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Perceptions of Italian medical students on human dissection and modern technology in anatomy learning

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Abstract. Since 2021, the Azienda Ospedaliero-Universitaria of Sassari, Italy, has been authorized to preserve and utilize post-mortem tissues and bodies for research, study, and training. Before this date, no body dissection was performed. Medical students who wanted the opportunity were given the chance to go abroad for dissection courses. The primary purpose of the present study was to assess retrospectively, and using a questionnaire, the attitudes of medical students at the University of Sassari who had travelled to the University of Bordeaux to undertake anatomical body examinations. Students were invited to complete a survey, a 14-item questionnaire was developed. Over 85% of the students were very satisfied with the dissection course, the majority of medical students find the experience of dissection to be a unique and exciting opportunity, despite it being stressful and negative for some. Despite the wide range of electronic learning resources available today, unexpectedly with respect to our original hypothesis, the majority of our students have indicated that traditional dissection methods cannot be replaced by modern tools.

Keywords: medical students, perceptions, human dissection, anatomy learning.

INTRODUCTION

Human body dissection has been the main pedagogic approach for the teaching and learning of anatomy for more than 400 years (Persaud, 1984, 1997; Azer and Eizenberg, 2007; Moxham and Plaisant, 2014; Tubbs et al., 2019) and it is still often perceived by anatomists, medical students and the lay public as being essential for acquiring anatomical knowledge (Elizondo-Omaña et al., 2005; Patel and Moxham, 2006; Moxham and Moxham, 2007; Korf et al., 2008; Moxham et al., 2016). In Italy, however, there were no spe-

cific regulations for the donation of human bodies for anatomical examination (De Caro et al., 2009) until a legal decree was recently approved (Law-Decree n°10/20 dated February 10th, 2020, <http://www.senato.it/leg/18/BGT/Schede/Ddliter/50386.htm>). This law governs the criteria for body donation, including the requirement for informed consent from living donors, proper management of donors' bodies, and the identification of national reference centers (Maghin et al., 2020; De Caro et al., 2021; Orsini et al., 2021; Boscolo-Berto et al., 2023).

Since 2021, the Azienda Ospedaliero-Universitaria of Sassari, Italy, has been authorized to preserve and utilize post-mortem tissues and bodies for research, study, and training. Before this date, no body dissection was performed. Medical students who wanted the opportunity were given the chance to go abroad for dissection courses.

The primary purpose of the present study was to assess retrospectively, and using a questionnaire, the attitudes of medical students at the University of Sassari who had travelled to the University of Bordeaux to undertake anatomical body examinations. Our initial hypothesis was that the students were equally divided into those who see the educational and professional benefits of undertaking dissection and those who do not. Furthermore, given rapid technological developments resulting in the availability of an extensive range of electronic resources for anatomical education (Shaffer, 2004; McMenemy et al., 2014; Losco et al., 2017; Trelease, 2016), we evaluated the opinions of the students as to whether human dissection could, or should, be replaced by new technological 'tools. In this regard, since the students surveyed are often categorised as belonging to the Millennial generation (Benninger et al., 2014), our initial hypothesis was that the students believed that new technologies were preferable to human dissection. Understanding students' attitudes is important for fulfilling the major task of easing students' efforts and increasing students' engagement (McMenemy et al., 2018), for it is essential to understand what engages the new generation of learners before selecting a pedagogic approach. Students' preferences represent a useful tool when designing a course by helping educators identify effective teaching methods that are best suited to their students' learning styles (Davis et al., 2014).

2. MATERIALS AND METHODS

2.1. Educational context

Anatomy education at the Medical School of the University of Sassari, Italy, is organized into two annual

courses taught in the first and second years of a six-year medical curriculum.

In the first course (Anatomy I), students gain knowledge of general anatomical terms and locomotor systems. In the second course (Anatomy II) the curriculum consists of cardiovascular, respiratory, digestive, genitourinary and nervous systems as well as the lymphoid, endocrine and sense organs.

