

Face-to-face vs distance learning in human anatomy education: a longitudinal study of students' perspective and learning outcomes during COVID-19 pandemic

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Abstract

On March 9, 2020 attendance classes in Italian universities were suspended due to Covid-19 Pandemic. Thanks to the fast actions put in place by Sapienza University Governance and to the efforts made by all components of the university, the face-to-face courses were turned into on-line courses in only one week. This sudden change has been an even more exciting challenge for the Faculties of Medicine, whose members were also involved in the frontline battle against the virus. Anatomy academics, recognizing the challenges as opportunities to innovate anatomy teaching, set up at the same time: a specific survey to investigate students' perspective on educational preferences and their mood; a longitudinal quantitative study to compare, for the first time in the same student's population, exam grades after face-to-face classes and after online classes. The students, although with different motivations, considered valid both modes of attendance. Exam grades statistical analysis showed that anatomy exam marks after the online course had a higher average value (statistically significant) and with an excellent correlation factor, compared to the marks obtained at the end of the face-to-face course. Considering our data as a whole, we can suggest that face-to-face classes and online classes, rather than being interchangeable education modes, should be considered as modes with different characteristics that offer different educational benefits. These advantages may have different relevance for individual students, depending on their specific needs and individual preferences. This suggests the opportunity to propose customizable courses, centered on the student's needs.

Keywords

Anatomy education, COVID-19, computer-assisted learning, e-learning, web-based learning.

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1. Introduction

In the Italian universities the academic year 2019/20 began, as usual on October 1, 2019, nothing foreshadowed the advent of a pandemic, due to the SARS-CoV-2 virus.

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Following government indications (DPCM 8-3-2020 GU n. 59 8-3-2020), on March 9, 2020 schools and educational institutions were closed to students, attendance classes were suspended, so universities had to organize and implement distance learning activities in a few days.

Sapienza University of Rome governance has made available resources to support the transition from face-to-face teaching to online teaching, after just one week, on March 16, 2020. During the second semester, a very rapid infrastructural adjustment of classrooms to support the education digitalization was carried on. Professors, with a great sense of responsibility and attachment to the university institution, have responded quickly to the need for continuity of educational activities with great commitment, allowing to switch instantly the education provided face-to-face to online education. The students immediately adhered to the new educational delivery method with order and discipline. All technical, administrative, and library staff gave their full support, which was essential for the continuation of educational activities in online mode. Anatomy teaching consist mainly of “hands-on” practical experience, in which cadaveric dissection is considered the “gold standard” in anatomy education (McLachlan, 2004; Darras et al., 2018; Singal et al., 2020) has had to adapt to the emergency, trying to ensure the continuity of teaching to the students. The transformation of teaching activities in presence into online lessons made it possible to ensure the continued delivery of anatomy teaching, respecting social distancing and providing a safe learning environment, during the COVID-19 pandemic.

However, several challenges as well as opportunities were recognized by anatomy academics in this period including time, resources, technical capability, and teaching innovation that will continue to support the learning experience of our students during the COVID-19 emergency period, and will improve our existing face-to-face teaching when the situation begins to return to normality (Brasset et al., 2020; Byrnes et al., 2020; Evans et al., 2020; Iwanaga et al., 2020; Longhurst et al., 2020; Moszkowicz et al., 2020; Pather et al., 2020). According to several authors, using new e-learning platforms allows the research of increasingly rich and complex materials and stimulates the creation of knowledge-building communities (Scardamaglia and Breiter, 2004). Moreover, they call for a collaborative, reflective, and metacognitive approach to study through the comparison of the objectives and content of educational activity (Bereiter; 2004; Varisco, 2009; Alby and Zuccheromaglio, 2008, 2009; Trentin, 2011; Zuccheromaglio and Alby, 2016). Studies in literature state that social media as well have shown to have potential as learning environments, if developed within educational projects (Siemens and Weller 2011; Manca and Ranieri 2013). Blended learning, defined as the combination of conventional face-to-face learning and asynchronous or synchronous e-learning, is effective, complementary to traditional education for teaching human anatomy, as well (Khalil et al., 2018; Relucenti et al. 2019). Anatomical education has been greatly enriched by recent on-line accessible technological improvements in simulation and material sciences, namely 3D printing (Clifton et al., 2020), virtual interactive anatomy dissection table, and 3D reconstruction models (Moszkowicz et al., 2011, 2020).

For what concern the human and clinical anatomy integrated course of the medicine and surgery undergraduate course at Faculty of Medicine and Psychology at the Sapienza University of Rome, COVID-19 pandemic gives the possibility to compare the face-to-face teaching (used in the first semester) with on-line teaching (uti-

lized in the second semester), in the same first-year medicine and surgery undergraduate students.

Therefore, the present study aims to examine students' perceptions, comparing both face-to-face and on-line learning, considering that anatomy successful learning may be obtained, in the post-COVID-19, through a complimentary use and integration of both educational methodologies.

