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A comparative quali-quantitative analysis of student perspectives on microscopic anatomy labs: traditional glass slide versus virtual slides approach

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Abstract. This study, with its potential to significantly impact the field of medical education, is a testament to the active participation and invaluable contributions of a cohort of 59 first-year medical students. These students, the future of medical practice, shared their perspectives on two distinct methods of learning microscopic anatomy—traditional glass slide and microscope-based lessons versus online microscopical anatomy lessons employing the virtual slides in the Histology Guide website. They attended traditional microscopic anatomy lessons using a histology glass slide and a light microscope; the same group attended online lessons using virtual slides. Their feedback was gathered through a comprehensive questionnaire of 27 questions, which assessed effectiveness, convenience, engagement, and overall preference. Our quantitative and qualitative results clearly show that the same students who attended both the in-person and distance microscopic anatomy labs, while appreciating the usefulness and effectiveness of the two types of experiences, significantly prefer the in-person microscopic anatomy labs, judging the latter to be more interactive, due to the possibility of being able to directly use an optical microscope and slides containing histological preparations and the opportunity to work in groups with other students, being able to interact directly with the lecturer in the classroom. The remote experience of the light microscopy lab also allowed them to access it at their preferred times and review the lab several times during their available time. As reflected in the findings, these students' preferences and perceptions regarding these contrasting educational modalities offer insights crucial for refining anatomy teaching practices in medical education.

Keywords: microscopy, virtual microscopy, microanatomy, medical education, technology-enhanced instruction.

INTRODUCTION

Understanding medical students' preferences between distance learning and face-to-face teaching, particularly in the context of the COVID-19 pandemic, is a topic of significant interest. Our study, which stands out for its novel and explicit comparison of the traditional glass slide and microscope-based lessons with online microscopical anatomy lessons employing the virtual slides on the Histology Guide website, builds on the valuable insights provided by numerous studies in this area. For instance, Khalil et al. (2020) examined undergraduate medical students' perceptions of synchronized online learning during the pandemic, revealing a shift to online methods (Khalil et al., 2020). Similarly, Abbasi et al. (2020) highlighted students' perceptions of e-learning during COVID-19, indicating a transition to online platforms (Abbasi et al., 2020). However, Rahm et al. (2021) noted that despite the necessity of e-learning due to the pandemic, medical students initially preferred face-to-face teaching in clinical settings (Rahm et al., 2021).

Similarly, medical students' preferences for microscopic anatomy labs have been studied, particularly in the context of the COVID-19 pandemic. Studies have explored students' perceptions of online versus traditional face-to-face teaching methods for anatomy education. Singal et al. (2020) found that most students missed traditional anatomy learning, including face-to-face lectures and mentor interaction. Similarly, Mahdy & Sayed (2022) reported that while a significant percentage of students were satisfied with online learning materials for anatomy, there was still a preference for face-to-face teaching. This sentiment was echoed by (Mahdy & Ewaida, 2022), who highlighted that students missed various aspects of anatomy education, including face-to-face lectures and interaction with mentors.

Practical lessons in microscopic anatomy can classically be conducted either in-presence within the microscopic anatomy laboratories, through traditional microscopic anatomy teaching methods, using classical light microscopes and histological preparations on slides that are observed and discussed together with students, or through online microscopic anatomy learning platforms, where students are at a distance and use their computers to observe histological preparations, always guided by the lecturer who is remotely located (Hortsch et al., 2023A, B; Meyer, 2023).

Also related to technology's increased use and low cost, virtual microscopy is increasingly replacing the traditional use of microscopes and histological slides in microscopic anatomy laboratories, with both advantages and disadvantages to students (Hortsch et al.,

2023A). The use of laboratories equipped with optical microscopes and adequate collections of histological preparations may be costly for those universities where these resources are not possessed. At the same time, the increase in the number of students attending Italian medicine and surgery course degrees requires, in many cases, a sharp rise in rotations within the available laboratories due to the small number of faculty members available for this type of practical activity. The use of technology, in these cases, can be of great help to properly carry out this practical part of the study of microscopic anatomy. However, it must always be able to lead to the self-directed and independent learning that students need (Meyer, 2023).

In this study, our primary objective was to analyze the perceptions of the students who, in conducting the course on the microscopic anatomy of the respiratory, digestive, and urogenital systems, have experienced both types of hands-on laboratories in the presence and at a distance. We aimed to understand their preferences, engagement levels, and overall satisfaction with these contrasting educational modalities.