These courses are structured with traditional lectures and practical sessions. During the practical sessions, students have the opportunity to examine plastic models and view microscope glass slides to learn histology. All these activities are carried out with the support of teachers and near-peer tutors.

Dissections are only performed occasionally because the centre is new and most donors are still alive. We use only fresh materials, as we currently do not have any frozen bodies available.

2.2. Participants

Since 2013, medical students have been invited to participate in an extracurricular dissection course at the Anatomical Laboratory of Surgery School at the University of Bordeaux.

Usually, the course is scheduled at the end of the second year and lasts one week.

A maximum of fifteen students are admitted annually.

Students are chosen based on the highest score (28-30) achieved in the final examination of the anatomy course and on the general education curriculum. Students' involvement is voluntary.

After enrolling, students attend three meetings where a professional staff consisting of two anatomists and two plastic surgeons provide instructions on practical aspects such as the use of scalpels, forceps, and suture threads. They also explain dissection procedures and review the most important anatomical regions. The discussion also focused on the ethical behaviour to have in the dissecting room.

2.3. Dissection course

Throughout the dissection course, students were divided into two groups, and one body was assigned to each group of seven or eight students. The same body was used throughout the course.

Within each group, students dissected the body in a rotatory manner under the supervision of the tutors. A sequence of regions to dissect was established before

starting and a checklist with the most important anatomical structures was projected on a screen during dissection. Tutors asked students to identify anatomical structures.

All students performed skin incisions and dissections based on anatomical planes.

The anatomical regions dissected were the neck, superior and inferior limbs (with a specific focus on some clinically relevant areas, i.e., cubital fossa, inguinal ligament, popliteal fossa, and femoral triangle), thorax (ventral and dorsal walls, organs of the thoracic cavity), and abdomen (ventral and dorsal walls, organs of the abdominal cavity). Each organ was further sectioned to view and appreciate its internal structure.

Participants were engaged for eight hours in day.

2.4. Data collection

A few months after the end of the dissection experience, students were invited to complete a survey. Invitations were sent by email to all participants. The email included a detailed description of the study along with a link to the questionnaire. All students were adequately informed about the study's purpose. To better guarantee anonymity and confidentiality regarding their data, we decided to not include the question about gender.

A 14-item questionnaire was developed by teaching staff: it comprised 1 item (Q1) to characterize the academic features of students, 12 items (Q2-Q13) to evaluate students' attitudes towards several aspects of the course (general organization, teaching modalities, teacher/student interaction, course's usefulness in improving anatomical knowledge, importance of dissection in clinical practice, possibility to replace dissection with modern technological tools) using a five-point Likert scale (1 poor, 5 excellent) and 1 item (Q14) to ask students in an open question format comments, criticisms, or suggestions regarding the dissection course.

The data were recorded in a database for statistical processing. Ethical approval was not required, as this was part of routine course evaluation.

2.5. Statistical analysis

An *ad hoc* electronic form was used to collect all study variables. Variables were described with absolute and relative (percentage) frequencies. In-between group comparisons of questionnaire items were performed with Chi-squared or Fisher exact tests when appropriate. A two-tailed *p*-value less than 0.05 was considered statistically significant. STATA version 16 (StataCorp, TX)

was the statistical package used to perform all statistical computations.

3. RESULTS

70 out of 95 students (73.6%) agreed to participate in this study.

The majority of students were in the second and third years of the medical curriculum (23, 32.9% and 24, 34.3%, respectively). The remaining were in the fourth (14, 20%), fifth (7, 10%), and sixth (2, 2.9%) years.

The majority of the students (87.1%, 61 out of 70) expressed high satisfaction with the course.

The participants' satisfaction was evaluated based on several factors: their overall satisfaction with the course (5 and 4 on the Likert scale: 46, 65.7% and 24, 34.3% respectively), the support provided by tutors (5 and 4 on the Likert scale: 63, 90.0% and 7, 10.0% respectively), and their level of engagement in the dissection activity (5 and 4 on the Likert scale: 60, 85.7% and 9, 12.9% respectively).

