

2023



Virtual Microscopy Histology and Histopathology

MAPPING RESEARCH

IN SPAIN

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

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AUTHORS

José Luis Girela López¹, Noemí Martínez Ruiz¹, Rosa María Pérez Cañaveras² and Flores Vizcaya Moreno².

¹ Biotechnology Department and ² Nursing Department, University of Alicante, Alicante Spain.



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Phase 1 - Literature research

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

This year we are celebrating the 150th anniversary of the first Chair in Histology in Spain, obtained by Dr Aureliano Maestre de San Juan in 1873, at the Central University in Madrid (currently Complutense University of Madrid). Six years later, in 1879, Maestre de San Juan published the first Treatise in Normal and Pathological Histology, been considered the father of the Spanish Histology discipline. Since the end of the XIXth century, Histology has become a central discipline in Medical Studies, especially thanks to the contributions of Dr. Santiago Ramón y Cajal, who was awarded the Nobel Prize in Physiology or Medicine in 1906 and is considered the precursor of neurosciences.

Medicine studies are regulated at Spanish Universities, with a duration of six academic years. Histology is present in all studies programs in Medicine at Spanish Universities. It usually is structured as two basic subjects, General Histology and Special Histology (Organography), presented in the first year or the first and second year of the programme, complemented by a compulsory subject for Histopathology between the third and the fourth year.

2. Use of Virtual Microscopes on Medical Universities in Spain

There are 50 public universities in Spain, 34 of which offer a degree in Medicine.

In order to find out which of them use some types of VM systems in Histology and Histopathology studies in Medicine, we have reviewed the teaching guides for these subjects and searched for websites of VP, both open access and restricted access. In some cases, we have not found any information. However, these universities likely use VM, but that information is not reflected on their website.

These data indicate that 18 universities (53%) use VM in combination with slides using conventional optical microscopy. Of these, most have developed their own VM providing access to their students, and 6 are freely accessible to the general public.

There are two universities, Almería and Jaén, whose Medicine degree started in the 22-23 academic year and therefore, they had only Histology studies, and on the other hand, the University of Vigo, which, although it does not have these studies, it has an interesting VM developed by themselves. Chart 1 summarizes the availability of VM systems in Histology and Histopathology studies in Public Universities in Spain.





Chart 1. Use of VM systems in Spanish Public Universities with Medicine studies.

University	Additional information	Self developed / external service
Alcalá	https://practicas-citologia-histologia.web.uah.es/principal-practicas.htm	Self developed
Almería*	Not Known	
Autónoma de Barcelona	CD-Rom/DVD- ROM. DML.(Digital Microscopy Lab) 06-07 Red UAB	Self developed
Autónoma de Madrid	Not Known	
Barcelona	User code needed	Self developed
Cádiz	Not Known	
Cantabria	Not Known	
Castilla-La Mancha	Not Known	
Complutense de Madrid	https://histologiavirtual.com/ https://www.practicasdehistologia.com/	Self developed
Córdoba	Not Known	
Extremadura	Not Known	
Girona		External service
Granada	User code needed	Self developed
Illes Balears	Not Known	
Jaen*	Private	Self developed
Jaume I	Not Known	
La Laguna	https://histologia1.webnode.es/fotogaleria/	Self developed
Las Palmas de Gran Canaria		External service
Lleida	Not Known	
Málaga	dj.uma.es/microscopio. Private	Self developed
Miguel Hernández	Not Known	
Murcia		Self developed
Navarra	Their own images, Aperio 2016 visor	Self developed/ External service
Oviedo		Self developed
País Vasco	Virtual resources	External service
Pompeu Fabra	Not Known	
Rey Juan Carlos	Not Known	
Rovira i Virgili	Not Known	
Salamanca	https://campus.usal.es/~histologia/histologia.htm	Self developed
Santiago de Compostela	Not Known	
Sevilla	Not Known	
Valencia	https://www.uv.es/histomed/	Self developed
Valladolid		External service
Zaragoza	http://wzar.unizar.es/acad/histologia/	Self developed
Vigo (No Medicine)	https://mmegias.webs.uvigo.es/7-micro-virtual/virtual-todas.php	Self developed





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

After extensive research, we only found 2 articles in international repositories of research on VM conducted by Spanish institutions. They are research and review articles from the same group at the University of Barcelona Medical School.

