

2023



Virtual Microscopy Histology and Histopathology

MAPPING RESEARCH

IN POLAND

ON SETTING UP THE EU CURRICULA ON HISTOLOGY AND
HISTOPATHOLOGY FOR THE VIRTUAL MICROSCOPY
DIGITAL TRANSFORMATION



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DIGITAL TRANSFORMATION OF HISTOLOGY AND HISTOPATHOLOGY BY VIRTUAL MICROSCOPY (VM) FOR AN INNOVATIVE MEDICAL SCHOOL CURRICULUM

ERASMUS+ PROJECT, REF.NO. 2022-1-RO01-KA220-HED-000089017

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Phase 1 - Literature research

1. A brief introduction on the histology and histopathology studies in Medical Universities in Poland

Teaching the subject of histology with cytophysiology is obligatory for students of medical faculties of the first year of study. According to the regulation of the Polish Minister of Science and Higher Education of April 6, 2021 (Journal of Laws of the Republic of Poland on April 23, 2021, item 755), learning the subject of histology, belonging to the morphological sciences, is obligatory for the fields of medicine, dentistry and laboratory diagnostician. In addition to the correct histological nomenclature, students must acquire the skills to operate an optical microscope and recognize histological images using it. On the other hand, preclinical sciences in the third year of studies include pathology, which requires the ability to recognize microscopic images without the need to use microscopes. Therefore, universities in Poland, providing training in medical professions, use mainly bright field optical microscopes in the practical study of histology. Practical classes are based on multimedia presentations on a projector supported by an image from a leading microscope connected to a camera and projector. Each student during practical classes (microscopic laboratories) has a binocular microscope with x4, x10 and x40 lenses available. As part of the classes, the student observes the preparations under the microscope, archives the images (there are different approaches) under the supervision of the teacher. Didactic classes are conducted by teaching staff with a master's degree and higher, while lectures are conducted by persons with the degree of doctor habilitated and the title of professor.

Teaching the subject of histology at the Medical University of Gdańsk is conducted by employees of the Department and Department of Histology: 2 professors, 4 habilitated doctors, 8 doctors, 3 doctoral students with the help of 5 technicians. Teaching histology as part of the subjects (as of 2022/23): medical field: 3170 h, medical ED: 552 h, medical and dental: 354 h, medical analytics: 257, dental techniques: 80; total 4413 h. Example of scheduling teaching hours for the medical field: (24 h of lectures and 16 h of practical classes (seminars) of 62 hours for labs (bright field microscopy).

Teaching practical histology at the Medical University of Gdańsk for several years has been conducted at a higher level than at other medical universities in Poland; we have created an interactive modern digital histology learning system. Each of the 4 microscope rooms is equipped with 12 student stations based on microscopes with a 5Mpix camera and a 10' or 12' tablet. Two rooms are equipped with the Olympus CX23/MoticBTU10 systems, and the other two with the more modern Leica DM500/iPad10 AirTeach/Airlab system. The teacher has a full "live" view of all student workstations, the image from a given workstation can be shared on a projector or with





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other students along with a discussion of the given image. After graphic processing of the image (applying annotations), students archive the photos via e-mail or via bluetooth or air-drop. The VM system is not currently implemented, however, there are system facilitations for working with VM thanks to student workstations equipped with tablets.

Teaching the subject of pathomorphology at the Medical University of Gdańsk takes place in the third year of studies and is carried out by the Chair and Department of Pathomorphology. Sample teaching schedule (2022/23): (40 h for lectures and 85 hours of seminars, 26 h for practical classes - virtual and digital microscopy and 9 for labs - autopsy). Recognition of preparations under a microscope is not taught and there is no practical exam in this element. A helpful element of teaching is the pathomorphological database <https://wirtualnymikroskop.mostwiedzy.pl/>. However, it does not include a test system for checking knowledge and/or adding interesting/distinctive details.

