Viewpoint

Viewpoint on the Application of Virtual Microscopy in Teaching at a Medical College in Saudi Arabia

Shahid Akhund

Conventional light microscopy (CLM) was the primary technique used to teach histology and pathology for a long time. However, it cannot view slides simultaneously, making it difficult for group discussions and cooperative learning. Multiple microscopes, glass slide production and storage, are expensive and require time-consuming maintenance. The invention of projectors and digital video cameras in the early 20th century made using CLM more effective. However, these tools could only be used by one person at a time, which prevented them from totally replacing CLM.[1] the 1980s, the initial digital images were generated from histological slides, but it wasn't until the availability of personal computers with sufficient memory capacity that digital microscopy advanced rapidly, this led to the development of imaging converter programs and servers that facilitated the uploading of virtual slides to the internet, enabling image viewing and zooming capabilities. Presently, numerous systems can generate high-quality virtual images of histological tissues. Users can browse the images using a mouse or joystick, allowing them to navigate through different areas of the slide and simulate the zooming functionality of an optical microscope[1,2].

Medical education incorporates immersive technologies that allow for human-computer interaction.[3] Virtual Microscopy(V.M.) refers to simulating microscopic glass slides or tissue sample slides using immersive technology. In V.M., a high-resolution scanner or a microscope with a digital camera is used to digitalize glass slides or tissue samples. A computer or server is used to upload the digital image, which may be viewed and edited. The images may be viewed in high definition, and one can navigate around the images and zoom in and out. It offers alternatives for marking up and annotating images for teaching or research. This technology enables sharing and cooperation amongst numerous users, including pathologists, researchers, teachers, and medical students, to see and analyze tissue remotely[2].

The use of V.M. in medical education is significant and has several benefits over CLM. Students can view digital slides using V.M. at any time and from any location, allowing them to study and learn at their speed; this might be extremely helpful in distance learning programs, where students might not have access to a physical lab or classroom environment. In addition, its expanded accessibility, enhanced collaboration and communication between students and teachers has improved learning outcomes[4]. It is simple for students to download digital photographs and annotations, get teacher feedback, and engage in online discussions. To build clinical skills and professional abilities. It is essential to create a learning atmosphere that is more collaborative and active. V.M. enhances student engagement and learning outcomes in medical education. According to studies, students who used V.M. performed better in exams and retained more information than those who used CLM[5-7]. This might be because students can more readily recognize and comprehend essential characteristics of the tissue specimens because of the improved capacity to alter and interpret digital images.

The V.M. is a valuable tool in medical education, offering improved access to tissue slides and enhanced learning outcomes. It has been widely adopted in medical curricula worldwide, with institutions incorporating it into their educational programs[8-10]. However, opinions among medical educators vary regarding its application and potential impact. Supporters acknowledge virtual microscopy's advantages over conventional microscopy, emphasizing features such as the ability to edit and annotate digital images, which enhance student engagement and conceptual understanding.[11] Research indicates that medical students using virtual microscopy perform better on exams and retain information more effectively[5-7]. Nevertheless, concerns exist among some educators. Critics argue that virtual microscopy may not fully replicate the tactile experience of traditional microscopy, potentially impacting the development of clinical skills. They also highlight the limitations of relying solely on digital images, which may restrict exposure to the full range of diseases and abnormalities found in real specimens. Some students have reported feeling distant from the specimens and prefer CLM[7]. As V.M. continues to evolve, further research is needed to optimize its integration, address concerns, and ensure its effective utilization in medical education.

Despite the conflicting opinions, educators and institutions worldwide are using virtual microscopy as a tool in medical teaching. As Gurcan MN et al.[10] discovered, virtual microscopy was well-liked by medical educators, indicating that it may improve uniformity, collaboration, and communication in pathology teaching. Virtual microscopy, according to Amer MG 2020[12], is not only a valuable tool for teaching histology but it can also be used to gauge student performance in online assessments.

In conclusion, medical educators' and teachers' perspectives on using virtual microscopy in medical education are varied and complex. Some see it as a valuable and advantageous tool to improve student

Department of Medical Education and Department of Anatomy, College of Medicine, Al-Faisal University, Riyadh, KSA.
Correspondence: *sakhund@alfaisal.edu*
doi:10.22442/jlumhs.2023.01041

involvement, understanding, and collaboration, while others worry about its limitations. To keep up with the fast-changing technological world, medical institutions must use virtual microscopy more widely in their curriculum. Virtual microscopy is an appealing alternative for educators of all levels because of developments in digital imaging and related technologies that have made it more available and affordable. Since educators want to employ the most recent techniques and technology to give their students the most effective and efficient educational experiences possible, the usage of virtual microscopy in medical education is expected to continue to develop and expand.