ARTICLE 1

Oriol Ordi, Jose Antoni Bombi; Antonio Martinez; Jose Ramírez; Lucia alós Adela Saco; Teresa Ribalta; Pedro Fernandez, Elias Campo and Jaume Ordi
“Virtual microscopy in the undergraduate teaching of pathology”
Journal of Pathology Informatics. Volume 6, Issue 1, January–December 2015, 1
<https://doi.org/10.4103/2153-3539.150246>

General information:

- Publication name: Pathobiology Journal. Ed. Karger.
- DOI or bibliographic reference: 10.4103/2153-3539.150246
- Year of publication: 2015
- Country: Spain.
- Type of institution Department of Pathology, Hospital Clínic University of Barcelona School of Medicine (public).
- Subject and degree: General Pathology, Degree in Medicine.
- VM platform:

VENTANA iScan HT (Roche-Ventana Medical Systems, Tucson, AZ, USA) at a magnification of $\times 20$. The images are viewed in the Virtuoso viewer (Roche-Ventana Medical Systems, Tucson, AZ, USA)

- URL or website address of VM platform – Moodle of the university.

Educational intervention:

- Number of students participating and Gender distribution of the students: two groups CM course had 88 students, 67.0% (59/88) females and 33.0% (29/88) males, with a mean age of 20.6 ± 1.4 . The VM course had 93 students, 68.8% (64/93) females and 31.2% (29/93) males, with a mean age of 20.8 ± 1.3 .
- Grouping of students (balanced groups of students registered in third year medical school). One group received teaching by CM and the other by VM.
- Type of images WSI
- Tissues studied through VM: histopathology slides
- Variables to be measured:
 - number of visits to the VM from the opening of the website to the day of the exam
 - length of the students' accesses
 - Time of accesses to the virtual slides during the day
 - students' ratings for the main items of the survey concerning the use of VM





-The mean mark in the CM and VM courses online tests. No differences were observed between the two groups

Conclusions: Virtual microscopy can effectively replace the traditional methods of learning pathology, providing mobility and convenience to medical students.

According to CrossRef: Number of Citations 24.

ARTICLE 2

Adela Saco; Jose Antoni Bombi; Adriana Garcia; Jose Ramírez; Jaume Ordi

“Current Status of Whole-Slide Imaging in Education”

Pathobiology (2016) 83 (2-3): 79–88.

<https://doi.org/10.1159/000442391>

General information:

- Publication name: Pathobiology Journal. Ed. Karger.
- DOI or bibliographic reference: 10.1159/000442391
- Year of publication: 2016
- Country: Spain.
- Type of institution Department of Pathology, Hospital Clínic University of Barcelona School of Medicine (public).
- Subject and degree: Review article

According to Clarivate Web Of Science (WoS): Number of Citations 38.

PROJECTS

Regarding research projects, we at the University of Alicante conducted an Educational intervention on the use of VM in 2015. The project results “Learning histological images using a virtual microscope: methodology and opinion of the students”, are published in the institutional repository of the University of Alicante

<http://hdl.handle.net/10045/49169>





Phase 2 - Interview questionnaires on virtual microscopy potential

1. Methodology of the interview questionnaires applied in Spain

One of the objectives of this work package was to conduct Institutional research to discuss and collect data on VM potential use in their teaching practices. The first step was to create an Expert Group of didactic staff in the discipline. In this regard, we contacted and enrolled a group of 5 experts with experience teaching both Histology and Histopathology. The characteristics of the experts are:

Expert 1: Full Professor. Pathologist. 50 years of experience teaching Histology and Histopathology.