MATERIALS AND METHODS

The course of the human anatomy module 2

Module 2 of the human anatomy course of the master's degree program in medicine and surgery in the Faculty of Medicine and Psychology at the Sapienza University of Rome covered the study of the macroscopic and microscopic anatomy of the lymphoid system, respiratory system, digestive system, urogenital system, male reproductive system, and female reproductive system. This teaching module was held in the first year, second teaching semester, from March to May of the academic year 2022-2023. Students enrolled (n=220) who attended at least 67% of the mandatory Anatomy Module 2 course were eligible for an ongoing examination with oral and practical tests (autopsy identification of the organs, microscopic examination, and diagnosis of the structure of the organs).

Students took, in addition to the theoretical lectures given in the classroom, N. 2 macroscopic anatomy labs with the cadaver using the prosection, N. 4 macroscopic anatomy labs using the Sectra® 3D anatomical table, and the following hands-on microscopic anatomy lectures (delivered both in-person and remotely):

A) four practical laboratories on microscopic anatomy conducted in the presence at the laboratories of the Department of Anatomical Histological, Medical-Legal, and Locomotor Sciences, in the presence of the lecturer

who showed histological preparations using an optical microscope equipped with a camera connected to monitors on the tables where each student had a slide similar to the one shown by the lecturer and an optical microscope that they used. Practical laboratories included the study of microscopical anatomy of the following organs: 1) the trachea and lungs, 2) the esophagus, stomach, and duodenum, 3) the mesenteric small intestine and large intestine, and 4) the lymph node and spleen.

B) four practical laboratories on microscopic anatomy delivered remotely using computers and the Histology Guide website (Sorenson and Brelje, 2014). In this case, the lecturer showed the specimens by sharing their screen with the remotely connected students. The lecture, delivered through the Google platform of Sapienza University of Rome, was recorded and saved in a drive shared with the students who could independently see the lecturer's explanation. Later, the same students could log on to the site and independently view the preparations for the desired time. It should be pointed out that the platform allows dynamic viewing of the entire histological preparation, moving the field and varying the magnification used. The four hands-on distance learning lectures included the study of microscopical anatomy of the following organs 1) the liver and pancreas; 2) the kidney and urinary bladder; 3) the uterine tube, uterus, and ovary; and 4) the testis, epididymis, and prostate.

Student sampling

Students enrolled in the first year of the master's degree program in medicine and surgery in the Faculty of Medicine and Psychology at the Sapienza University of Rome were enrolled in the study after taking the entire Human and Clinical Anatomy module 2 for at least 67% of the mandatory anatomy module 2 course. The students asked to complete the evaluation questionnaire were selected from those who had attended at least three in-person and at least three distance workshops. The selection was conducted randomly, using simple random sampling. There were 56 students enrolled in completing the questionnaire (n=56; n=39 female and n=17 male, mean age SD = 19.91.02).

Students' views

The questionnaire used in this study, validated by Familiari et al., 2013, was administered after the last microscopic anatomy course laboratory lesson to all the students who had attended at least three of the four microscopic anatomy labs either remotely or in their

presence. The students were asked to fill out the questionnaire anonymously. Informed consent to participate was obtained from each student after the aim and purpose of the study had been thoroughly explained, ensuring the validity and reliability of the data collected.

The questionnaire consisted of three subsections, A-C. Subsection A was devoted to evaluating the virtual microscopy laboratory, subsection B was dedicated to assessing the in-person microscopy laboratory, and subsection C consisted of dichotomous items regarding the reasons behind their preferences. More than one answer to the questions proposed in subsection C of the questionnaire was possible. Subsections A and B contained nine items related to the laboratory types, distance, and presence, respectively. Students responded to each item using a 5-point Likert scale (1=strongly disagree, 2=disagree, 3=neither agree nor disagree, 4=agree, 5 = strongly agree).

Subsection C contained descriptive items mainly dealing with the reasons that had determined students' preferences between distance and in-person microscopic anatomy practical laboratories.

Data analysis of students' views

Individual responses obtained using the Likert scale were treated as variables measured at equivalent intervals and then means and standard deviation were computed as adequate statistics for this measurement level (Cario and Perla, 2008; Finney & Di Stefano, 2013). Pairwise comparisons of sections A and B were performed using the t-Student test. Statistical significance was established at $p \leq 0.05$. The size effect was calculated using the Cohen's-d test. The general guidelines for interpreting the effect size are as follows: 0.2 = small effect; 0.5 = moderate effect; 0.8 = large effect (Lakens, 2013).

Cronbach's Alpha coefficient assessed the internal consistency of items from sections A and B. A Cronbach's Alpha value higher than 0.70 is adequate for the questionnaire's internal consistency (Bland and Altman, 1997). The data were analyzed using IBM-SPSS 27 (<https://www.ibm.com/it-it/analytics/academic-statistics-software>).