The majority of students reported an improvement in their anatomical knowledge after the dissection course, with 39 students (55.7%) rating it as a 5 on the Likert scale and 25 students (37.7%) rating it as a 4. Additionally, 77.1% of students found the course to be "very useful" (31 students, 44.3%) and "useful" (23 students, 32.9%) for developing their clinical skills.

70% of students considered dissection essential for medical training.

The majority of students (61.4%) believe that dissection cannot be replaced by digital learning tools, with 27.1% strongly agreeing and 34.3% somewhat agreeing. 21.4% of students are neutral on the issue, while 17.1% believe that dissection can be replaced, with 11.4% somewhat disagreeing and 5.7% strongly disagreeing.

All these results are shown in Table 1.

As illustrated in Table 2, there were no statistically significant differences between students of the second and third years.

Some students did not respond to the open-ended question. However, 50% of the participants shared their personal views on the dissection course. They appreciated the educational, emotional, and cultural value of this experience. The students highlighted the educational value, as they observed that they had solidified their anatomical knowledge through dissection. Additionally, they gained a better understanding of how structures are interrelated.

They encountered a cadaver for the first time, which is an important rite of passage for any future physician.

Table 1. Descriptive analysis.

Questionnaire	n (%)		Questionnaire	n (%)	
Which year of course are you enrolled in?	2	23 (32.9)	Is your anatomical knowledge improved after the stage? (Likert scale)	1	-
	3	24 (34.3)		2	-
	4	14 (20.0)		3	6 (8.6)
	5	7 (10.0)		4	25 (35.7)
	6	2 (2.9)		5	39 (55.7)
What is the level of your satisfaction for this stage? (Likert scale)	1	-	How much the stage's activities may have contributed to improve your clinical skills? (Likert scale)	1	-
	2	-		2	1 (1.4)
	3	-		3	15 (21.4)
	4	9 (12.9)		4	23 (32.9)
	5	61 (87.1)		5	31 (44.3)
What is the level of your satisfaction for the organizational aspects of the stage? (Likert scale)	1	-	How do you evaluate tutors' support during the stage? (Likert scale)	1	-
	2	-		2	-
	3	-		3	-
	4	24 (34.3)		4	7 (10.0)
	5	46 (65.7)		5	63 (90.0)
What is your assessment of the preparatory meetings for the stage? (Likert scale)	1	-	Do you think that dissection is essential in the training of future physician? (Likert scale)	1	-
	2	-		2	-
	3	6 (8.6)		3	5 (7.1)
	4	33 (47.1)		4	16 (22.9)
	5	31 (44.3)		5	49 (70.0)
Did you feel engaged in the stage's activities? (Likert scale)	1	-	Can be dissection replaced with digital tools? (Likert scale)	1	19 (27.1)
	2	-		2	24 (34.3)
	3	1 (1.4)		3	15 (21.4)
	4	9 (12.9)		4	8 (11.4)
	5	60 (85.7)		5	4 (5.7)
How do you evaluate your anatomical knowledge before the stage? (Likert scale)	1	-			
	2	2 (2.9)			
	3	24 (34.3)			
	4	29 (41.4)			
	5	15 (21.4)			

They described experiencing an unusual sensation and, based on this feeling, they dissected the human body with respect and an awareness of death. Lastly, the cultural value was related to the opportunity to get to know a university organized differently from the University of Sassari.

4. DISCUSSION

The field of anatomical sciences has experienced numerous changes over time. Despite these changes, dissection continues to be used as a teaching tool in many medical curricula. However, in some medical schools around the world, this practice has been reduced or replaced by other learning methods (Elizondo et al.,

2005; Flack and Nicholson, 2018). The primary aim of this study was to examine students' perceptions of a brief anatomy dissection experience.

In this study, over 85% of the students were very satisfied with the dissection course. One aspect they particularly appreciated was the high level of engagement during the course. The variables of engagement and motivation are of great importance with regard to the learning process. Active dissection engages all three domains of learning (cognitive, psychomotor, and affective) (Granger, 2004). Student engagement has been defined as students' involvement in activities that are likely to generate high-quality learning (Brown et al., 2018). Furthermore, student engagement is closely linked to motivation. Students with high motivation tend to be more engaged. The significance of motivation in learn-

Table 2. Descriptive analysis per year of study.

