

Students' and Practitioners' Perceptions and Attitudes Related to Anatomy Education in a Low-Income Country, Experience from Mali

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Abstract

Background: Human gross anatomy has played a significant role in the advancement of scientific observation throughout the centuries. Many argue that it has survived the most demanding pedagogic test-time. However, human anatomy has recently been gradually squeezed from the medical curriculum. Studies have reported decreases in allocated time, teaching staff, and dissection in many anatomical education schools. Despite data provided from the literature, the assessment of anatomical education is lacking in low- and lower-middle-income countries (LLMICs). Our study aimed to assess early students' perceptions and attitudes toward anatomy education in low- and lower-income countries (LLICs). **Methods:** Likert-scale questions were used to assess the opinions of 108 students, graduates, and post-graduates toward anatomical education. The questionnaires were given to the respondents with respect to their consent and confidentiality. **Results:** The age group from 20 to 25 was the most predominant (n = 91, 85%), followed by practitioners from 26 to 30 (n = 15, 14%). The male gender predominated (n = 67,



62%) with a 1.63 sex ratio. According to students' satisfaction with the anatomical curricula taught, 51.4% (n = 55) agreed, and 34.6% (n = 37) strongly agreed that the anatomy training was invaluable. Therefore, dissection-based learning was the most suggested way for a deep understanding of anatomical knowledge (n = 73; 68.8%). **Conclusion:** Our study reported that the majority of participants agreed that anatomy education was invaluable in their curricula and expected to deepen their anatomical knowledge in the future.

Keywords

Anatomy, Education, Students, Perception, Attitude, Questionnaires, Low-Income Country

1. Introduction

Anatomy has been a cornerstone of medical education for hundreds of years. It has played a large part in the progress of scientific observation throughout the centuries and was pivotal in elevating anatomy from the magical thinking of the Hippocrates era and freeing it from subservience to medicine, which was all-powerful in the past [1] [2]. Many argue that it has survived the most demanding pedagogic test-time. However, in recent years, human anatomy has been slowly squeezed from the medical curriculum [3]. Anatomy has a long and checkered past as a scientific discipline. In ancient Egypt, dissection was a religious ritual. Its heyday came in the 19th century, with the development of quick, effective surgical techniques on the battlefield and, later, the introduction of anaesthesia, when knowledge of the structural intricacies of the body began to have practical significance for doctors [4]. A deep understanding of anatomy is fundamental for safe clinical practice, particularly in the discipline of surgery [5]. The teaching of human anatomy, like any course, requires constant revision and analysis to determine the teaching tools and approaches that best suit the learning process [6]. For nearly 30 years, there has been discussion of the decline in undergraduate knowledge of anatomy among the surgical community [7]. Studies have reported a decrease in allocated time, teaching staff, and dissection in many anatomy education schools. It is very difficult to assess objectively whether this decrease in anatomy teaching has been excessive. However, the few studies that have been conducted suggest that the knowledge of qualifying doctors is now below an acceptable level, particularly in LLICs [8]. Therefore, anatomy has an established value in medical education and is supported by students, clinicians, anatomists, and the general public. Is the decline of anatomy a result of a decrease in time and resources allocated to anatomy teaching, or is it a result of the changes in teaching methodology? Our study aimed to assess early students' perceptions and attitudes in anatomy education in the preclinical and clinical settings in a low-income country.

2. Material and Methods

A transversal descriptive study was carried out from September 2025 to February 2026 in a single low-income country Medical School. The study included 3 groups of 108 participants. The first group consisted of medical undergraduate students ($n = 93$). Among those students, 53 (54.6%) were in a 1 to 3-year curriculum (license), and 40 (41.2%) were in a 4 to 6-year curriculum (Master). The second group consisted of internship students who had not yet graduated ($n = 4$, 4.1%), and the last and third group was graduates and postgraduates (practitioners) ($n = 11$, 10.2%) who had obtained their diplomas. Graduates and postgraduates consisted of 10 physicians and 1 resident in the surgical specialty. Undergraduate students were given their questionnaires in a medical school setting, while the internship students and practitioners had their questionnaires in a healthcare system setting. The assessment included multiple-choice confidential self-administered questionnaires based on students' perceptions, from strongly disagree to strongly agree, passing through intermediate answers such as no agreement, neutral, agree, and no response. Different questions referred to students' perceptions and attitudes related to anatomical curricula, anatomical learning, anatomical lecture courses, anatomical teaching procedures, and didactic materials. The questionnaire, including 32 questions, was obtained from our literature review through Smith and Mathias's questionnaire design. The questions were translated from English into French and submitted to participants. Only the questions requiring commentary have been revised and adapted to our setting. Those questions assessed participants' feedback and expectations towards anatomy education in our low-income country setting. Questionnaires were distributed, completed, and collected at the end of the time frame. Our study aimed to highlight early students' and practitioners' perceptions and attitudes related to anatomical education in a low-income country.

