potential advantages of VM include active student engagement in sessions with one or up to three students per PC, increased depth and breadth of coverage of learning objectives, and the practicability of self-directed learning.[10]

Some researchers have found that students' performances are comparable to their previous performances regardless of the learning method assigned.[11]

VM has its own drawbacks, including the neglect of LM skills and frequent technical troubleshooting.[12]

The virtual microscopic slides require an enormous amount of computer memory for storage, and the use of free internet resources requires a fast internet speed. We have chosen a timeframe for the session after consulting the IT office to determine the most convenient timeframe that affords the highest available bandwidth.

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