2. Materials and methods

2.1 The Human and Clinical Anatomy integrated course of Sapienza Medical School at S. Andrea Hospital

The human and clinical anatomy integrated course (HCA) of Sapienza Medical School at S. Andrea Hospital is divided into 3 modules (HCA1-2-3) that are spread over the first two years, lectures in the three modules are delivered by four professors. Each one of them gives lectures in all three modules, and exams are administered by all four professors. The HCA 1 program includes the musculoskeletal and cardiovascular systems, it is delivered during the first year first-semester; the HCA 2 program includes the lymphatic, respiratory, urinary, gastrointestinal, and genital systems, it is delivered during the first year second-semester; the HCA 3 program includes tegumentary, endocrine, and nervous systems with sensory organs, the second year first semester. Lessons were delivered by both anatomy and clinical teachers, specifically in HCA 1 clinical lectures were delivered by orthopedics and cardiologist; in HCA 2 clinical lectures were delivered by general surgeons and internal medicine physicians; in HCA 3 clinical lectures were delivered by neurosurgeons and neurologists. Practicals include: attending to light microscopy laboratory to manage with glass slide recognition, attending to gross anatomy sectory room, to attend prosections and practice dissection.

At the end of each semester, students have an oral formative examination, representing a part of the student's overall assessment for the summative examination for the HCA course. The assessment was conducted by the same four teachers for the entire three semesters period. The maximum mark/grade achievable in each HCA 1 or HCA 2 examination was 30/30 cum laude, which was the result of the sum of the marks attributed independently by three teachers (10/10 for each teacher, Laude corresponds to an extra point) in each examination at the end of the semester. Marks were established by the Academic Rules and Regulations for Italian Universities (the minimum pass mark is 18/30, while the top mark is 30/30 cum laude).

At Sapienza Medical School of S. Andrea Hospital, in the academic year 2019-2020, 110 students attended face-to-face (over 67% of classroom attendance) the HCA 1, in the October/December 2019 period. Traditionally, medical undergraduate degree students attend integrated theoretical lectures, workshops, and practical laboratory classes. During practical classes, students work in small groups under teaching tutor supervision, using cadaveric prosection, plastinated specimens, plastic models, plastic bones, radiographs, MRI and CTI scans using multimedia systems (Familiari et al., 2013) and a digital touch screen anatomy table (SECTRA®).

To facilitate human anatomy learning and teacher-student relation, one of the human anatomy teachers created a professional Facebook profile (named ProfMi-

chelaRelucenti) and a YouTube channel (named Michela Relucenti) dedicated to human anatomy topics. The Facebook profile was used by the teacher to share useful information, such as the lesson calendar (with related topics, specifying time and location), dates and location of examinations, the presence of scientific seminars of possible interest to the students, the deepening of some anatomy issues, as well as the reference to the YouTube channel (Relucenti et al., 2019).

2.2 The Human and Clinical Anatomy integrated course of Sapienza Medical School at S. Andrea Hospital: educational transition during COVID-19 pandemic

Starting with the second semester, remote/distance learning was implemented, for the same students, following Sapienza University instructions for remote/online learning published on the Sapienza website (<https://www.uniroma1.it>). Considering the lockdown, *HCA 2* asynchronous theoretical as well as practical lessons were prepared as PowerPoint files with integrated recorded videos, explained by teachers (both voice and face were shown in each slide by one teacher, whereas the other three teachers showed only voice in each slide). Teachers uploaded lessons on a Google Drive folder shared with students at the beginning of each week from March 16 to May 25, 2020. Files were available to all the students following the course. At the beginning and the end of the semester, some lessons were delivered in synchronous mode, using the hangouts/meet conferencing tool (Google, CA, US). Practical lessons were developed basing on the contents offered by the digital anatomical table (SECTRA®). One of the four anatomy teachers (R.H.) was able to connect remotely thanks to the special permission of Sectra. Besides, the company offered 100 student licenses for free to use with the Uniview platform, so that students could access the anatomical table remotely. With these “remote-practical” lessons shown on the video, the teacher tried to guide the students on which cases to search and what to observe (they cannot edit but only browse the cases). A Professional Facebook profile and a YouTube channel dedicated to human anatomy topics remained active, being utilized by students. Almost the same students who attended the face-to-face *HCA1* attended the online *HCA 2* in the March/May 2020 period.

2.3 S. Andrea hospital medical degree course students survey

Two surveys were designed and then distributed to S. Andrea students (SAS) who attended the face-to-face *HCA1* as well as the online *HCA 2* courses. The first was a pilot survey, that provided the ground to design the second one, a multiple-choice survey. The pilot study consisted of 16 questions, some with dichotomous answers and others with open answers, involving 10 voluntarily recruited students, belonging to the Degree Courses in Medicine and Surgery. A qualitative content analysis (Graneheim and Lundman, 2004; Hsieh and Shannon, 2005; Alby and Fatigante, 2014) was performed on the open-ended questions to identify emic categories for the closed-ended questions of the final multiple-choice survey. Specifically, the final survey consisted of 17 questions (16 multiple-choice questions and 1 open-ended question), arranged in three set, each one concerning specific topics. The final survey had an initial incipit (that constitutes the informed consent, in which the questionnaire is presented, the average filling in time is communicated, the privacy regulations were

Table 1. Students' opinion on classes usefulness.