At the College of Medicine, Al Faisal University in Riyadh, Medical students are taught histology using CLM and virtual microscopy. Virtual microscopy is a valuable tool that has the potential to completely change how histology and other subjects like pathology are taught in medical school. I advise using a hybrid approach to teaching and learning with traditional and virtual microscopy combined with self-evaluation. The College possesses an Olympus microscope for scanning glass slides used in histology teaching. A virtual microscope image archive is created from high-quality scanned images. These images have annotations and are saved in a repository in the university's online learning management system accessed by authorized users. The users must download OlyVIA, a free image viewer software. Teachers and students can study the slides at their own pace and convenience. Students bring their digital devices to the histology lab sessions to view the photographs and the same tissue slide under a microscope. They view the tissue glass slides under a microscope at various magnifications while studying digital pictures. The students benefit from this mixed-method experience of real and virtual microscopy. The students are asked to complete an interactive self-assessment at each session's conclusion to gauge their comprehension of essential histological structures. In the self-assessment quiz, students identify different microscopic structures in the photographs and respond appropriately to the questions. Many students have responded favorably to this mixed method experience with self-evaluation exercise. They get the chance to connect more deeply and actively with the histological content, and it also lets them recognize where they still have knowledge gaps.

Our experience suggests that virtual microscopy can potentially change how histology and other topics linked to pathology are taught in medical school. We can improve students' comprehension of essential knowledge and skills by giving them access to CLM and virtual microscopy by providing high-quality, digital photographs and histology tissue slides to observe. Additionally, interactive tests and other stimulating educational activities can help maintain students' interest and motivation, resulting in more significant learning outcomes and enhanced patient care. Our unique mixed-method approach to teaching histology addresses the issue of optimizing the integration of V.M., addresses the concerns, and ensures its effective utilization in medical education.

REFERENCES

1. Saco A, Bombi JA, Garcia A, Ramírez J, Ordi J. Current status of whole-slide imaging in education. Pathobiology. 2016; 83(2-3): 79-88. doi: 10.1159/0004 42391. Epub 2016 Apr 26.
2. Paulsen FP, Eichhorn M, Bräuer L. Virtual microscopy-The future of teaching histology in the medical curriculum?. Ann Anat. 2010; 192(6): 378-82. doi: 10.1016/j.aanat.2010.09.008. Epub 2010 Oct 25.
3. Al-Hiyari N, Jusoh S. The current trends of virtual reality applications in medical education. In: 2020 12th International Conference on Electronics, Computers and Artificial Intelligence (ECAI) 2020 Jun 25 (pp. 1-6). IEEE. doi: 10.1109/ECAI50035. 2020.9223158.
4. Maity S, Nauhria S, Nayak N, Nauhria S, Coffin T, Wray J et al. Virtual Versus Light Microscopy Usage among Students: A Systematic Review and Meta-Analytic Evidence in Medical Education. Diagnostics (Basel). 2023; 13(3): 558. doi: 10.3390/diagnostics 13030558.
5. Ahmed S, Habib M, Naveed H, Mudassir G, Bhatti MM, Ahmad RN. Improving Medical Students' Learning Experience of Pathology by Online Practical Sessions through Virtual Microscopy. J Rawalpindi Med Coll. 2022 Mar 31;26(1).
6. Ordi O, Bombí JA, Martínez A, Ramírez J, Alòs L, Saco A et al. Virtual microscopy in the undergraduate teaching of pathology. J Pathol Inform. 2015; 6: 1. doi: 10.4103/2153-3539.150246.
7. Blake CA, Lavoie HA, Millette CF. Teaching medical histology at the University of South Carolina School of Medicine: Transition to virtual slides and virtual microscopes. Anatomical Record. 2003; 275(1): 196-206.
8. Rani RV, Manjunath BC, Bajpai M, Sharma R, Gupta P, Bhargava A. Virtual microscopy: The future of pathological diagnostics, dental education, and telepathology. Indian J Dent Sci. 2021; 13(4): 283-88. doi: 10.4103/IJDS.IJDS_194_20.
9. Pantanowitz L, Valenstein PN, Evans AJ, Kaplan KJ, Pfeifer JD, Wilbur DC et al. Review of the current state of whole slide imaging in pathology. J Pathol Inform. 2011; 2: 36. doi: 10.4103/2153-3539.83746. Epub 2011 Aug 13.
10. Gurcan MN, Boucheron LE, Can A, Madabhushi A, Rajpoot NM, Yener BN. Histopathological Image Analysis: A Review. IEEE. Rev Biomed Eng. 2009; 2: 147-171. doi: 10.1109/RBME.2009.2034865.
11. Somera dos Santos F, Osako MK, Perdoná GD, Alves MG, Sales KU. Virtual microscopy as a learning tool in Brazilian medical education. Anat Sci Educ. 2021; 14(4): 408-16. doi: 10.1002/ase.2072. Epub 2021 Apr 4.
12. Amer MG, Nemenqani DM. Successful use of virtual microscopy in the assessment of practical histology during pandemic COVID-19: A descriptive study. J Microsc Ultrastruct. 2020; 8(4): 156-161. doi: 10.4103/JMAU.JMAU_67_20.