Questionnaire		Year of study					p-value
		2	3	4	5	6	
What is the level of your satisfaction for this stage? (Likert scale)	1	-	-	-	-	-	0.25
	2	-	-	-	-	-	
	3	-	-	-	-	-	
	4	1 (4.4)	5 (20.8)	1 (7.1)	2 (28.6)	0 (0.0)	
	5	22 (95.7)	19 (79.2)	13 (92.9)	5 (71.4)	2 (100)	
What is the level of your satisfaction for the organizational aspects of the stage? (Likert scale)	1	-	-	-	-	-	0.35
	2	-	-	-	-	-	
	3	-	-	-	-	-	
	4	10 (43.5)	9 (37.5)	2 (14.3)	3 (42.9)	0 (0.0)	
	5	13 (56.5)	15 (62.5)	12 (85.7)	4 (57.1)	2 (100)	
What is your assessment of the preparatory meetings for the stage? (Likert scale)	1	-	-	-	-	-	0.45
	2	-	-	-	-	-	
	3	2 (8.7)	1 (4.2)	2 (14.3)	1 (14.3)	0 (0.0)	
	4	11 (47.8)	10 (41.7)	9 (64.3)	3 (42.9)	0 (0.0)	
	5	10 (43.5)	13 (54.2)	3 (21.4)	3 (42.9)	2 (100)	
Did you feel engaged in the stage's activities? (Likert scale)	1	-	-	-	-	-	0.32
	2	-	-	-	-	-	
	3	0 (0.0)	1 (4.2)	0 (0.0)	0 (0.0)	0 (0.0)	
	4	1 (4.4)	5 (20.8)	1 (7.1)	2 (28.6)	0 (0.0)	
	5	22 (95.7)	18 (75.0)	13 (92.9)	5 (71.4)	2 (100)	
How do you evaluate your anatomical knowledge before the stage? (Likert scale)	1	-	-	-	-	-	0.27
	2	0 (0.0)	1 (4.2)	0 (0.0)	1 (14.3)	0 (0.0)	
	3	5 (21.7)	8 (33.3)	7 (50.0)	4 (57.1)	0 (0.0)	
	4	11 (47.8)	9 (37.5)	6 (42.9)	2 (28.6)	1 (50.0)	
	5	7 (30.4)	6 (25.0)	1 (7.1)	0 (0.0)	1 (50.0)	
Is your anatomical knowledge improved after the stage? (Likert scale)	1	-	-	-	-	-	0.37
	2	-	-	-	-	-	
	3	3 (13.0)	2 (8.3)	1 (7.1)	0 (0.0)	0 (0.0)	
	4	5 (21.7)	8 (33.3)	7 (50.0)	5 (71.4)	0 (0.0)	
	5	15 (65.2)	14 (58.3)	6 (42.9)	2 (28.6)	2 (100.0)	
How much the stage's activities may have contributed to improve your clinical skills? (Likert scale)	1	-	-	-	-	-	0.72
	2	0 (0.0)	1 (4.2)	0 (0.0)	0 (0.0)	0 (0.0)	
	3	5 (21.7)	4 (16.7)	3 (21.4)	3 (42.9)	0 (0.0)	
	4	8 (34.8)	6 (25.0)	7 (50.0)	1 (14.3)	1 (50.0)	
	5	10 (43.5)	13 (54.2)	4 (28.6)	3 (42.9)	1 (50.0)	
How do you evaluate tutors' support during the stage? (Likert scale)	1	-	-	-	-	-	0.40
	2	-	-	-	-	-	
	3	-	-	-	-	-	
	4	1 (4.4)	3 (12.5)	1 (7.1)	2 (28.6)	0 (0.0)	
	5	22 (95.7)	21 (87.5)	13 (92.9)	5 (71.4)	2 (100)	
Do you think that dissection is essential in the training of future physician? (Likert scale)	1	-	-	-	-	-	0.44
	2	-	-	-	-	-	
	3	1 (4.4)	1 (4.2)	3 (21.4)	0 (0.0)	0 (0.0)	
	4	4 (17.4)	5 (20.8)	4 (28.6)	3 (42.9)	0 (0.0)	
	5	18 (78.3)	18 (75.0)	7 (50.0)	4 (57.1)	2 (100)	

(Continued)

Table 2. (Continued).