| Questions | Answers |
|---|--|
| 1. What did you find most useful on attending first-semester face-to-face anatomy classes? | Possibility to clarify doubts, ask questions; possibility of interactive discussion with teacher; possibility to deepen topics covered in the text; Other |
| 2. What did you find most useful on attending second-semester's online classes? | Possibility to clarify doubts, ask questions; possibility of interactive discussion with teacher; possibility to listen and re-listen to the lessons; to be able to have more concentration and attention; possibility to organize autonomously the times of attendance of classes and study; do not waste time moving around; other |
| 3. What did you find most useful on your independent activities on the anatomical digital table? | Allows to visualize the topographic relations between the various organs; allows to combine the study of the macroscopic anatomy with the microscopic one; it is possible to study on images similar to those used in diagnostics; other |
| 4. Have you been given clear information on how to attend the online classes? | Yes/no |
| 5. Was the procedure to connect and follow the online classes simple? | Yes/no |
| 6. Some online anatomy classes showed the teacher, others had audio only, which one did you prefer? | The one in which the teacher was also seen; the one with audio only |
| 7. Justify your choice: I preferred to see teacher because | Gestures and expressions support understanding; gestures and expressions support attention and interest; both of the above; other |
| 8. Justify your choice: I preferred the one with audio only because | Seeing the teacher is not relevant; the teacher's box covers the slides; both of the above; other |

explained, a reference e-mail was provided for further questions). The first set contained questions on students' classes usefulness perception (Tab 1).

Students' opinion on overall *HCA2* course organization, their preferences and aspects to improve, were asked in the second question set (Tab 2).

Information about Covid-19 impact on students' skill an mood were asked in third question set (Tab 3).

The questionnaire was distributed as a Google Modules file to the SAS who attended the face-to-face *HCA1* as well as the online *HCA2* courses. Answers collection extended from May to June 2020. Survey participation was anonymous, voluntary, and free of charge. The final survey was completely filled by 104 students, their answers were collected as a data set and then analyzed by descriptive statistical

Table 2. Students perspective on HCA 2 course management.

| Questions | Answers |
|--|--|
| 1. Indicate, among those listed, which aspects of the organization of the anatomy course in on-line mode are particularly effective for anatomy study. | Access to teaching materials (video, digital anatomical table, images, slides, texts); bi-weekly organization of the supply; rapidity in making the course available online; listen to and re-listen to the lectures; organize independently the times of attendance and study; do not waste time moving around; other |
| 2. Would you improve something of the organization of the online anatomy course? | Yes/no |
| 3. What would you improve? | Open-ended |
| 4. Do you miss face-to-face classes? | Yes/no |
| 5. Indicate, among the following, the aspect that you miss the most | Physical use of the table and infrastructure; direct interactions with the professor; interactions with fellow students; other |
| 6. Do you prefer face-to-face or online classes? | Face to face; online; I do not have a preference |

Table 3. Covid-19 impact on students' skill and mood.

| Questions | Answers |
|---|--|
| 1. Have you experienced any study-related difficulties due to the Covid-19 emergency? | Yes/no |
| 2. What were the biggest difficulties for you? | Time management problems; concentration difficulty; increased anxiety; low efficiency and productivity in the study; other |
| 3. From the adjectives listed below, choose those that describe your prevailing mood during this emergency period | Sad; industrious; Cheerful; Calm; Worried; Lazy |

analyses. We did not proceed with a psychometric validation of the questionnaire for the following two reasons: 1) the exploratory purpose of the study; 2) the needing to build a questionnaire to obtain information from the students of a specific course, that is the need for a situated instrument linked to their educational activities, without therefore having the purpose of generalizing its use. The research was carried out on students according to the Helsinki Declaration.

2.4 Marks evaluation: *HCA 1* vs *HCA 2*

The *HCA 1* oral formative examinations were exclusively conducted in a face-to face mode between January/February 2020 (winter session, WS), whereas the *HCA 2* oral formative examinations were conducted using the hangouts/meet conferencing tool (Google, CA, US), according to Rules and Regulations of Sapienza University of

Rome, between June/July 2020 (summer session, SS). To assess the effect of different education methods on SAS students' examination outcome, we compared *HCA1* marks with *HCA2* marks (*HCA1* N=104, *HCA2* N=103). Statistical analysis was conducted by using the paired two-sample, two-tailed t-test. Statistical significance was established at $P \leq 0.05$. The median, upper, and lower limits of the 95% confidence interval for both the difference and the mean were also considered. The mark evaluation 30 cum laude was accounted for as 31 in the informed system of the Sapienza University, and used for the statistical analysis. Correlation coefficient r was also conducted; statistical significance was established at $P \leq 0.05$. The 95% confidence interval for r was also considered. The data were analyzed using MedCalc® statistical software version 19.5.3 (MedCalc Software, Ostend, Belgium; <https://www.medcalc.org>; 2020).

3. Results

3.1 SAS Survey data

3.1.1 SAS opinion on *HCA1* face-to-face and *HCA2* on line classes and practicals: pros and cons

SAS student said that *HCA1* face-to-face classes have several benefits: the possibility to interactively discuss with the teacher and to deepen the links with the clinical practice (43.9%), to deepen what is discussed in the books (25.8%) and to ask questions to the teacher to clarify doubts (22.7%). Some students (7.6%) also stated that attending facilitates study and provides an overview of the topic (Fig. 1).