2.1. Ethical Approval

This project was submitted to the ethical committee of the Medical Faculty Sciences from Bamako (Mali), which provided approval for the project to be completed without the need for subsequent review or submission to another ethical committee for our questionnaire's assessment. The study adheres to the principles outlined in the Declaration of Helsinki, with all participants given a participant information sheet and signing a consent form before commencing the study.

2.2. Data Analysis

Data were compiled in EPI Info Version 3.4.5 and analysed using Microsoft Excel 2010. EPI Info allowed us to yield frequencies of variables and to obtain data tables.

3. Local Anatomy Curriculum

In our medical school setting, anatomy curricula are taught in the first 2 years. Our anatomy education system is then horizontally based. According to the time

allocated to anatomy education, the first year accounts for 60 hours of lecture-based teaching, whereas the second year consists of 45 hours. In the first year, anatomy is taught both by anatomist teachers and non-anatomist teachers who are surgeons. Therefore, only 12 hours are given to non-anatomist teachers, while the remainder of the curriculum is taught by anatomist teachers. Second-year curricula are taught entirely by anatomy teachers. The curricula taught in the first year consist of bone anatomy, muscle anatomy, bone joint anatomy (lower limbs and upper limbs), and abdomen anatomy. The second-year curriculum consists of head anatomy, neck anatomy, and, lastly, chest anatomy. There are 60 hours of dissection time allocated to both first- and second-year students. Overall, the number of students is estimated to be 450 for the first and second year curricula. Students are divided into 30 teams for dissection courses. Each team engages in prosection- and dissection-based learning for 15 to 20 minutes. The assessment method is based on the modular system. Students are given an examination at the end of each anatomy course module.

Our laboratory includes 3 desk rooms. The first 2 are for the laboratory headmaster and his assistant, while the last one is the trainees' room. There is a wide hall that serves both as a teaching space and for dissection. There are 4 tables for dissection and 6 mortuary cells for corpse conservation at 4° Celsius temperature.

4. Background

4.1. Anatomical Knowledge

Much debate has arisen about how to teach anatomy. This polarises into those who favour dissection of human cadavers and those who support newer teaching modalities (e.g., self-directed learning, problem-based learning (PBL), and computer-assisted learning (CAL)) [5]. Dissection has been the primary method for teaching anatomy for more than 400 years. Learning through dissection of human cadavers has advantages that are not easy to quantify, such as enhancing active and deep learning, preparing students for clinical practice, preparing students for encounters with death, the practice of manual skills, and understanding the relationship between patients' symptoms and pathology [1]. However, it suffered from myths, superstitions, and popular and religious beliefs that for millennia forbade dissection: "the human body is untouchable and sacred if the man at his death wants to resurrect or win the world that is promised him, he must keep an intact earned envelope" [9]. Anatomy as a subject has suffered as a result of its failure to evolve and adapt quickly enough. Under old-style medical training, students were expected to learn details with little understanding of relevance. Learning anatomy became a rite of passage rather than an educationally valid process and clearly required reform. Anatomy as a subject has suffered because it is regarded as banal, archaic, didactic, traditional, overly factual, and unable to adapt to modern educational methods – an obvious choice for those looking to reduce curriculum content and modernize the learning experience [5]. Teaching anatomy has been fundamental to the training of surgeons, both from the tech-

nical viewpoint, guiding the surgical gesture, and from the intellectual viewpoint, leading them to familiarize themselves with scientific observation [2]. Anatomy is also subject to many extrinsic pressures. Maintaining a dissecting room in accordance with national and international laws is very costly, and changes in the anatomy department and surgical training have reduced the numbers of medically qualified anatomy teachers [3]. This is within the context of an increase in the numbers of medical students, which puts more pressure on an overstretched system. The combined problems of a banal image and an unsupportive academic infrastructure may explain the decline of anatomy as a subject more than the teaching methodology changes in the last 15 - 20 years. It is therefore worrying that publications in diverse journals have highlighted the problem of decreased anatomical knowledge of today's medical students, which, in the worst-case scenario, might lead to medical errors [10]. In an analysis of teaching and learning, it is necessary to examine the curriculum, the mode of teaching, the quality of how this is delivered, and the infrastructure within which it is delivered (5).