2. Use of Virtual Microscopes on Medical Universities in Poland

Chart with the availability of VM systems in Histology and Histopathology studies in Public Universities in Poland:

University PL name	University EN name	VM in histology	VM in pathology
Uniwersytet Medyczny w Białymstoku*	Medical University of Białystok	No data	No data
Gdański Uniwersytet Medyczny*	Medical University of Gdansk	no	https://wirtualnymikroskop.mostwiedzy.pl/
Śląski Uniwersytet Medyczny*	Medical University of Silesia, Katowice	http://atlas-histologiczny.sum.edu.pl/ - static pictures	No data
Uniwersytet Medyczny w Lublinie*	Medical University of Lublin	No data	No data
Uniwersytet Medyczny w Łodzi*	Medical University of Lodz	No data	No data
Uniwersytet Medyczny im. Karola Marcinkowskiego w Poznaniu*	Poznan University of Medical Sciences	www.caom.pl – 2009-2013, currently inactive	No data
Pomorski Uniwersytet Medyczny*	Pomeranian Medical University	No data	No data
Warszawski Uniwersytet Medyczny*	Medical University of Warsaw	No data	No data



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Uniwersytet Medyczny im. Piastów Śląskich we Wrocławiu*	Wroclaw Medical University	No data	No data
Uniwersytet Jagielloński Collegium Medicum	Jagiellonian University Medical College	No data	No data
Uniwersytet Mikołaja Kopernika w Toruniu Collegium Medicum w Bydgoszcz	Nicolaus Copernicus University in Toruń Collegium Medicum in Bydgoszcz	https://atlashistologiczny.pl/ - static pictures – 2010-2012 https://www.atlashistologiczny.pl/preparat.html - VM under construction	No data
Uniwersytet Warmińsko-Mazurski w Olsztynie	University of Warmia and Mazury in Olsztyn	http://213.184.24.21/CaseCenter/index.php - 3DHitech system, needs login	No data
Uniwersytet Rzeszowski	University of Rzeszów	No data	No data
Uniwersytet Medyczny w Białymstoku*	Medical University of Białystok	No data	No data
Gdański Uniwersytet Medyczny*	Medical University of Gdansk	no	https://wirtualnymikroskop.mostwiedzy.pl/
Śląski Uniwersytet Medyczny*	Medical University of Silesia, Katowice	http://atlas-histologiczny.sum.edu.pl/ - static pictures	No data
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Collegium Medicum w Bydgoszczy	Collegium Medicum in Bydgoszcz	pictures – 2010-2012 https://www.atlashistologiczny.pl/preparat.html - VM under construction	
Uniwersytet Warmińsko-Mazurski w Olsztynie	University of Warmia and Mazury in Olsztyn	http://213.184.24.21/CaseCenter/index.php - 3DHitech system, needs login	No data
Uniwersytet Rzeszowski	University of Rzeszów	No data	No data

* medical schools. Other medical faculties within universities.

3. Publications and projects (at the country level) in the application of VM in histology and histopathology education

1 review

2 original articles – published in 2020

1 PhD thesis

Article 1

- J. Skokowski, M. Bolcewicz, K. Kreft, Th. van de Wetering, J. Gulczyński, A. Lewandowska, L. Kalinowski,
- "The Digital Tissue and Cell Atlas and the Virtual Microscope" 2022, <https://wirtualnymikroskop.mostwiedzy.pl/>
- DOI: 10.34808/x55q-sz53_dyr_roz3_OK

The most important data:

- Medical University of Gdansk + Gdansk University of Technology + CI TASK
- Only human pathological tissues, data collected (disease, sex, age, stage, grade)
- Proceeded (fixed, stained etc.) in only one lab
- HE, special stains (i.e. trichrome), IHC, IF, ISH, FISH
- Ca. 20000 slides scanned – 3DHitech, x20, x40, autofocus
- Stored in very powerful computer and server - TRYTON Supercomputer in Gdansk
- No annotations, no quizzes