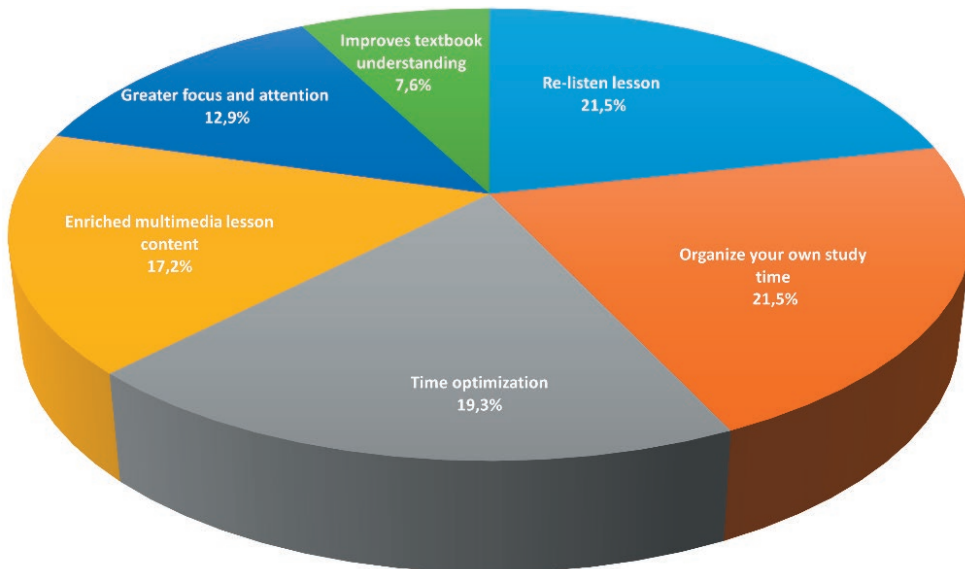


Figure 1. Evaluation of first-semester face-to-face anatomy classes.

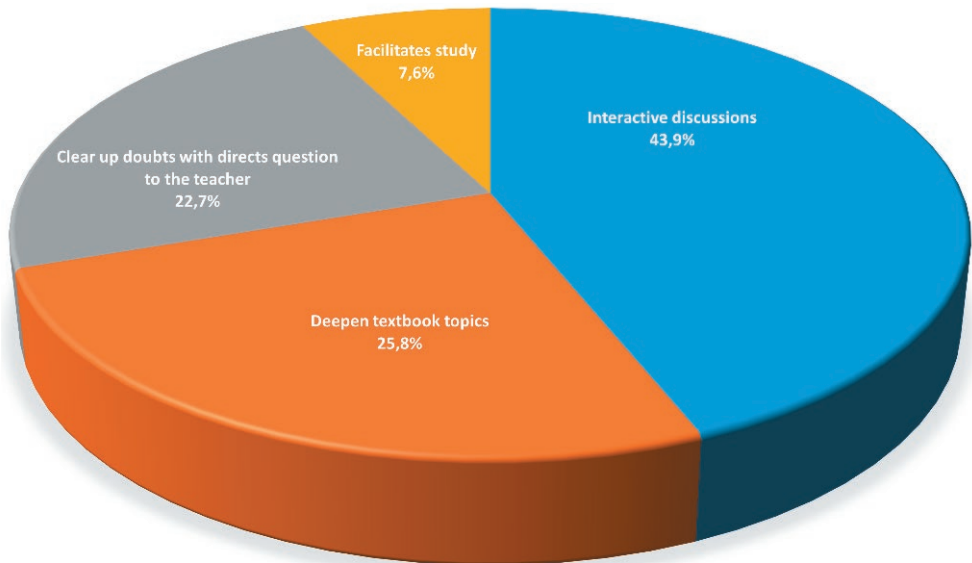


Figure 2. Evaluation of second-semester online classes.

In HCA2 online lessons, several positive aspects were found, as the possibility to listen to the lessons several times (21.5%) and to organize autonomously both lessons attendance times and study times (21.5%). Many students also found it advantageous not to waste time in traveling to reach university (19.3%) and to have lessons enriched with multimedia content absent books, useful to integrate study (17.2%). Some students also state that during online lessons they can be more attentive and focused (12.9%) and that these online lessons are useful to increase textbook comprehension (7.6%). (Fig. 2).

As concerns the online practicals organization, the anatomical digital table with remote access was used by 61.8% of the students who answered the questionnaire. Most found it useful and formative experience (89.7%), as it allows to combine the study of macroscopic anatomy with microscopic (50%), allows to visualize the topographic relationships between the various organs (23.1%), and allows to study on images similar to those used in clinical diagnostics (19.2%). Finally, some students believe that using the table remotely allows more time than using it in the presence (7.7%). (Fig. 3).

Regarding the technical aspect of online classes and practicals, students report ease of connection (96.1%) and clarity about online lessons organization (96.1%). The lessons in which it was possible to see the teacher on the video were preferred over those in which only audio was available to most students (84%), this preference was justified by the possibility of observing gestures and expressions of the teacher, considered elements of support of attention, and understanding. A minority of students (16%) expressed a preference for lessons only with audio, considering the video image of the teacher as an element of distraction from reading the slides, the element on which it is useful to focus.