RESULTS

Questionnaire Sections A and B

As shown in Table 1, the answers showed that a very high number of students expressed their appreciation for both types of courses, online and in-person. In both cases, the mean scores were far higher than the "theoretical" mean of 3.

Table 1. Student answers are given as mean and standard deviation to questions in sections A and B of the questionnaire.

| Questions | Mean | SD |
|--|------|-------|
| A1 How much did you enjoy the virtual microscopy lab experience? | 4,36 | 0,724 |
| A2 How helpful was the virtual microscopy lab experience in understanding microscopic anatomy? | 4,07 | 0,71 |
| A3 How engaging was the virtual microscopy lab experience? | 3,57 | 0,499 |
| A4 To what extent did the virtual microscopy lab experience meet your learning needs? | 3,79 | 0,948 |
| A5 How likely will you recommend the virtual microscopy lab experience to other students? | 4,57 | 0,599 |
| A6 How comfortable were you with the technology used in the virtual microscopy lab experience? | 4,34 | 0,815 |
| A7 How clear were the instructions provided for the virtual microscopy lab experience? | 4,29 | 0,706 |
| A8 How sharp were the digital images for the virtual microscopy lab experience? | 4,43 | 0,628 |
| A9 How satisfied were you with the virtual microscopy lab experience overall? | 4,57 | 0,628 |
| B1 How much did you enjoy the in-presence microscopy lab experience? | 4,71 | 0,456 |
| B2 How helpful was the in-presence microscopy lab experience in understanding microscopic anatomy? | 4,29 | 0,594 |
| B3 How engaging was the in-person microscopy lab experience? | 4,32 | 0,716 |
| B4 To what extent did the in-presence microscopy lab experience meet your learning needs? | 4,07 | 0,806 |
| B5 How likely will you recommend the in-presence microscopy lab experience to other students? | 4,64 | 0,483 |
| B6 How likely will you recommend the in-presence microscopy lab experience to other students? | 4,36 | 0,483 |
| B7 How clear were the instructions provided for the in-presence microscopy lab experience? | 4,23 | 0,539 |
| B8 How sharp were the images seen with the microscope for the in-presence microscopy lab experience? | 4 | 1,079 |
| B9 How satisfied were you with the in-presence microscopy lab experience overall? | 4,68 | 0,606 |

We compared the items related to the same aspect of the course using a t-test for paired samples. The following table (Table 2) presents the results of this analysis. As can be easily seen, except for Items 6 and 7, all the comparisons were statistically significant, evidencing a higher appreciation for the “in presence” laboratory. Cohen’s d indices of effect size evidenced moderate to large effect size for the statistically significant effects, except for items 5, 7, and 9, whose effect sizes were small.

To obtain a summary score of appreciation of Online and Presence courses, we aggregated the scores across, respectively, the nine items related to these courses. Aggregating these scores is legitimate by the very high Cronbach alphas (being .98 and .95, respectively, for the online and the in-presence laboratory). The mean average scores for the online and in-presence labs were 4.21 (SD = .65) and 4.38 (SD =.57). These aggregated scores confirm the strong appreciation of the two courses. The mean difference between the scores was -.162 resulting statistically significant, $t(55) = -8.128$, $p > .001$, $d = -1.086$.

Questionnaire Section C

The questions in section C of the questionnaire were partly dichotomous and devoted to highlighting the motivations behind the students’ preferences in the study. On the first question about the preferred over-

Table 2. Results of statistical analysis between the responses of sections A and B of the questionnaire.

| | Mean Difference | T | P | Cohen’s d |
|-----------|-----------------|---------|-------|-----------|
| A1 vs. B1 | -0,357 | -5,528 | <,001 | -0,739 |
| A2 vs. B2 | -0,214 | -3,873 | <,001 | -0,518 |
| A3 vs. B3 | -0,75 | -12,845 | <,001 | -1,717 |
| A4 vs. B4 | -0,286 | -4,69 | <,001 | -0,627 |
| A5 vs. B5 | -0,071 | -2,057 | 0,022 | -0,275 |
| A6 vs. B6 | -0,018 | -0,207 | 0,418 | -0,028 |
| A7 vs. B7 | 0,054 | 0,83 | 0,205 | 0,111 |
| A8 vs. B8 | 0,429 | 5,104 | <,001 | 0,682 |
| A9 vs. B9 | -0,107 | -2,569 | 0,006 | -0,343 |

all experience, the virtual microscopy lab received no response; 14.3% of the students stated that they had no particular auto preference, while 85.7% indicated that they preferred the in-person lab experience (Fig. 1).