Expert 2: Full Professor. 40 years of experience teaching Histology. President of the Spanish Society for Histology and Tissue Engineering (SEHIT).

Expert 3: Full Professor. 40 years of experience teaching Histology and Histopathology. Vice President of the Spanish Society for Histology and Tissue Engineering (SEHIT).

Expert 4: Assistant Professor. Pathologist. 30 years of experience teaching Histology and Histopathology. Director of the Teaching program for the specialisation of Pathologists at Hospital Vinalopo.

Expert 5: Associate Professor. 20 years of experience teaching Histology and Histopathology.

Each one of the experts was contacted, providing them with a link to an online questionnaire. The questionnaire consisted of 16 questions: 10 questions with a sentence related to a Likert scale, 2 multiple-choice questions and 4 open-answer questions.

2. Analysis of the applied interview questionnaire in Spain

Q1. 4 of the respondents (80 %) answered that they are completely familiar with VM technology and VM-based teaching. Only one of the experts declared it to be partially familiar (Fig 1).





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

5 respuestas

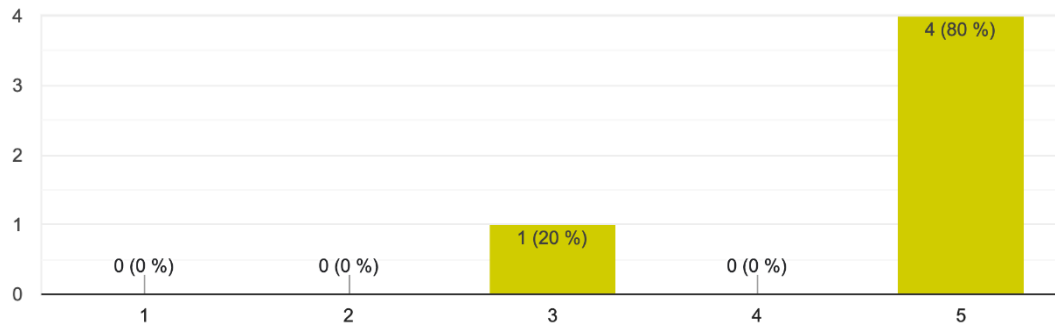


Fig 1. Q1 of the questionnaire.

Q2: All respondents answered that they would be interested in accessing a free VM library to improve their knowledge of histology and histopathology (Fig. 2).

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

5 respuestas

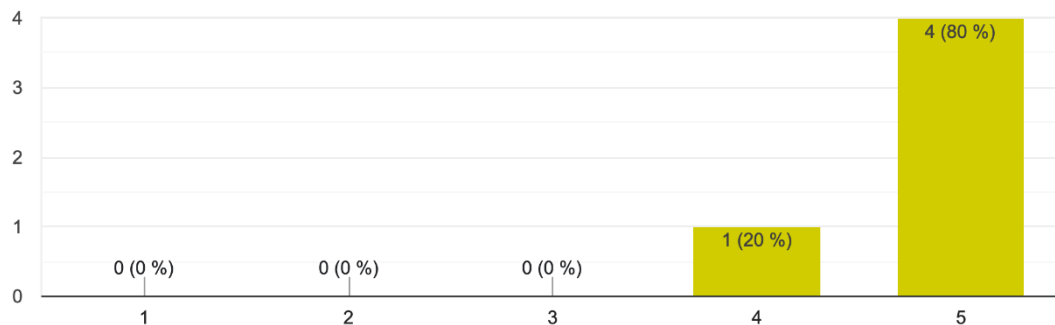


Fig 2. Q2 of the questionnaire.

Q3: All respondents answered that VM will help students understanding of the histological structures of the different tissues (Fig. 3).





