LETTER TO THE EDITOR

Keeping histology students under the microscope during Covid-19 lockdown: Lessons learned from the University of Genoa

To the Editor, Anatomical Sciences Education:

We have read, with great interest, articles published recently in Anatomical Sciences Education that describe histology education during the Covid-19 pandemic (Evans et al., 2020; Caruso, 2021; Cheng et al., 2021a, b; Somera Dos Santos et al., 2021). As histology educators at the University of Genoa, we would like to add our perspective to these conversations.

At the University of Genoa, the undergraduate human anatomy course is divided into three sections: musculoskeletal anatomy, systematic anatomy (including topographic and microscopic anatomy), and neuroanatomy. The first two sections are taught in the first year and neuroanatomy is taught in the second-year curriculum. In Italian universities, a histologist describes the structure and function of cells and tissues, and anatomists provide a hands-on look at organs through the use of traditional light microscopes. This strategy is believed to be effective as student learning is based on the structure of organs presented under the microscope. In this way “analytical observation” skills are built as students examine tissue preparations under a microscope and relate these observations to didactic knowledge that provides key characteristics and functions of the organ. For this reason, the microscopic anatomy course has a practical laboratory component that tests student visual recognition of specific cells, tissues, and organs. Prior to the Covid-19 pandemic, each student had access to sets of glass slides, binocular light microscopes, and faculty members who were on hand to address student questions. These laboratory sessions accounted for 32 h of the first-year medical curriculum.

Unfortunately, the last two academic years courses could not be held face-to-face due to the pandemic (Government of Italy, 2020). Digitization has been embraced in the patient care arena as an avenue for reaching patients at a distance, but its development in the field of medical education has been lacking (de Carvalho Filho et al., 2021). Fortunately, in recent years, medical schools have increasingly combined traditional teaching methods with computerized learning particularly in anatomical sciences (Cheng et al., 2020; Cuschieri & Calleja Agius, 2020; Lee et al., 2020). The Covid-19 pandemic accelerated digitization through the necessary development of engaging online teaching formats (Pather et al., 2020; Smith & Pawlina, 2021). However, online lessons present specific challenges for histology courses that previously emphasized hands-on microscopy experience.

Anatomists have embraced innovative, engaging, creative, and multimodal means to stimulate proactive learning. The aim is not only to involve students (Longhurst et al., 2020; Donkin & Rasmussen, 2021) but also to align learning with the goals of the profession (Durrani et al., 2021; Saverino, 2021). Based on reports from the literature, distance-learning instructors are employing several strategies as they prepare for the virtual sessions. Especially in histology, many prepare videoclips of images under a microscope with descriptions of anatomical characteristics for asynchronous learning sessions. Others used virtual laboratory simulations, such as Labster (Labster, ApS, København K, Denmark); McGraw-Hill Connect (McGraw-Hill Education, New York, NY); Howard Hughes Medical Institute (HHMI) Biointeractive (HHMI, Chevy Chase, MD), (Mione et al., 2013; Cheng et al., 2017; Alvarez, 2021). Virtual laboratory simulations reach a large number of students simultaneously, enable laboratory experiences to be run with a limited number of teachers, eliminate biosafety concerns, and engage digital-age students more effectively (Pyatt & Sims, 2012; Alvarez, 2021; Darici et al., 2021; Somera Dos Santos et al., 2021). However, these simulation platforms are unfortunately prohibitively expensive for some institutions.

Thus, at the University of Genova, we took a different path. We aimed to recreate the microscopy experience as much as possible with our online microscopic anatomy sessions. Our faculty in the laboratory used a microscope equipped with a camera. The images captured by the camera were distributed in a live transmission to all students using Microsoft Teams (Microsoft Corp., Redmond, WA) as a virtual communication platform. This digital imaging station was made up of a Leica DM750 binocular light microscope (Leica Microsystems GmbH, Wetzlar, Germany) with a mounted Leica Flexacam C1 microscope camera equipped with a 12 megapixels CMOS sensor (Leica Microsystems GmbH, Wetzlar, Germany). A MacBook Pro 16" laptop computer (Apple, Inc., Cupertino, CA) with Leica Acquire software, version 3.4 (Leica Microsystems GmbH, Wetzlar, Germany) provided acquisition, analysis, and processing of high-quality digital images. This technology offered a high level of interactive functionality and collaborative potential (Hang et al., 2015).