Questionnaire	Year of study						p-value
	2	3	4	5	6		
Can be dissection replaced with digital tools? (Likert scale)	1	8 (34.8)	4 (16.7)	3 (21.4)	3 (42.9)	1 (50.0)	0.82
	2	8 (34.8)	9 (37.5)	4 (28.6)	3 (42.9)	0 (0.0)	
	3	3 (13.0)	6 (25.0)	4 (28.6)	1 (14.3)	1 (50.0)	
	4	3 (13.0)	2 (8.3)	3 (21.4)	0 (0.0)	0 (0.0)	
	5	1 (4.4)	3 (12.5)	0 (0.0)	0 (0.0)	0 (0.0)	

ing has been well established (Biggs, 1991), and research has shown that cadaveric dissection significantly impacts students' motivation (0; Shell et al., 2020). Although motivation was not quantified in this study, it is reasonable to assume that the dissection activity increased the motivation of our students.

They expressed how this experience made them more enthusiastic, not only because of what they saw (e.g., a three-dimensional view of the human body), but also because it was their first close encounter with death. Learning about human cadavers has aspects that are not easy to objectively evaluate, especially in relation to the approach to death (Winkelmann, 2007).

However, evidence suggests that dissection contributes to the development of humanistic and social qualities (Pizzimenti et al., 2016) and should be seen as a valuable opportunity that every future physician should experience (Pawlina et al., 2004).

The majority of medical students find the experience of dissection to be a unique and exciting opportunity, despite it being stressful and negative for some (Dinsmore et al., 2001). Our students also perceived the relevance of dissection, with most of them rating it as essential for their medical training. They agreed that dissection improved their anatomical knowledge and clinical skills.

The results are consistent with previous studies (Patel and Moxham, 2008; Kerby et al., 2011; Jayakumar et al., 2019; Gosh et al., 2017), which have shown that hands-on dissection is beneficial for students to enhance and solidify their knowledge gained from other teaching methods.

Despite the wide range of electronic learning resources available today, such as online websites and mobile apps, unexpectedly with respect to our original hypothesis, the majority of our students have indicated that traditional dissection methods cannot be replaced by modern tools. This finding is supported by other studies that reveal students' preferences for traditional methods over new ones (Biasutto, 2006; Ramsey-Stewart, 2010; Moxham and Moxham, 2007; Davis et al., 2014). However, even if the minority comprises 17.4%, we have to take into account the attitudes of some stu-

dents surveyed who were in favour of replacing dissection with other modern methods.

Similarly, other students or Authors have previously expressed their favour towards other tools, in particular prosection (McLaclan et al., 2004).

This finding shows that students have different learning styles, emphasizing the need to gather students' preferences to determine the best teaching approach for anatomy curriculum.

Some limitations of this study need to be addressed. Firstly, the number of participants was low and not every year of attendance was represented homogeneously; therefore, a larger sample size would enhance the power of this study. Additionally, this study was based on students' perceptions rather than outcomes; a future investigation based on students' performance will be conducted. Furthermore, this study evaluated students' perspectives on their dissection experience without comparing it to other teaching methods.

CONCLUSION

Student perceptions indicate a preference for body dissection in learning anatomy. Although digital tools facilitate students' approach to anatomical structures, the opportunity for direct contact with anatomical elements cannot be replaced.

Therefore, even though some medical schools have reduced or omitted dissection, an integrated approach that combines traditional and modern tools should be considered the best solution. Because no single tool fulfils curricular and individual requirements, educators should offer students the option of participating in dissections or learning through other methods.

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