Article 2

- K. FILIPIAK, A. MALIŃSKA, D. KRUPA, M. ZABEL,
- "INNOVATIVE METHODS OF ARCHIVING, PRESENTATION AND PROVIDING ACCESS TO HISTOLOGICAL SECTIONS"





- 2011, ADVANCES IN CELL BIOLOGY, VOL. 3, ISSUE 3/2011 (41–54),
- DOI: 10.2478/v10052-011-0003-4

The most important data:

- Department of Histology and Embryology, University of Medical Sciences in Poznan
- 2009-2013, currently – inactive
- Mirax-Midi scanner (Carl Zeiss) with a tray for maximum 12 histological specimens (x20, x40, autofocus), 3DHistech – planned
- 130 histological slides scanned in 24 thematic folders
- histology, embryology and cell biology courses
- Class with stationary 80 PCs with proper software (no internet)
- No data regarding results of teaching

Article 3

- Bartłomiej Bartoszek¹, Mateusz Mościński¹, Tomasz Niklewski², Bożena Szyguła-Jurkiewicz², Andrzej Lekston,
- "Wirtualna histologia — nowoczesna metoda oceny tętnic wieńcowych"
- 2011, Folia Cardiologica Excerpta, 2011, tom 6, nr 3, 203–209.

The most important data:

- Article in polish
- Review regarding usage of VM in clinical examination with intravascular ultrasound
- VM software used to create 3D map of atherosclerotic plaques inside examined blood vessels
- No connection between article and VM teaching

Article 4

- Jacek Jąkała, MD, PhD thesis:
- "Ocena metodą ultrasonografii wewnątrznaczyniowej i wirtualnej histologii wyników przezskórnych interwencji wieńcowych u pacjentów z zawałem serca / Assessment by intravascular ultrasound and virtual histology results of percutaneous coronary interventions in patients with myocardial infarction"
- 2012, Repository of Jagiellonian University Medical College
- <https://portalwiedzy.cm-uj.krakow.pl>

The most important data:

- VM used to locate hidden necrotic mass („geographic miss”) close to stent
- VM may be good support when properly utilized
- No connection between article and VM teaching





PL literature research – summary

Take home message:

- Despite having a large IT potential and sufficient financial resources, the teaching of histology does not contain elements of VM.
- The introduction of VM to the teaching of histology/histopathology must be associated with hardware/software support and training, which forces the need to obtain stable long-term funding.

Phase 2 - Interview questionnaires on virtual microscopy potential

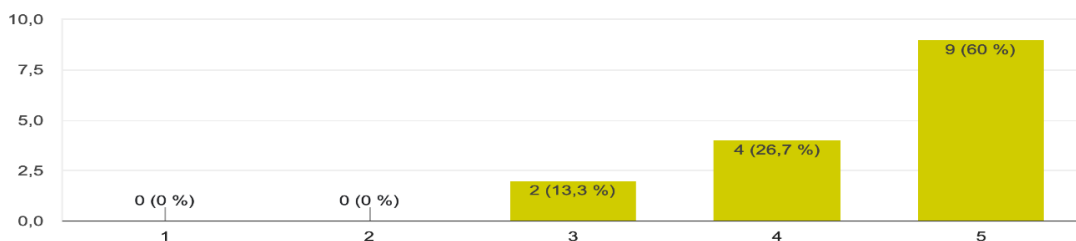
1. Methodology of the interview questionnaires applied in Poland

15 experts participated in the study. All of them have a PhD degree and are active academic teachers with at least 10 years of teaching experience. The request of the leader of the Polish group was answered by employees of several academic centers, i.e. Nicolaus Copernicus University in Toruń Collegium Medicum in Bydgoszcz, University of Rzeszów, Wrocław Medical University and University of Warmia and Mazury in Olsztyn. Also from the Medical University of Gdańsk, several experienced teachers responded to the survey.