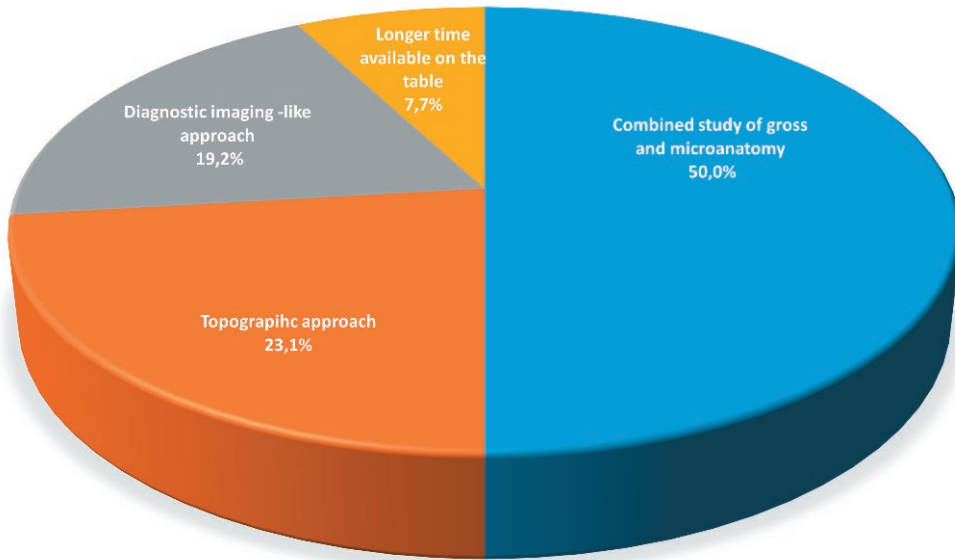


Figure 3. The anatomical digital table usefulness.

3.1.2 SAS Overall evaluation of online HCA2 organization: Preferences and aspects to improve

Students were asked for an overall evaluation of online HCA 2 organization, they expressed appreciation mainly (23.3%) for the possibility to access to a wide amount of learning materials (video, digital anatomical table, images, slides, texts), then they liked the possibility of independently organize the time devoted to class attendance and that devoted to study (21.4%). Other factors considered important were the possibility to listen to the lessons whenever you want (19.5%), but also not to waste time travelling to university (17.6%). Finally, the rapidity in making the online course available in the face of sudden emergency (11%) and the bi-weekly organization of the delivery of lessons, the same as the course in attendance (7.2%), was appreciated. In addition, students emphasize the importance of learning material availability, provided to a greater extent during the online course with respect to the face-to-face classes. (Fig. 4).

Most of the students (71.1%) state that they miss face-to-face classes. They suffer from the lack of interaction with each other (70.4%), but also the interaction with the teacher (22.2%), and the physical use of the anatomical table and infrastructure (7.4%). Only 23.7% of students express an opinion on something to improve in the online course. Among the most mentioned aspects, there is the introduction of moments of synchronous interaction with the teacher to ask questions to create more participatory lessons. Finally, when an even more direct question is asked, students respond that overall they prefer to attend face-to-face classes (51.3%), although a not low percentage prefer online classes (40.8%), and a percentage of 7.9% state that they have no particular preference.

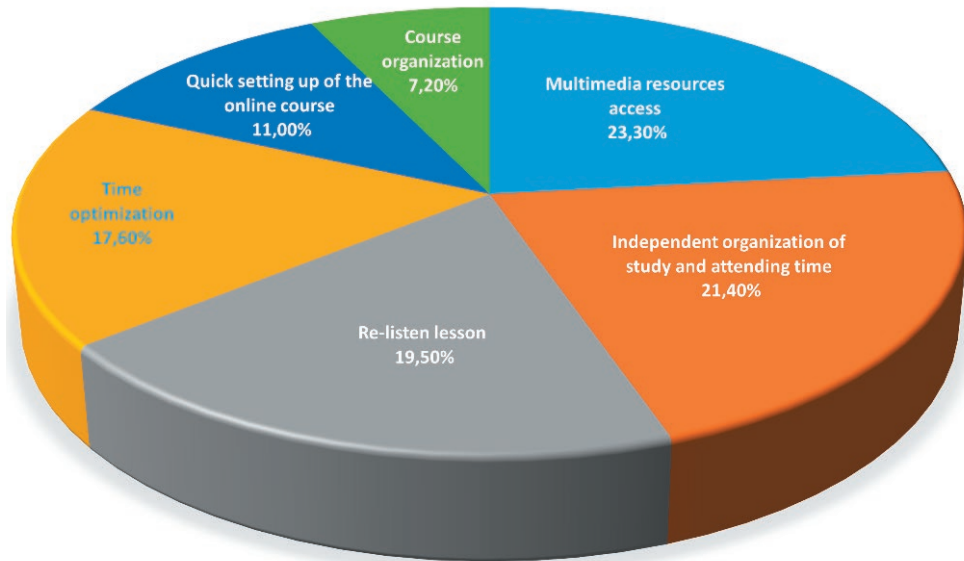


Figure 4. Students' opinion on HCA 2 course organization, preferences and aspects to improve.

3.1.3 COVID-19 impact on SAS learning skills and mood

The spread of COVID-19 that has upset the normality of Italian daily life, forcing population to social distancing and self-isolation, had an impact also on the student population.