The second question was devoted to indicating what the student had liked about the in-person lab experience. The student could select more than one of the four response options. 100% of the respondents indicated that they appreciated having a hands-on experience with the light microscope; 85.7% of the students stated that they enjoyed the very interactive experience; 75.4% of the respondents indicated that they appreciated being able to see slides with histological preparations in person;

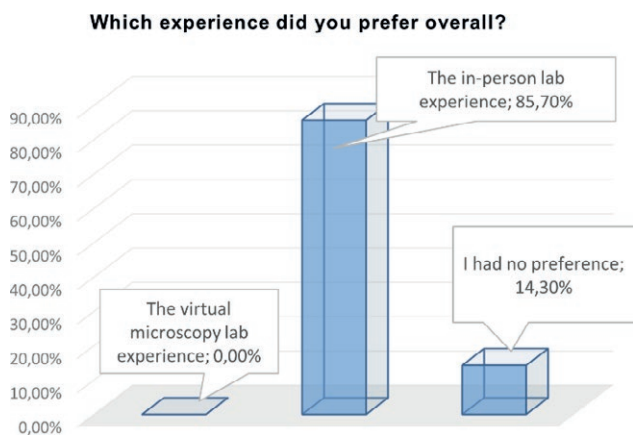


Figure 1. Students’ opinion about the preferred overall experience.

and 33.3% stated that they enjoyed being able to work in groups with other students (Fig. 2A).

On the other hand, the third question was devoted to exploring what the student did not enjoy from the in-person laboratory experience. The student could select more than one of the four response options. None of the student respondents (0.0%) highlighted difficulties in using the light microscope or handling glass slides; 35.7% of the students indicated less flexibility in terms of schedules; 14.3% of the students showed the need to be physically in the lab, while only 7.2% indicated, under “other,” difficulty in getting to the location (Fig. 2B).

The fourth question indicated what the student had enjoyed about the virtual microscopic anatomy lab experience. Again, the student could select more than one of the four response options. 71.4% of the students surveyed indicated that they liked the ability to access the

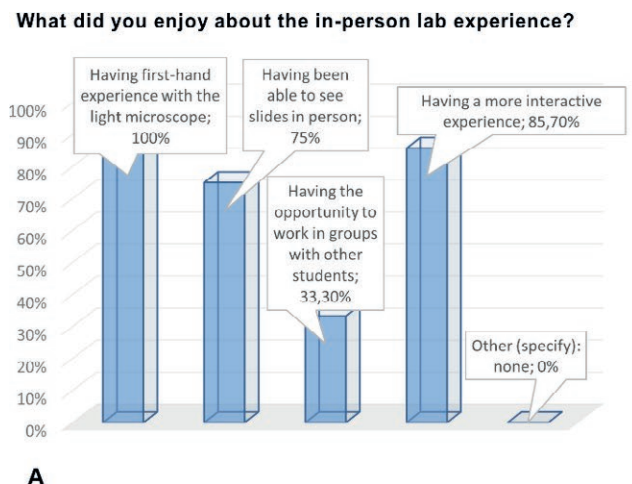
lab experience remotely; 64.3% of the students stated that they preferred the ability to review the lab experience at their own pace, while 35.7% indicated that they preferred the ability to zoom in and out of images. 7.5% of students indicated, under “other,” explaining all histological structures examined in detail (Fig.3A).

On the other hand, the fifth question was devoted to exploring what the student did not enjoy from the distance laboratory experience. The student could select more than one of the four response options. None of the students surveyed (0.0%) indicated difficulty using the technology, while 72.6% indicated less interactivity with other students or the lecturer; only 21.4% stated a limited ability to ask questions in real-time. Some students (14.3%) indicated under “other” that they did not like the proposed schedules, suboptimal audio quality, and problems with the remote connection (Fig. 3B).