2. Analysis of the applied interview questionnaire in Poland

Q1. 60 % of the respondents answered that they are very familiar with VM

1. I am familiar with VM technology and VM based teaching.
15 respuestas



Q2. All participants are interesting in usage of free VM library to improve level of knowledge.

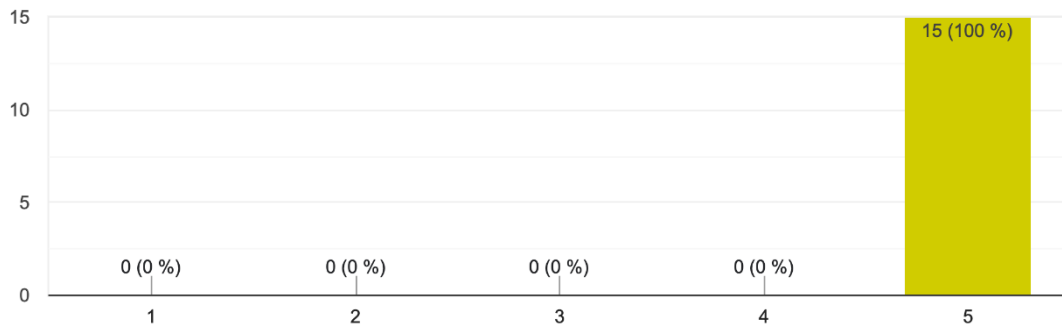


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2. I would be interested in accessing a free VM library to improve my knowledge of histology or histopathology.

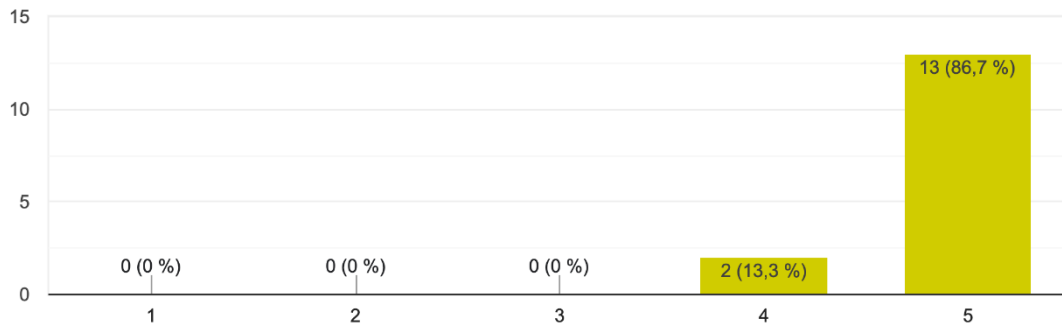
15 respuestas



Q3. Almost all (13/15 = 87%) participants think that VM may increase understanding of practical histology.

3. VM will increase my/the student's understanding of the histological sections.

15 respuestas



Q4. Less than half (7/15 = 47%) participants think that VM may increase student-teacher relationship.



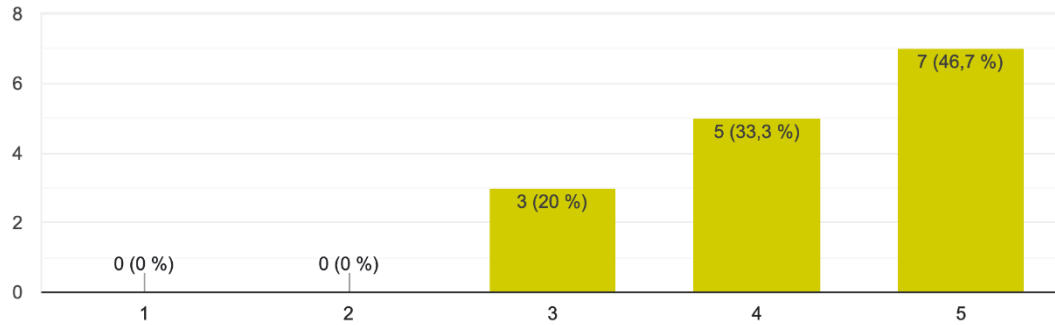
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4. VM may strengthen the teacher-student relationship.