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

5 respuestas

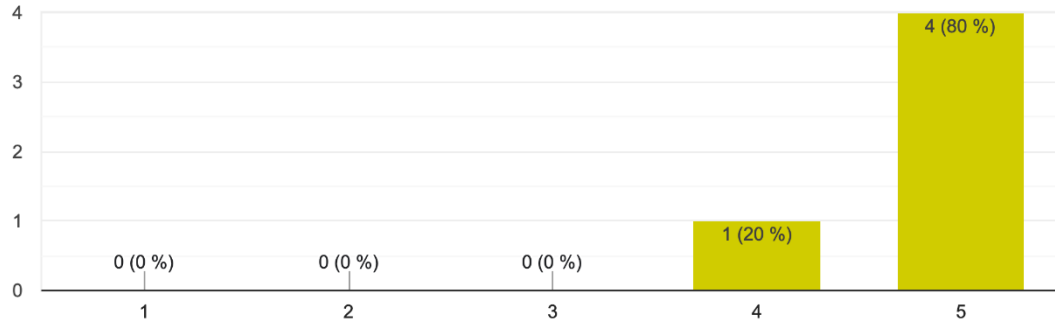


Fig 3. Q3 of the questionnaire.

Q4: 2 of the respondents completely agree that VM may strengthen the teacher-student relationship. On the other side, one expert think that the impact of VM on the teacher-student relation will be negative. The rest answered that it will have no impact, or the impact will be limited (Fig. 4).

4. VM may strengthen the teacher-student relationship.

5 respuestas

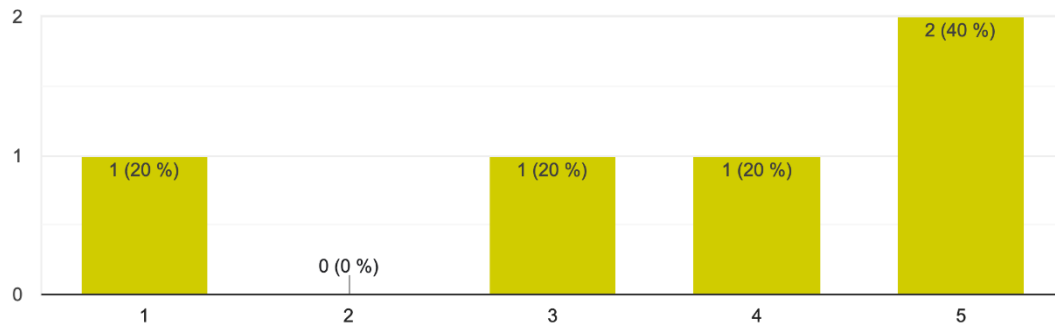


Fig 4. Q4 of the questionnaire.

Q5: All the experts answered that it would be helpful for students to have a tutorial on using the digital slide platform (Fig. 5).





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

5 respuestas

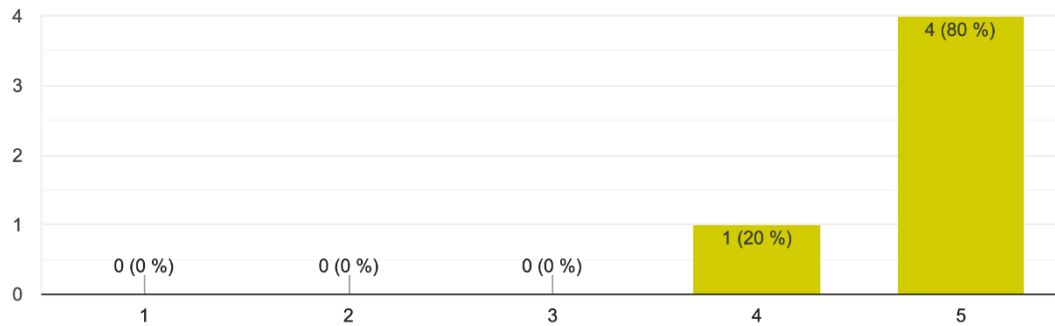


Fig 5. Q5 of the questionnaire.