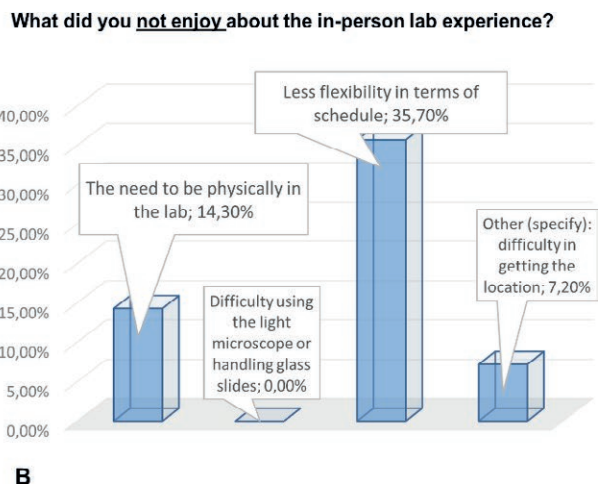
In the sixth question, students were asked which laboratory experience, remote or in-person, they perceived most helpful in understanding microscopic anatomy. 57.2% of students indicated that both experiences had been equally beneficial. 35.7% stated the in-presence laboratory experience as more functional, while only 7.3% indicated the virtual microscopy laboratory experience as more practical. No students (0.0%) showed that the two experiences were perceived to be of little use (Fig. 4).

The last three questions in section C were devoted to the specificity of the content compared to the classroom lecture.

In the seventh question, students were asked whether the in-person laboratory experience provided content different from the classroom anatomy microscopy lecture. 57.1% of students responded that in these in-person labs, they had covered some of the same content as the



A



B

Figure 2. Students’ opinion about the in-person lab experience.

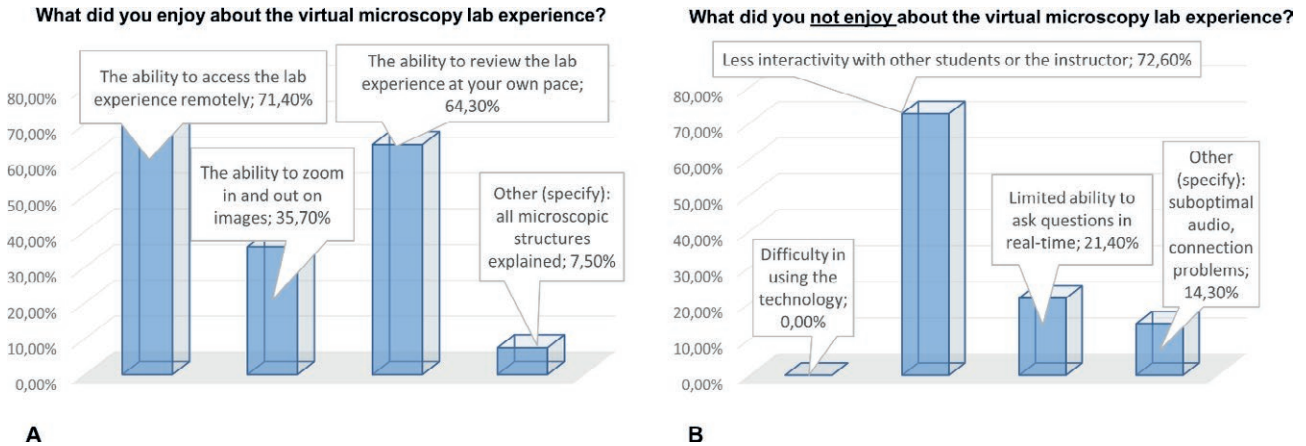


Figure 3. Students' opinion about the virtual microscopy lab experience.

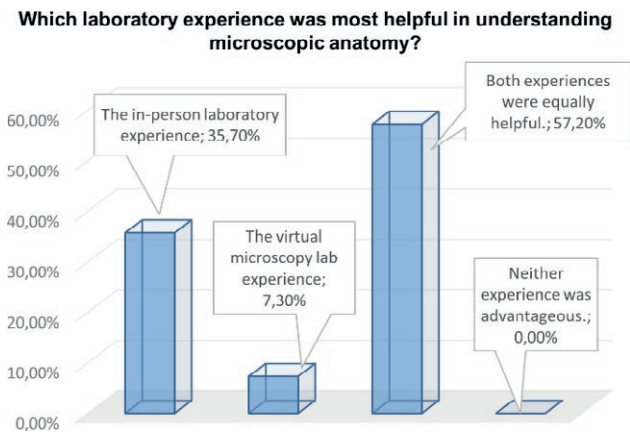


Figure 4. Students' opinions about the most helpful lab experience.

theoretical lectures but in a different way and with a different emphasis. 28.6% responded that the in-person labs had covered some additional and more detailed content than the classroom lecture. At the same time, only 14.3 percent of students thought the in-person labs covered the same topics as the classroom course, with no particular differences (Fig. 5A).