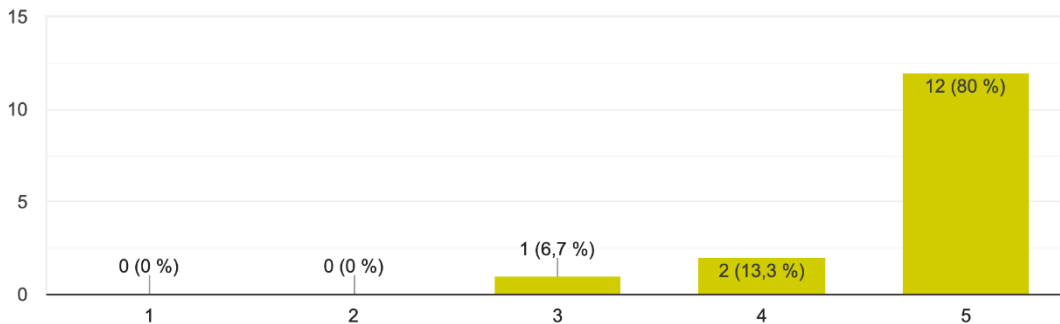
15 respuestas



Q5. Almost all (12/15 = 80%) participants suppose that tutorial of VM may be useful for the students.

5. It would be helpful for students to introduce a VM tutorial on using the digital slide platform in the introductory lecture on histology.

15 respuestas



Q6. MCQ must be introduced in VM platform (13/15 = 87%)



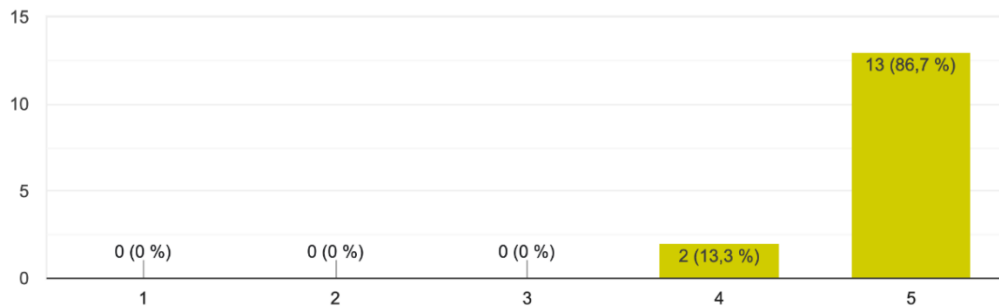


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6. It would be useful to introduce the Multiple Choice Questions MCQ / quiz section regarding virtual slide understanding for self-testing the student's level in histology & histopathology.

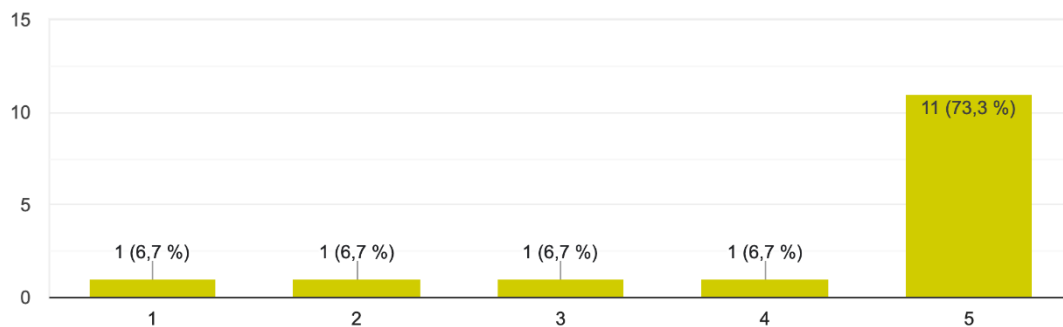
15 respuestas



Q7. More than half of participants (11/15 = 73%) want to share their slides with others.