Q6: All the expert see necessary to introduce Multiple-Choice Questions MCQ / quiz section for self-testing in the VM platform (Fig. 6).

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.

5 respuestas

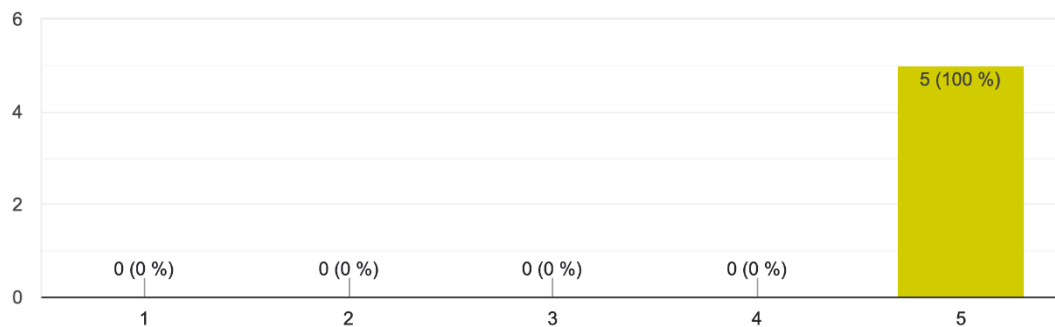


Fig 6. Q6 of the questionnaire.

Q7: The majority of the responders would like to contribute providing their own collection of slides, to a VM library of Histology, Cytology and Histopathology. (Fig. 7).





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

5 respuestas

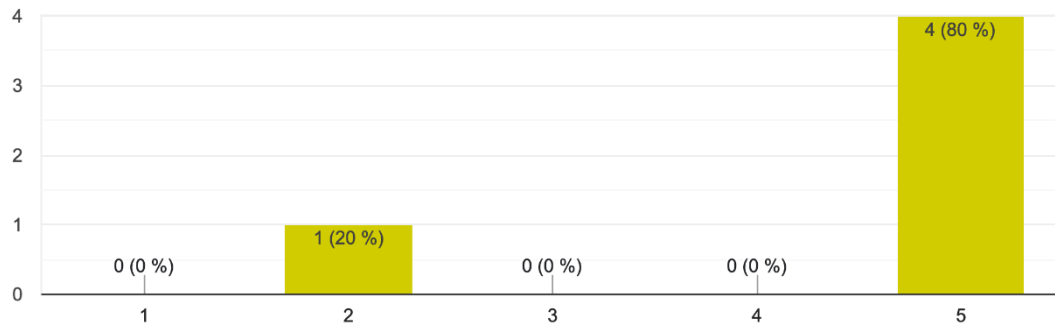


Fig 7. Q7 of the questionnaire.

Q8: There is no consensus on the security risks of a VM platform. Approximately half of responders thinks that the risk is medium-high and another half medium-low (Fig. 8).

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

5 respuestas

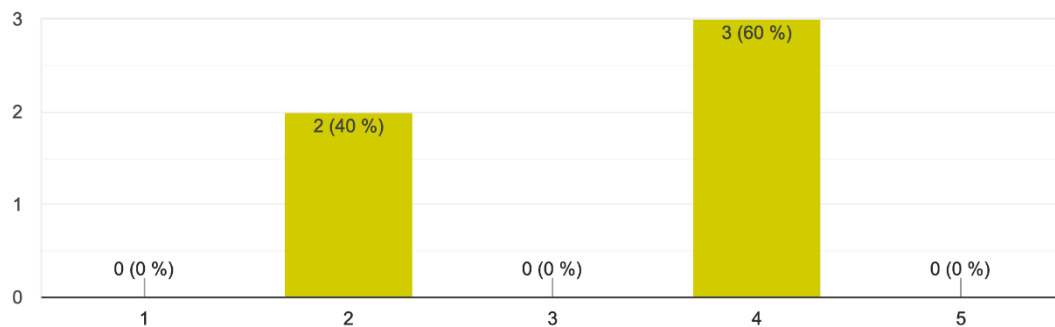


Fig 8. Q8 of the questionnaire.