Similar results were obtained in the responses to the eighth question, in which students were asked whether the virtual laboratory experience provided teaching content different from the regular lecture on microscopic anatomy. In fact, in this case, 49.7% of students answered that the virtual laboratory had covered some of the same content as the theoretical lectures but in

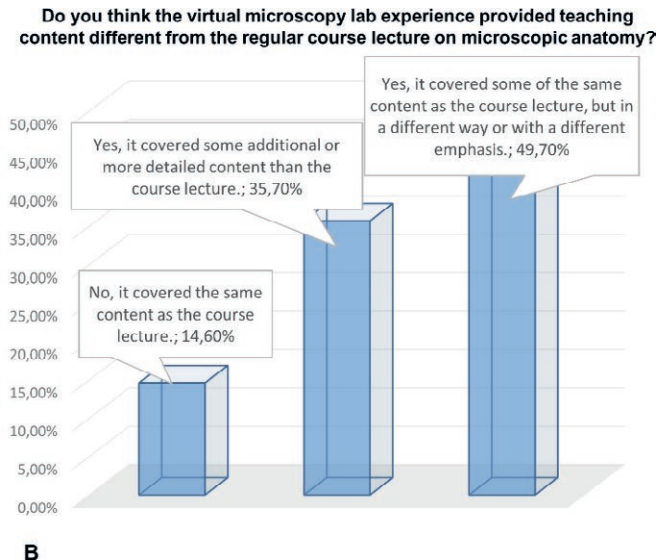
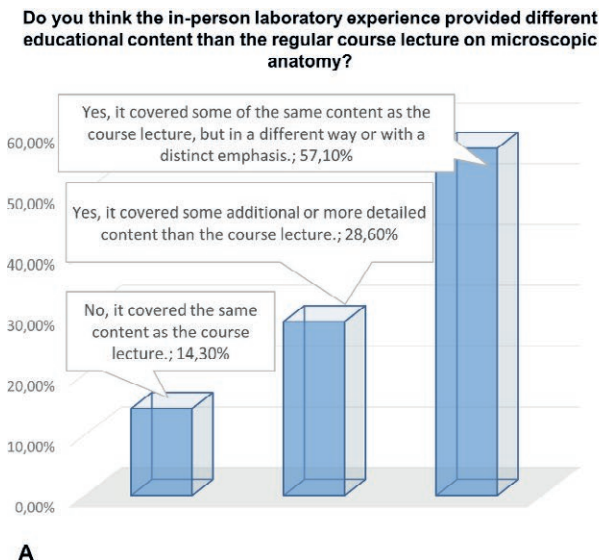


Figure 5. Students' opinions about the educational content of the two lab experiences.

Which laboratory experience provided different educational content than the usual lecture on microscopic anatomy?

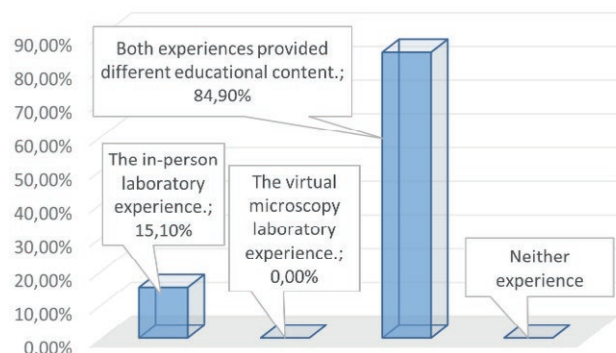


Figure 6. Students' opinions about different educational content between labs and lectures.

a different way and with a different emphasis. 35.7% responded that the virtual labs had covered some additional or more detailed content than the theoretical lectures. At the same time, only 14.6% of students indicated that the virtual labs had covered the same content as the theoretical lectures in the course (Fig. 5B).

The last question, the ninth, directly compared the two experiences. Students were asked which laboratory experience had provided different educational content than the usual classroom lectures on microscopic anatomy. In this case, 84.9% of the students responded that both experiences had provided different educational content; only 15.1% identified the in-person laboratory experience; no student (0.0%) indicated the virtual microscopy laboratory experience. No students (0.0%) indicated that none of their experiences had provided different educational content (Fig. 6).

DISCUSSION

Our quantitative and qualitative results clearly show that the same students who attended both the in-person and distance microscopic anatomy labs, while appreciating the usefulness and effectiveness of the two types of experiences, significantly prefer the in-person microscopic anatomy labs, judging the latter to be more interactive, due to the possibility of being able to directly use an optical microscope and slides containing histological preparations and the opportunity to work in groups with other students, being able to interact directly with the lecturer in the classroom.

The remote experience of the light microscopy lab also allowed them to access it at their preferred times and review the lab several times during their available time.