Traditionalists sustained a decline in knowledge and attribute it to the modern method of teaching and learning. Reformers point to evidence that modern approaches offer equivalent results when compared to traditional courses. It seems that three aspects need to be resolved: when, how much, and how to teach anatomy (3)?

4.1.1. When Should Anatomy Be Taught?

Historically, anatomy has been taught predominantly in the first undergraduate years. Although anatomical knowledge is assessed again in many specialist professional examinations, there is very limited exposure to anatomy teaching in later training [5]. Within traditional undergraduate medical curricula, the preclinical/first years usually concentrate on basic sciences, and subsequent years on clinical science and clinical training. Previously, students had very limited exposure to anatomy during clinical training. This mode of teaching has led to frequent criticism from clinical tutors due to a lack of relevant anatomical knowledge among new medical graduates [11]. This has led to concerns that anatomical knowledge among newly qualified doctors may be at a level where patient safety could be compromised. Reforms within medical education have led to efforts to develop vertically integrated curricula [12]. With this, clinical sciences are introduced in the early years, while continued attention is paid to anatomy and other basic sciences in the later years of the curriculum [10]. In this process, specific areas of anatomical knowledge can be prioritized such that only anatomy relevant to general practitioners will be taught to all students in the preclinical years, and trainees with surgical or other specialized interests who need advanced knowledge of anatomy will receive it later in the clinical years and residency program [13].

4.1.2. How Much Anatomy Should Be Taught?

A minimum working knowledge should be that which allows independent leading anatomists to put together some guidelines on an anatomy curriculum that they feel any independent medical practitioner should know. This consensus should be welcomed, as it enables a benchmark to be set for medical schools. It is a promise

that it will permit better comparison of teaching methods and permit meaningful assessment of both medical students and teaching establishments to take place.

4.1.3. How Should Anatomy Be Taught?

Traditionally, learning anatomy has been dissection-based. Dissection has become synonymous with traditional courses and has come to be regarded as the antithesis of problem-based learning [5]. A few have argued that pro-sections can replace the experience of individual dissection. Until recently, no one has argued that the cadaver can be dispensed with altogether. It is obvious that there are some drawbacks related to cadaver dissections. Among others, we should cite the cadaver's anatomy colour, texture, and smell, which are not like real life. Cadavers cannot be palpated, auscultated, or usefully asked to change position. Then, we ask ourselves how doctors encounter anatomy in clinical practice. The answer is through living and surface anatomy on the one hand, and medical imaging on the other. It therefore seemed to make sense to teach students anatomy in this context right from the beginning. This matches our desire for authentic experiences throughout the course [14].

5. Results and Discussion

Our study included 108 respondents out of 140 questionnaires, yielding a response rate estimated at 77%. The age group 20 to 25 was the most predominant ($n = 91$, 85%), followed by practitioners from 26 to 30 ($n = 15$, 14%). There were 97 students who answered the questionnaires and 11 practising clinicians (10.2%). Among the 11 practitioners, 10 were physicians and 1 was a resident in a surgical specialty. Male gender predominated ($n = 67$, 62%), and the sex ratio was 1.63. In a study including 140 medical student alumni from the University of Southampton, 49% were male while 51% were female [15]. The latter was different from our study due to the discrepancy between our samples and the regional setting, the latter being conducted in a developed country, as women may have had more access to high school education than in our university setting. Overall, respondents were from the new educational system (e.g., the Medical Sciences Faculty) compared to the ancient educational system, which was the School of Medical Sciences. Respondents to our questionnaires included mainly medical students ($n = 97$, 89%), followed by general practitioners ($n = 10$, 9.3%) and surgical specialists ($n = 1$, 1%) respectively. Students from the first to third medical curriculum years were predominant among respondents who answered our questionnaire ($n = 40$, 41%). Respondents' perceptions and attitudes toward gross anatomy education raised a certain number of questions exploring different aspects of the anatomy curricula. Among those aspects, the following points are discussed:

1) Relevance of anatomy as one of the most basic sciences in daily clinical practice

Our study reported that 55 out of 107 (51%) respondents agreed that they personally enjoyed their time studying anatomy, and 44 out of 108 (42%) preferred to learn anatomy by having the structures demonstrated to them. In contrast, 61/107 (56.5%) agreed they preferred learning anatomy by exploring it in their

own way (**Table 1**). A study conducted by B. J. Moxham and O. Plaisant, including 350 medical students, reported that all students considered anatomy to be clearly important in clinical medicine. Luis A. A. A and *al* reported in their study, including 1250 self-administered questionnaires; the respondents considered gross anatomy to be more relevant in 51% of cases compared to other fundamental sciences, followed by physiology (38.6%) and pharmacology (32.1%) [16]. Students' early experience through medical curricula showed that they did not realize the relevance of anatomical knowledge as soon as possible. Our study depicted 30.6% of respondents who did not begin to realize anatomy's relevance to clinical practice until they graduated. In terms of medical specialty, anatomical knowledge was considered fundamental or very relevant in the development of orthopaedic-traumatology in 77.3%; and to the development of neurology in 70.5% (16). In our study, three-quarters of respondents whose profiles trend towards surgical specialties strongly agreed on the relevance of anatomical knowledge. According to students' satisfaction with the anatomical curricula taught, 51.4% (n = 55) agreed, and 34.6% (n = 37) strongly agreed that the anatomy training was invaluable to them. Despite students being aware of the relevance of human gross anatomy, 26.5% (n = 27) agreed, whereas 22.5% (n = 23) disagreed, and 20.6% (n = 21) had a neutral opinion; respectively, their knowledge and interest in anatomy influenced their chosen career path.

Table 1. Students', graduates', and practitioners' perceptions and attitudes related to human gross anatomy learning.

Questionnaires	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	No answer
1. I personally enjoyed my time studying anatomy.	5 (4.6%)	4 (3.7%)	8 (7.4%)	55 (50.9%)	36 (33.3%)	0
2. I preferred learning anatomy by having the structures demonstrated to me.	1 (0.9%)	8 (7.4%)	10 (9.3%)	45 (41.7%)	44 (40.7%)	0
3. I preferred learning anatomy by exploring it in my own way.	4 (3.7%)	13 (12%)	6 (5.6%)	61 (56.5%)	24 (22.2%)	0
4. We were given advice and instructions on the possible ways to learn anatomy.	10 (9.3%)	15 (13.9%)	9 (8.3%)	44 (40.7%)	30 (27.8%)	0
5. My motivation for learning anatomy was primarily driven by the examination structure.	19 (17.8%)	37 (34.6%)	4 (3.7%)	33 (30.8%)	14 (13.1)	1 (1.07%)
6. The structures and concepts on which we were examined clearly reflected the anatomy that I used as a House Officer.	6 (5.7%)	16 (15.2%)	19 (18.1%)	34 (32.4%)	9 (8.6%)	21 (20%)
7. I saw clearly how anatomy would be part of clinical practice from the beginning.	9 (8.3%)	16 (14.8%)	4 (3.7%)	47 (43.5%)	32 (29.6%)	0
8. I applied my basic science knowledge of anatomy while learning it in the first 2 years of the course.	6 (5.6%)	16 (14.8%)	12 (11.1%)	52 (48.1%)	16 (14.8%)	6 (5.6%)
9. Studying human cadaveric prosections was an effective way to learn anatomy.	7 (6.6%)	10 (9.4%)	16 (15.1%)	35 (33%)	38 (35.8%)	2 (2.16%)
10. The dissecting room experience helped me deal with the issues of death.	9 (8.7%)	15 (14.4%)	31 (29.8%)	30 (28.8%)	19 (18.3%)	4 (4.32)
11. The dissecting room helped my learning of the language of medicine.	10 (9.8%)	25 (24.5%)	20 (19.6%)	34 (33.3%)	13 (12.7%)	6 (6.12%)