Q9: VM will not reduce the study time of histological sections (Fig. 9).





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

5 respuestas

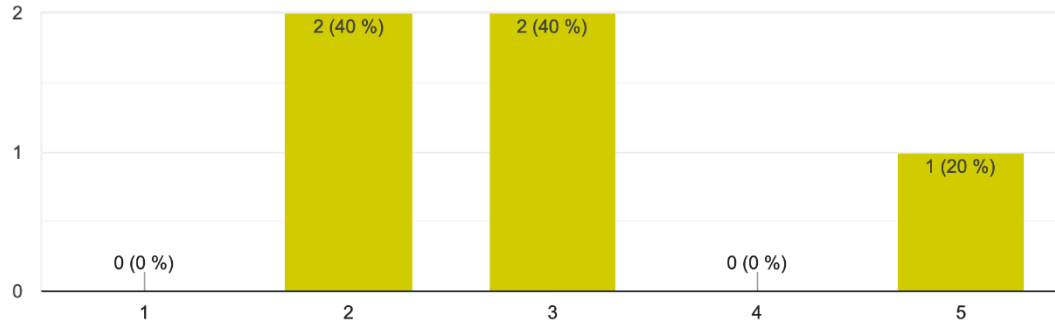


Fig 9. Q9 of the questionnaire.

Q10: There is no consensus regarding the type of education. Even there is a tendency to favor self-learning by students, there is not a clear positioning of the experts (Fig. 10).

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

5 respuestas

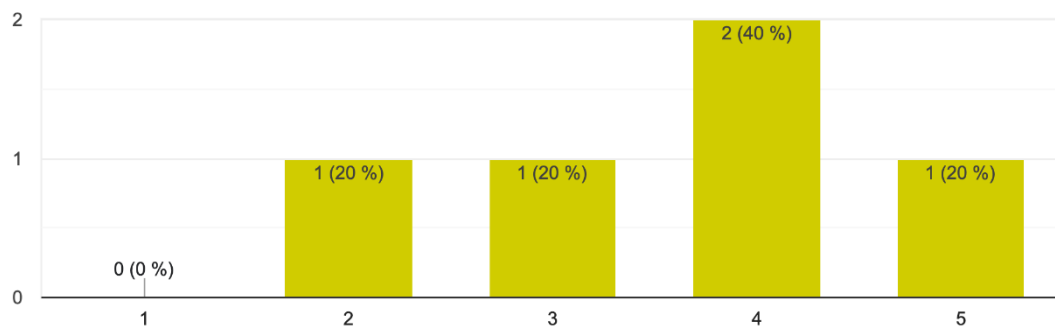


Fig 10. Q10 of the questionnaire.

Q11: All the responders say they use a slide collection for histology/ histopathology (Fig. 11).





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

5 respuestas

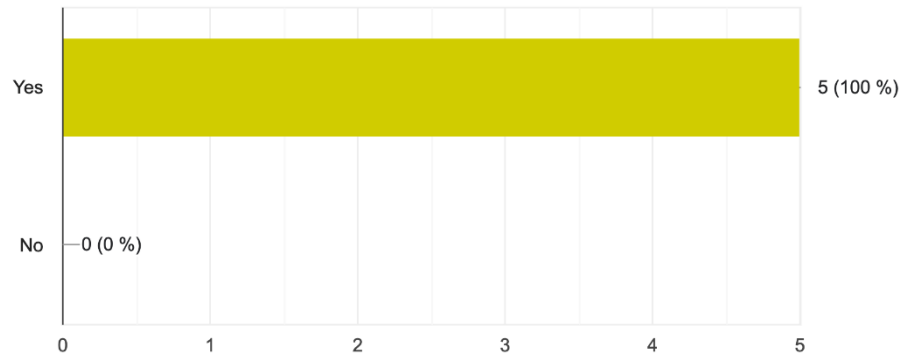


Fig 11. Q11 of the questionnaire.