7. I would like to contribute with my collection of slides to a VM library of histology, cytology and histopathology.

15 respuestas



Q8. Participants are not convinced regarding the electrical/internet security of VM platform.



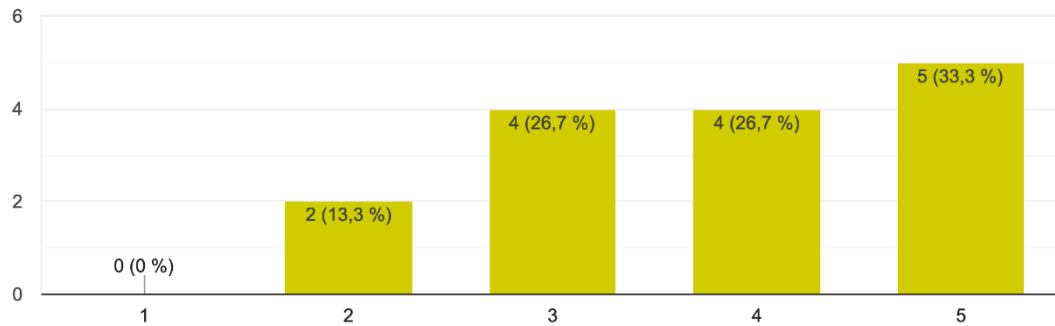
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8. A VM system, accessible outside a limited institutional frame, can be prone to electronic fraud and IT hacking.

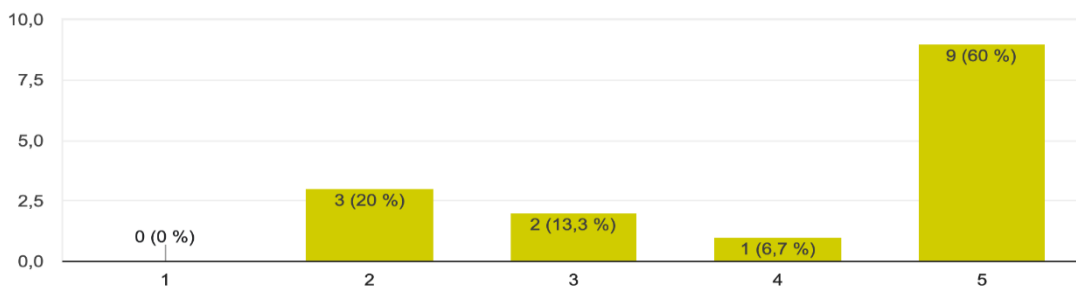
15 respuestas



Q9. VM will not definitely reduce time of studying of practical histology.

9. Virtual microscopy will reduce the time for studying the histological sections.

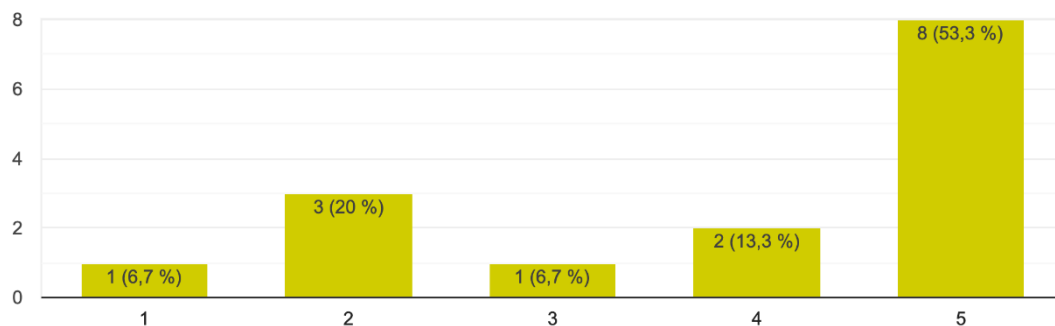
15 respuestas



Q10. Participants do not share any common view regarding place and time method of education.