Through this setup, students observed the histology slides as if they were using a microscope in person: "The teacher’s eye has become the eye of all connected students." For each glass slide, an
overview of the tissue and organ was provided first at low magnification, and then further details were presented at higher magnification. In addition, recordings of these sessions were available on Microsoft Teams to all the students. During the Covid-19 pandemic, this method was used to teach approximately 250 medical students per year.

At the beginning of live transmissions, we experienced poor Internet connections and slow communication between computer and microscope which created some difficulties. We resolved the Internet connection speed by asking the students to turn off cameras and microphones during the lessons and by pausing at the end of each slide for any student questions or clarifications. Similarly, connection problems during the examinations were resolved by asking students to keep the cameras and microphones off when they were not personally taking the oral examination. Finally, communication between the microscope and computer communication was solved by installing the newest update of the Leica Acquire image acquisition program, version 3.4.6, released in 2020 on the advice of Leica technicians.

The addition of this new format presented a natural comparison of face-to-face and virtual learning. Thus, the faculty compared the performances and experiences of the students in the two pre-pandemic years (n = 488 students in face-to-face classes) against two years of pandemic classes (n = 495 students in online classes). Students’ experience was measured using the University of Genoa’s custom-made, anonymous, online course evaluation tool. The evaluation utilizes a five-point Likert scale and open-ended free text questions. Students answered the following: “I participated to the course with the following frequency:”, “Rate the course on a free scale (from 1 to 5),” “How did you like the methodology of the microscopic anatomy course (in terms of compatibility, quality, clarity, etc.),” “Are you overall satisfied about the didactic quality of the human anatomy course?”, “Additional questions were asked of the students in the online course: “How did you like the implemented digital tools (in terms of possibility to view glass slides, questionnaire tools, commentary function, etc.),” “Did you have technical issues during the class?”, “The following elements helped me with learning: (1) Virtual microscopy and annotations, (2) Availability of recorded lessons,” etc.

Most students (85%) appreciated the new methodology used in laboratory exercises. Interestingly, they considered both the live transmissions of images directly from the microscope, which allows them to interact with the teacher, and the asynchronous recordings (97%) the most useful. The appreciation of the course was greater for in online cohort when compared to the face-to-face cohort (84% vs. 81%, respectively).

However, many students described challenges resulting from the lack of interpersonal interactions. Prior work has highlighted that the socializing of in person learning and studying with other students is important and cannot be replaced by online lessons (Barry, 2016).

For both course formats, the final oral examination tested recognition of anatomical structures under the microscope and was administered online during the pandemic. The examining professors were the same for both course formats. The examination was divided into two parts. During the oral microscope portion, students identified structures seen under the microscope, and in the virtual format, students directed the faculty to appropriate fields of view that allowed them to describe the relevant structures. Students who identified one of two structures correctly passed this part and then moved on to the second portion. Here, students were tested orally on their knowledge of topographical and systematic anatomy. Both examinations were oral, and the final grade took both portions into account. In the last two academic years, approximately 95% (470 out 495 students) of students in the online format successfully passed the examination on their first attempt. Importantly, a similar first pass percentage was obtained in prior years (before the Covid-19 pandemic) when laboratory exercises were held face-to-face and each student personally used a microscope (92% of students scored positively in the first attempt, 449 out 488, $P < 0.001$ one-tailed $t$-test, unpaired with equal variance). These results indicate that online teaching formats are not only effective in histology/microscopic anatomy but can also provide benefits to student performance (Amer & Nemenqani, 2020).

The Covid-19 pandemic forced teachers to quickly reconfigure courses for the virtual setting, and the prolongation of the pandemic has allowed for the improvement and optimization of virtual courses (Evans et al., 2020). The intent of this letter is not to suggest that all anatomy/histology courses for medical students should be delivered exclusively virtual, but rather to describe a fast, low-cost, in-house method for converting to virtual teaching in microscopic anatomy courses that previously emphasized traditional hands-on student light microscopy experience. We hope that the digital innovation and didactic virtual delivery skills that have been gained through this pandemic can thus be employed in the future to achieve optimal integration between face-to-face and virtual activity under the microscope.

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