The teaching methods delivered to students regarding the curricular structure of microscopic anatomy teaching, microanatomy didactics and laboratory, microscopy laboratory format, and other shared learning resources are similar to those of universities worldwide (Hortsch et al., 2023A). The site used for our remote microscopic anatomy laboratories, "Histology Guide" (Sorensen and Brejle, 2014), also appears to be on the list of open, freely accessible websites cited and used in the international literature (Hortsch et al., 2023).

Medical students' preferences for microscopic anatomy labs, whether in a distance learning or face-to-face setting, have been a subject of interest, particularly in the context of the COVID-19 pandemic. Studies have explored students' perceptions and attitudes toward online versus traditional teaching methods in anatomy education. For instance, a study by Sarkar et al. (2022) found that more than 90% of students preferred traditional anatomy teaching over online methods, indicating a strong preference for face-to-face interactions in the context of anatomy education. This preference for conventional teaching methods aligns with the sentiment that certain aspects of anatomy education, such as practical lab sessions, are best delivered in a face-to-face setting.

For instance, Gellisch et al. (2022) conducted a randomized experimental field study where medical students attended either regular face-to-face classes for microscopic anatomy or the same practical course online using the Zoom videoconferencing platform. This study provides insights into how students perceive and engage with online versus traditional face-to-face microscopic anatomy classes.

On the other hand, research by Totlis et al. (2021) aimed to determine the impact of the COVID-19 outbreak on anatomy teaching and compared traditional anatomy teaching with remote modalities, highlighting the shift towards online educational methods during the pandemic. This study sheds light on the challenges and adaptations in anatomy education brought about by the pandemic, emphasizing the need to explore alternative teaching approaches to ensure continuity in education. Zarcone & Saverino (2021) detailed experiences during the COVID-19 pandemic, where online platforms like Microsoft Teams and 3D anatomical modeling programs were used for teaching microscopic anatomy. This shift towards online platforms underscores the adaptability of medical education in response to challenging circumstances.

Furthermore, the study by Vinson (2019) emphasized the importance of the anatomy lab experience as a form of professional socialization, where students learn practical skills and interact with peers in a simu-

lated clinical setting. This highlights the unique role of hands-on learning in anatomy education and suggests that face-to-face interactions in the lab setting may offer valuable learning experiences that are challenging to replicate in online environments.

In a study by (Ortadeveci et al., 2022), it was noted that while theoretical aspects of anatomy could be presented remotely, face-to-face teaching was deemed essential for the practical components of anatomy education. This finding underscores the irreplaceable value of hands-on experience in microscopic anatomy labs, where students engage directly with anatomical specimens. Additionally, Cuschieri & Narnaware (2022) emphasized the importance of practical sessions in aiding medical students' understanding of basic sciences like anatomy and retaining knowledge effectively. Practical sessions reinforce theoretical knowledge and enhance students' comprehension of complex anatomical structures.

Overall, the literature suggests that while online platforms offer flexibility and adaptability, there is a strong preference among medical students for face-to-face teaching in microscopic anatomy labs. The hands-on nature of anatomy education, the value of practical experience, and the unique learning environment provided by traditional lab settings contribute to students' inclination towards face-to-face teaching for microscopic anatomy. Balancing the benefits of online and traditional teaching methods is essential to cater to diverse learning preferences and ensure a comprehensive educational experience for medical students.

In conclusion, while there is a growing trend toward incorporating online and remote teaching methods in anatomy education, especially in response to the challenges posed by the COVID-19 pandemic, the preference for face-to-face teaching in microscopic anatomy labs remains strong among medical students. Students value the hands-on nature of anatomical dissection and the interactive learning experiences offered in traditional lab settings. This highlights the importance of balancing technological advancements with preserving practical, experiential learning in microscopic anatomy education.

LIMITATIONS OF THE STUDY

The limited number of students who participated in the study, belonging to only a one-course master's program, represents a limitation of the research, even though this degree program has fewer students enrolled. Further analysis is needed to explain the differences in the usefulness and effectiveness of the two types of

experiences in teaching microanatomy laboratories in a multicenter national study.

AUTHOR CONTRIBUTIONS

Conceptualization, R.M., F.G., B.C.; methodology, F.G, B.C., F.P.; software, C.L., M.S.; validation, B.C., D.O.; formal analysis, B.C; D.O.; investigation, R.M., F.G., M.S; resources, F.G., R.M.; data curation, F.P.; writing—original draft preparation, R.M, F.G ; writing, review and editing, R.M, F.G B.C. D.O.; visualization, F.G., supervision, F.G.; project administration, F.G., R.M.; funding acquisition, RM. All authors have read and agreed to the published version of the manuscript.