Most of SAS (61.8%) say they have had difficulties in learning because of the COVID-19 emergency, especially difficulty concentrating (33.6%), low productivity and efficiency in learning (28.3%), time management difficulties (19.5%), increased anxiety and stress (17.7%), difficulty in finding study material (0.9%) (Fig. 5).

When SAS are asked to express their state of mind prevailing during this period, they state that they feel worried (29.6%), confirming a certain state of anxiety that also emerged in previous responses, but also that they can work at full speed (busy: 22.5%), showing the presence of initiative although, as a general mood, they are rather sad (15.4%). (Fig. 6).

3.2 Online vs face-to-face classes: examination marks as outcome evaluators

3.2.1 SAS exam grades

In order to evaluate the effect of the education transition (from face-to-face lessons and practicals, to online lessons and practicals) due to Covid-19, SAS examination marks obtained in the WS at the HCA1 examination, were compared with examination marks obtained in SS HCA2 examination. SAS who attended face-to-face HCA1

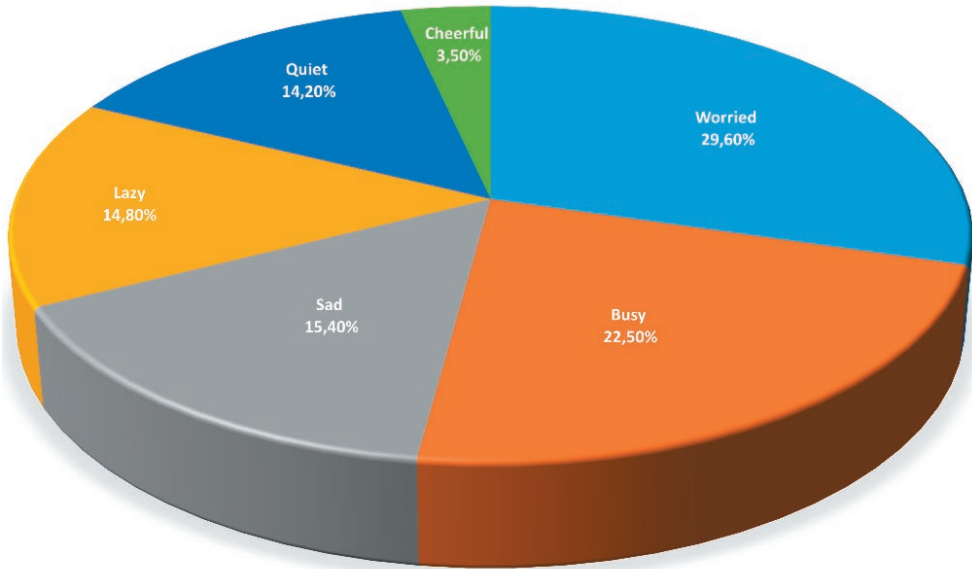


Figure 5. Covid-19 pandemic related study difficulties.

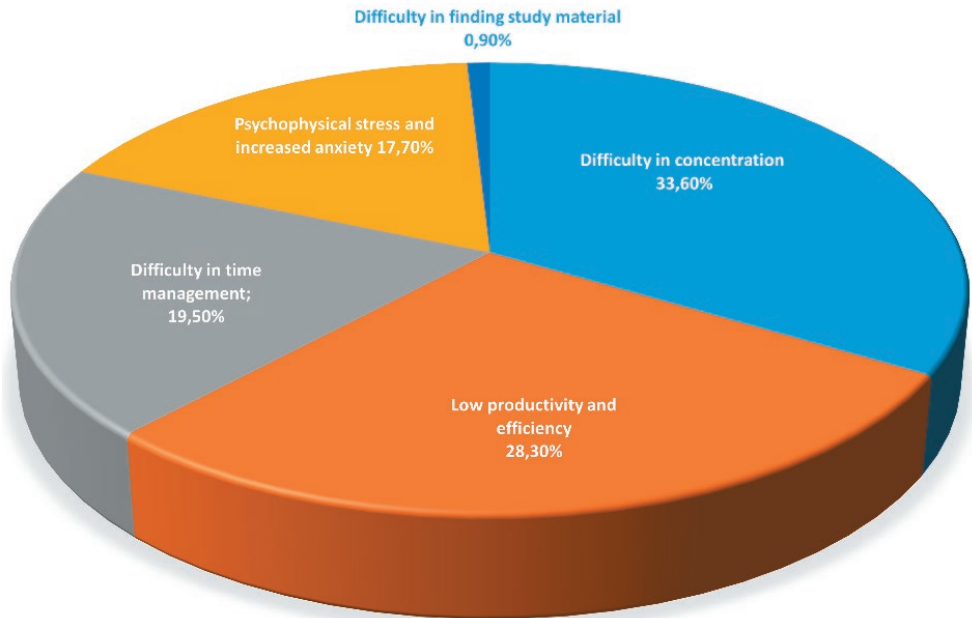


Figure 6. Students' mood during Covid-19 pandemic.