Q12: All the Experts considered better a combination of both VM and traditional Light microscopy practices (Fig. 12).

12. If available, which of the three methods would you apply to your teaching? (VM= Virtual Microscopy LM= Light microscopy)

5 respuestas

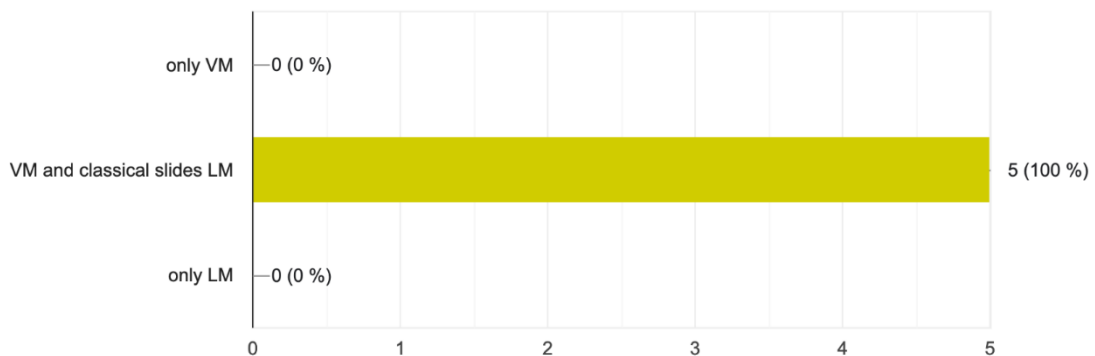


Fig 12. Q12 of the questionnaire.

Justification of the answer I

- The use of a microscope is a skill that need to be acquired by students and VM can complement the study of histological sections.
- Both are complementary
- I think both have advantages.





Q13. In your opinion, what are the advantages of virtual microscopy over conventional microscopy?

- Accessibility and the possibility to see slides whenever you want.
- cheaper, saves time, more ubiquitous
- Increased ability to visualize histological images that might otherwise be difficult to observe
- The immediate availability of the images and the non-limited time
- easier availability and self-learning

Q14. What hardware and software limitations can a teacher have?

- Access to high speed Internet connection. Device platform.
- Managing the software requires learning time, good computer equipment is necessary and is not always available to teachers.
- The number of students and licenses if needed
- Those derived from the computer limitations of their equipment and their cost
- the number of computers and not open access collections

Q15. What hardware and software limitations can a student have?

- Access to high speed internet connections. Device platform.
- Managing the software requires learning time, good computer equipment is necessary and is not always available to teachers.
- Having a device and internet access
- I think practically none
- computer with low graphics memory and not open access collections

Q16. In your opinion, what would be the limitations of applying VM in the curricula of a histology and histopathology teaching program?

- Quality of slides, variety of tissues and histopathological features. Easy access to the VM platform. Number of simultaneous connections.





**VM3.0 - Digital transformation of Histology and Histopathology by
Virtual Microscopy (VM) for an innovative medical school curriculum**

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- Resistance to change of part of the teaching staff.
- Lack of experience in microscope handling and possible limitations in resolution
- In your opinion, what would be the limitations of applying MV in the curricula of a histology and histopathology teaching program?
- In my opinion, I believe that applying VM in teaching would be very useful for the following reasons: 1. It would favor self-learning by having images continuously available; 2. It represents an economic saving in the acquisition and maintenance of microscopes; 3. Could improve the design and formats of practices.
- However, the availability of VM does not in any way guarantee that the student will improve their self-learning. It is well known that students do not use Atlases or even texts in their preparation.
- The teacher's supervision and guidance in learning histology and histopathology continue to be essential. I am of the opinion that the training in the observation of the preparations using the light microscope offers important advantages in the formation of our students.



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