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INSTITUTIONAL REVIEW BOARD STATEMENT

Ethical review and approval were waived for this study due to its observance of the Italian University System's evaluation regulations administered by the National Agency for the Evaluation of the University System and Research (<https://www.anvur.it/>, accessed on 03 June 2024) and due to the observance of Sapienza University rules for anonymous students' satisfaction evaluation and Teaching Quality Assessment Questionnaire.

INFORMED CONSENT STATEMENT

Informed consent was obtained from all subjects involved in the study.

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APPENDIX

SECTION A. The virtual microscopy lab.

| Questions | 1=strongly disagree | 2=disagree | 3=Neither agree nor disagree | 4=agree | 5 = strongly agree |
|--|---------------------|------------|------------------------------|---------|--------------------|
| A1 How much did you enjoy the virtual microscopy lab experience? | | | | | |
| A2 How helpful was the virtual microscopy lab experience in understanding microscopic anatomy? | | | | | |
| A3 How engaging was the virtual microscopy lab experience? | | | | | |
| A4 To what extent did the virtual microscopy lab experience meet your learning needs? | | | | | |
| A5 How likely will you recommend the virtual microscopy lab experience to other students? | | | | | |
| A6 How comfortable were you with the technology used in the virtual microscopy lab experience? | | | | | |
| A7 How clear were the instructions provided for the virtual microscopy lab experience? | | | | | |
| A8 How sharp were the digital images for the virtual microscopy lab experience? | | | | | |
| A9 How satisfied were you with the virtual microscopy lab experience overall? | | | | | |

SECTION B. The in-person microscopy lab.

| Questions | 1=strongly disagree | 2=disagree | 3=Neither agree nor disagree | 4=agree | 5 = strongly agree |
|--|---------------------|------------|------------------------------|---------|--------------------|
| B1 How much did you enjoy the in-presence microscopy lab experience? | | | | | |
| B2 How helpful was the in-presence microscopy lab experience in understanding microscopic anatomy? | | | | | |
| B3 How engaging was the in-person microscopy lab experience? | | | | | |
| B4 To what extent did the in-presence microscopy lab experience meet your learning needs? | | | | | |
| B5 How likely will you recommend the in-presence microscopy lab experience to other students? | | | | | |
| B6 How comfortable were you with the technology during your in-presence microscopy lab experience? | | | | | |
| B7 How clear were the instructions provided for the in-presence microscopy lab experience? | | | | | |
| B8 How sharp were the images seen with the microscope for the in-presence microscopy lab experience? | | | | | |
| B9 How satisfied were you with the in-presence microscopy lab experience overall? | | | | | |

SECTION C. in-person vs. remote microscopy

| Questions | Preferences |
|--|---|
| C1 Which experience did you prefer overall? | The virtual microscopy lab experience The in-person lab experience I had no preference. |
| C2 What did you enjoy about the in-person lab experience? (You may select more than one option) | Having first-hand experience with the light microscope Having been able to see slides in person Having the opportunity to work in groups with other students Having a more interactive experience Other (specify): _____ |
| C3 What did you not enjoy about the in-person lab experience? (You may select more than one option) | The need to be physically in the lab Difficulty using the light microscope or handling glass slides Less flexibility in terms of schedule Other (specify): _____ |
| C4 What did you enjoy about the virtual microscopy lab experience? (You may select more than one option) | The ability to access the lab experience remotely The ability to zoom in and out on images The ability to review the lab experience at your own pace Other (specify): _____ |
| C5 What did you not enjoy about the virtual microscopy lab experience? (You may select more than one option) | Difficulty in using the technology Less interactivity with other students or the instructor Limited ability to ask questions in real-time Other (specify): _____ |
| C6 Which laboratory experience was most helpful in understanding microscopic anatomy? | The in-person laboratory experience The virtual microscopy lab experience. Both experiences were equally helpful. Neither experience was advantageous. |
| C7 Do you think the in-person laboratory experience provided different educational content than the regular course lecture on microscopic anatomy? | No, it covered the same content as the course lecture. Yes, it covered some additional or more detailed content than the course lecture. Yes, it covered some of the same content as the course lecture, but in a different way or with a distinct emphasis. |
| C8 Do you think the virtual microscopy lab experience provided teaching content different from the regular course lecture on microscopic anatomy? | No, it covered the same content as the course lecture. Yes, it covered some additional or more detailed content than the course lecture. Yes, it covered some of the same content as the course lecture, but in a different way or with a different emphasis. |
| C9 Which laboratory experience provided different educational content than the usual lecture on microscopic anatomy? | The in-person laboratory experience. The virtual microscopy laboratory experience. Both experiences provided different educational content. Neither experience provided different educational content. |