10. I prefer a "whenever and wherever" method of education

15 respuestas



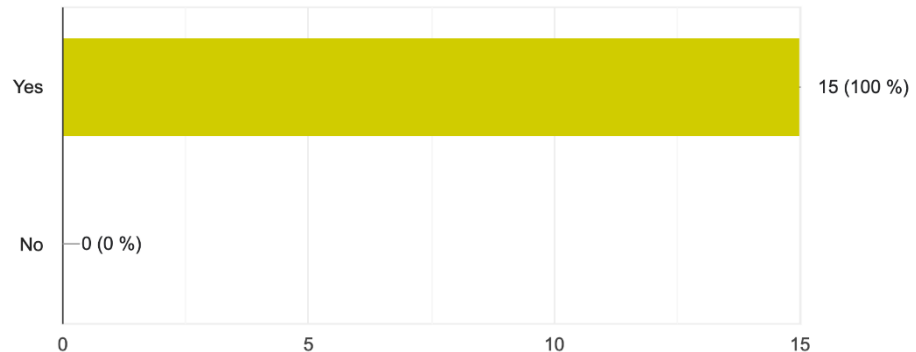
Q11. Most (9/15 = 60%) participants know well VM technology.





11. Do you use a slide collection for histology / histopathology (in classes, in the office or at home)?

15 respuestas



Q12. All participants use physical slide collection for teaching purposes.

Q13. All participants want to introduce VM for teaching together with LM.

Justification of the answer (optional):

7 answers

- Only digital images are like yesterday's Instagram
- Students must learn how to use microscopes and classical slides but when they study organs/tissues composition both techniques, LM and VR can be used as complementary techniques.
- Each method is suitable and has its own advantages. VM cuts down on time and makes it possible to teach even over long distances. LM, on the other hand, allows on direct contact with the student
- Personal experience of a student with studying not only the selected best histological slides (VM) is necessary to individually assess the artifacts and variability in staining intensity etc.
- LM is essential to teach microscope operating skills
- Students should know how to use microscope and what is classical slide
- The teaching methods should be diversified and attractive for students.

Q14. Participants know well the advantages of VM over LM.

In your opinion, what are the advantages of virtual microscopy over conventional microscopy?

15 responses

- We can observe everywhere
- Easier searching for details
- It can be used anytime and anywhere, without additional software (www works fine), you don't need many slides (i.e. all slides for every student) - only one or two good enough can be scanned and selected for teaching.





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- Continuous Access to resources
- Continuous Access to resources
- It's availability
- Quality of the slides, easy access to desired structures, students can observe multiple sections of one tissue/organ. Collection can be expanded with ease.
- Allows laboratory class to be conducted anywhere without the limitation of rooms equipped with microscopes
- Access to computer equipment and Internet
- software and hardware update, conflict between software used in particular university (databases) and promoted VM3
- Access to the large database of scanned slides and program/s that manage it.
- slow loading of images
- Accounts in CaseCenter are very expensive. Limited storage on server.
- lack of skills in using a VM computer program
- Too small discs and WF capacity to serve many students in the same time.

Q15. Participants understand well the possible problem of VM in normal teaching active phase of studies.

What hardware and software limitations can a student have?

15 responses

- Equipment quality
- Internet Speed in dormitories
- None
- Internet transfer can be a limitation. Some countries block access to servers localized in another countries. Software must be free or the system must be based on WWW.
- I think that at this point, every teacher and student already has at least one device which allows for the use of VM.
- Unstable internet connection
- In my opinion hardware and software limitations refers to how much access students have to the necessary devices.
- Access to computer equipment and Internet
- different platforms (iOS, Win, Android), poor WiFi, complication of VM3 software
- Access to fast internet and certified access to software.
- slow loading of images
- Limited accounts in CaseCenter. Students are waiting for their turn.
- lack of necessary equipment such as computer
- the same as above, can have problems with receiving photos of their own histological slides.



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