2) Description according to anatomy learning

Through a literature review, many studies have advocated different gross anatomy learning methods. Alia A and Javel I described some didactic tricks for better retaining gross anatomy information. There were different methods, including active learning, valuing visual information, cadaver dissection, ensuring clinical contextualization, bringing knowledge into action, mindful learning, organizing information, ensuring information retrieval, drawing to learn or consolidate, and assessment as well [17]. In our study, 65.4% of respondents advocated active learning as the best way to retain anatomy information. As mentioned above, 42% of students preferred learning anatomy by having the drawings or structures demonstrated through the lectures. From a cognitive psychology perspective, if text is joined with didactic visual information in the form of images, it stays longer in the memory and becomes easier to remember as compared to information that is only heard or read [17]. According to learning-based demonstration, 46.7% in our series agreed that information was conveyed into understanding when exploring specimens with their hands.

Traditionally, human gross anatomy was taught by lectures and laboratories. Because we are experiencing an information era, with escalating development of computer resources, appraisal of students' anatomical knowledge and the methodology of teaching and learning seem necessary [18]. Therefore, some medical staff usually advise students on tips and instructions for human gross anatomy learning. In our setting, 40.7% of respondents agreed they were given advice and instructions on the possible methods for learning anatomy. In addition to that advice and instructions, 43.5% of respondents agreed that they didn't realize clearly how anatomy would be part of clinical practice from the beginning, and 29.6% strongly agreed. Luis A. A and *al*, through their study, considered anatomy knowledge in daily clinical practice fundamental or even very relevant "to imaging diagnosis (87.9%), for performing an adequate physical examination (81.7%), for interpreting the symptoms obtained in the clinical story (80%), and in performing therapeutic procedures (78.8%)". They considered anatomy to be very useful in traumatology and neurology, without substantial differences according to professional status [16]. Learning anatomy required motivation from students due to the complexity of anatomical knowledge and the necessity to recall the courses [19]. Given the importance of anatomical knowledge as a basic foundation for good practice, examining students' motivations is imperative for predicting students' performance in anatomy programs [20]. This is especially true when there are always failure or withdrawal rates, which, in turn, impact students' progression. In our study, 34.6% (37/107) didn't agree that their motivation for anatomy learning was primarily driven by the examination structure, compared to 30.8% (33/107) who sustained their motivation related to the examination (**Table 1**). The findings of Clark and Schroth and Burman *et al.* suggest that student motivation is a vital determinant of academic performance and achievement [19] [21]. This was consistent with the research by Abdel Meguid, as the linear regression analysis

demonstrated that an increase in self-efficacy for learning and performance motivation subscale resulted in a higher examination score [19]. Fifty-one out of 108 respondents (47.2%) agreed they did very well in the anatomy examination (Table 2). Therefore, forty-four out of 108 respondents agreed, and 21.5% (n = 23) strongly agreed they felt they had learnt enough anatomy to practice competently, compared to 17.8% who felt they did not. In addition to being sure to practice competently, the majority of respondents (n = 47, 43.5%) said they agreed, and 19 respondents (17.6%) strongly agreed to find it easy to relate the anatomy they had been taught to practice, compared to 21 (19.4%) who didn't (Table 2). Thirty-three out of 108 respondents disagreed (30.6%) that they began to realise anatomy's relevance to clinical practice when they had only finished their internship or graduated. Some authors sustained that the more years in experience practice, the more students realize the relevance of anatomical knowledge. Luis A *et al.* reported that the relevance of anatomical knowledge reached the maximum score from medical specialists and professionals with practice experience ranging from 6 to 15 years. In contrast, pharmacology and physiology hold maximum appraisal from professionals with more than 16 years of experience [16].

Table 2. Students', graduates', and practitioners' perceptions and attitudes related to human gross anatomy curricula.