Table 4. Statistical analysis of SAS marks obtained in the WS (HCA1) and SS (HCA1).

| | | Exam session | |
|---|-------------------|----------------------|----------------------|
| | | WS: HCA1 1 | SS: HCA1 2 |
| SAS number | | 104 | 103 |
| Marks/grades (min. pass=18/30; max 31/30) | Mean | 26,98 ($\pm 2,41$) | 27,84 ($\pm 2,20$) |
| | 95% CI mean | 26,51 to 27,45 | 27,41 to 28,27 |
| | Median | 27 | 28 |
| | Lowest to highest | 19/30-31/30 | 19/30-31/30 |

WS: Winter session anatomy 1 marks, SS: summer session anatomy 2 marks.

Paired t-test WS vs SS: $P=0,0014$ (95%CI of the difference 0,4677 to 1,8818).

Correlation coefficient r between WS and SS, $r=0.80$ ($P<0,0001$; 95%CI of r 0,72 to 0,86).

course and underwent face-to-face *HCA1* examination obtained a mark mean value of $26,98\pm 2,41$ (Tab 4).

SAS who attended online the *HCA2* course and underwent online *HCA2* examination, a mark means value of $27,84\pm 2,20$, which is a statistically significant higher value ($P=0,0014$). Median grades values (27 for *HCA 1* examination, 28 for *HCA 2* examination) were also considered and their correlation coefficient r was calculated. Its high value ($r=0.8039$) resulted statistically significant ($P\leq 0,0001$).

4. Discussion

In the context of the COVID-19 pandemic and the related changes necessary in the maintaining active the medical education field, some articles argued on the “forced disruption” of anatomy education (Pather et al., 2020); some pointed on the strengths (development of new online resources, upskilling in new technologies and resources) and opportunities (academic collaboration, working remotely, incorporation of blended learning in future curriculum development) as well as on the weaknesses (time constraints, lack of practical sessions and cadaveric exposure, issues with assessment) and threats (reduced student engagement, diminished teacher/student relationship) of the adaptations to anatomical education (Longhurst et al., 2020); some pointed specifically on the problem of the no access to cadavers (Iwanaga et al., 2020; Singal et al., 2020); other articles underlined the need for technologies enabling communication such as video conferencing technology, collaborative tools, social media and networking platforms (Byrnes et al., 2021; Moszkowicz et al., 2020); other underlined the challenge related to teaching human anatomy to students with intellectual disabilities (Pacheco et al., 2020). On the other hand, in all the articles the undisputed usefulness of these online learning methodologies is also underlined, together with Evans et al. (2020), in medical education innovation (Byrnes et al., 2021; Iwanaga et al., 2021; Longhurst et al., 2020; Moszkowicz et al., 2020; Pacheco et al., 2020; Pather et al., 2020; Singal et al., 2020). These new learning resources will be very useful in the future post COVID-19 period when there is a return to a primarily face-to-face learning. Such integrated approach will allow personalization of

learning, its increasing flexibility, supporting the learning experience of students, *“developing a learning environment that caters for students with a different pace of learning and those that require multiple learning channels, as well as facilitating opportunities for deeper learning”* (Ozer et al., 2017; Guy et al., 2018; Evans et al., 2020). COVID-19 pandemic related learning organization at Sapienza University of Rome, contains the basic elements described in the literature (Familiari et al., 2013; Relucenti et al., 2019; Byrnes et al., 2020; Brassat et al., 2020; Hennessy et al., 2020; Iwanaga et al., 2020; Moszkowicz et al., 2020), as well as the use of virtual reality in anatomy (Birbara et al., 2020). Few studies, in addition, analyzed so far, the students' perspectives in this pandemic context, regarding current anatomy education (Franchi, 2020; Srinivasan, 2020). Franchi (2020) is a medical student and in its article describes how the lack of practical teaching with cadavers, through dissection, can adversely impact training and lead to losses for students; this author further outlined that the learning environment was less than ideal, not allowing the development of personal and professional competencies. On the contrary, Srinivasan (2020) reported that students were satisfied with the understanding and learning of anatomy using zoom video conferencing platform (zoom Video Communications, inc., San Jose, CA). In this study, two statements were proposed to the students attending an anatomical course using zoom video conferencing platform. The first question was about the students' satisfaction with the understanding and learning of anatomy using zoom. At the response rate of 88.88% of students (n. 16), about 87.5% of students (n.14) of Singapore University were satisfied.

At the second question, concerning one way in which zoom might be enhanced further to maximize learning in anatomy, several students reflected on the need for more interaction in the e-tutorial by zoom platform using Poll Everywhere; some students also proposed the use of regular individual quizzes or mini quizzes (not counted to overall grade) to assess their own progress in learning anatomy, or the addition of transcripts to slides for further explanations.

To compare the results of the study with those present in the literature, two peculiar features of the present course must be considered: a) the number of students attending, higher than the class analyzed in the study in Srinivastan (2020); b) the current reality of the use of dissection of corpses in Italy. In our country is currently available for study and teaching a small number of corpses and the use of dissection is accompanied by the use of prosection. Dissection courses are offered mainly as an activity of the student's choice, in the form of monographic courses. These courses are attended by a limited number of students (also enrolled in the years following the first two, those in which anatomy is studied), who are often involved in the preparation of prosections, used by students of the first and second year of the course (Macchi et al., 2003; 2007; 2014). The analysis of the results of our survey shows that both modes of attendance (face-to-face and online) are considered valid by students although with different motivations. In the face-to-face lessons the immediacy of the interaction with the teacher is appreciated, especially to deepen the clinical and surgical aspects of anatomy (e.g. discussing clinical cases with the teacher) and the possibility to ask questions that are immediately answered. In the online lessons, the possibility of organizing the study time independently according to one's own rhythm and needs is greatly appreciated. Finally, a significant percentage of students find it advantageous not to waste time moving around, listening to the lessons several

times, claiming to be more attentive and concentrated during the online lessons, compared to face-to-face lessons.

If in the first case, therefore, the possibility of direct interaction with the teacher is appreciated, in the second case the possibility of a more finely integrated study is appreciated, in which the frequency of lessons, the consultation of books and the use of digital teaching material are used together according to individual times and needs. This preference of the students could be an indication to be followed after the end of the pandemic emergency period, maintaining the accessibility of online teaching materials for deferred use, so as to allow learning according to everyone's personal rhythms and times. The characteristic feature of the lessons in presence, which during the online lessons has been missed the most, is the direct and immediate interaction with the teacher and with the classmates. An effort needs to be made to create and develop meaningful social interactions also in the online mode. In summary, SAS students have not shown any preferences for one of the two teaching modes. Face-to-face and online lessons are simply each one having different advantages, which can be suited to the needs of the individual student. The practical lessons carried out online have been greatly appreciated, in fact, the normal activities in presence have been effectively replaced by the activities carried out by the students using the digital anatomical table.

The analysis of the results regarding the state of mind and emotions of the students showed that the psychophysical stress suffered during the lockdown period has affected the study causing difficulties in concentration, time management, and reducing productivity. However, there was no significant conditioning in student performance. In fact, feelings of concern and anxiety, while present, have been harnessed and channeled into a hardworking attitude of commitment and work. Maintaining both a virtual attendance to the classroom and a focus on the study, from this point of view, has helped to maintain a proactive attitude, of those who have an influence on the events that affect them, having a balancing effect compared to an anxious attitude of withdrawal, more aimed at grasping the risks of a pandemic.

The analysis of the marks obtained by students in the anatomy examination shows that the marks of the examinations taken at the end of the distance learning course had a higher average value (statistically significant) and with an excellent correlation factor, compared to the marks obtained with examination in presence at the end of the course in presence.

These positive results show that in the lockdown period of the second semester, SAS have however had good learning opportunities, through the didactics delivered in online mode. It is possible that students who normally would not have attended face-to-face classes have benefited from a better access to educational activities and materials. In the analysis of the results should obviously also be considered factors independent of the didactic actions implemented by the degree courses. The inability to go out and devote time to social activities has increased the time dedicated to the study, this may have affected the best preparation and therefore hesitate in a better grade on the examination. However, the amount of time has not always been qualitatively good, in fact the students stated in the survey that they suffered from psychophysical stress that, in some cases, would have created difficulties in the concentration necessary for the study.

You may wonder if the higher grades in the summer session are due to a more permissive behavior of teachers in the conduct of the examinations at a distance

than those taken in attendance. This is a possibility, however it should be noticed that the teachers who delivered the course and carry out the examinations in the second semester were the same who delivered the course and carried out the examinations in attendance in the first semester, so they probably rely on the same method of judgment. All our data analyses suggest that face-to-face classes and online classes, rather than being interchangeable modes, should be considered as modes with different characteristics that offer different educational benefits. It is possible that these benefits may have a different relevance for individual students, depending on their specific needs and individual preferences. This suggests the opportunity to propose customizable courses, centered on the student's needs. Due to the pandemic continuation, Italian universities, according to ministerial directives, are adopting from September 21 the dual mode of teaching (blended mode). In our Sapienza University we are delivering in person the anatomy course scheduled for the first semester. Students access both in person, compatibly with the necessary safety measures, and remotely with online live lessons, except for activities with mandatory in-person attendance, such as small groups laboratories. Students have access to pre-recorded lectures and off-line educational material. Students who cannot attend in person – including international and off-campus students – can attend remotely. University facilities supply the largest number of physical classrooms at their disposal with multimedia equipment; access to classrooms is scheduled to guarantee all students, regardless of the year of enrolment, the possibility to attend in person as much as possible, with particular attention to first-year students. The program calendar is optimized so that students can have continuous and non-split periods of presence in the classroom. At the same time, it is also limited the movement of students to distant classrooms/locations; to access the classroom students are asked to register through a reservation system set up for this purpose (Sapienza Prodigit software). This blended modality is meant to provide the best integration between activities that can be carried out both at a distance and in presence (classroom activities), safeguarding the practical activities that are carried out in small groups within the laboratories. Activities are carried out in compliance with the conditions of social distancing and sanitization, imposed by the COVID-19 pandemic. Further studies might explore the students' perceptions of this educational modality.

5. Conclusions

Once the COVID pandemic has been brought under control, it will be necessary to continue to rethink medical teaching, by implementing different teaching techniques complementary to conventional face-to-face education. Our data, referring to the Italian context, document that distance learning mode in the teaching of Human Anatomy has been perceived by most students as useful and positive. Although within the limits of an exploratory study, we have highlighted how distance learning can be an effective support for anatomy teaching by facilitating a different learning modality, in which the lessons are more integrated with the study moments, respecting the times and the individual needs of the students.

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