Questionnaires	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	No answer
12. The curriculum and teaching methods in anatomy suited my style of learning at the time.	14 (13%)	34 (31.5%)	17 (15.7%)	33 (30.6%)	10 (9.7%)	0
13. I forgot most of the anatomy I learned in the first couple of years.	13 (12%)	28 (25.9%)	13 (12%)	44 (40.7%)	10 (9.3%)	0
14. I have a three-dimensional map of the human body in my mind, which I can visualize.	11 (10.3%)	42 (39.3%)	8 (7.5%)	34 (31.8%)	12 (11.2%)	1 (0.93%)
15. From what I recall, I did very well in anatomy examinations.	3 (2.8%)	11 (10.2%)	10 (9.3%)	51 (47.2%)	33 (30.6%)	0
16. I felt I had learned enough anatomy to practice competently.	4 (3.7%)	19 (17.8%)	16 (15%)	45 (42.1%)	23 (21.5%)	1 (0.93%)
17. I found it easy to relate the anatomy we had been taught to practice (e.g., why wrist drop is a sign of radial nerve damage).	5 (4.6%)	21 (19.4%)	16 (14.8%)	47 (43.5%)	19 (17.6%)	0
18. I only began to realize the relevance of anatomy to clinical practice when I graduated.	31 (28.7%)	33 (30.6%)	20 (18.5%)	9 (8.3%)	5 (4.6%)	0
19. I was concerned that there was still so much anatomy I did not know.	5 (4.6%)	15 (13.9%)	13 (12%)	48 (44.4%)	27 (25%)	0
20. I felt confident that I could ask for help with my anatomy knowledge if I needed to.	1 (0.9%)	12 (11.2%)	7 (6.5%)	64 (59.8%)	23 (21.5%)	1 (0.9%)
21. I was looking forward to learning more anatomy in my future career.	3 (2.8%)	3 (2.8%)	6 (5.6%)	54 (50%)	42 (38.9%)	0
22. I found that I could not remember details, but they came back quickly and easily with a small amount of study.	1 (1%)	12 (11.4%)	14 (13.3%)	59 (56.2%)	19 (18.1%)	3 (2.7%)
23. In practice, I do not see or think about anatomy as a separate subject.	21 (20.6%)	37 (36.3%)	13 (12.7%)	22 (21.6%)	9 (8.8%)	6 (5.5%)

3) Description according to the way of teaching gross anatomy

From a preclinical setting, students, at their first encounter with anatomical teaching, did not expect the relevance and complexity of anatomical knowledge. Through the questionnaires, to deal with these unexpected issues, the students' ability to get advice from trainers has been assessed. Fifty-nine point eight percent (59.8%, $n = 64$) agreed they felt confident that they could ask for help with their anatomy knowledge if they needed to (**Table 1**). In the past, anatomy theatres were the privileged and original place for teaching anatomy in Europe at the beginning of the 15th century. Modern surgery was born from progress accomplished in these theatres [2]. Nowadays, there are many ways for training in human gross anatomy, and other new ways are developed progressively in many medical faculty sciences worldwide. Teaching anatomy has been fundamental to the training of surgeons, from both the technical viewpoint, guiding the surgical gesture, and the intellectual viewpoint, including medical specialists, leading them to familiarize themselves with scientific observations.

Anatomical knowledge is too important to future doctors and postgraduates to leave questions about the best way to teach it to emotional discussions or to the educational fashion of the day. In the clinical setting, anatomical knowledge is mandatory for best practice. In our study, 69.4% ($n = 75$) agreed that they remembered anatomical knowledge they used routinely during clinical year practice (**Table 3**). A few decades ago, anatomy accounted for the largest number of lecture hours spent in any of the preclinical or para-clinical departments. Nowadays, however, anatomy, even involving the dissection of a cadaver, inspires few students to take it up as a career [22]. According to that lack of commitment, despite the majority of respondents, 47.2% ($n = 51$) in our series agreed, and 30.6% ($n = 33$) strongly agreed they remembered they did very well in the anatomy examination; therefore, 44.4% ($n = 48$) agreed, and 25% ($n = 27$) strongly agreed they were concerned that there was still so much anatomy they did not know (**Table 2**). Thus, relatively aware of this lack of sufficient knowledge in anatomy, one half (50% ($n = 54$)) of our respondents agreed, while 38.9% ($n = 42$) strongly agreed they were looking forward to learning more anatomy in their future career (**Table 2**).

As the way of teaching human gross anatomy varied, 40.7% ($n = 44$) agreed they forgot most of the anatomy they learned in the first couple of years because courses were more lecture-based than practice, while 25.9% ($n = 28$) in turn disagreed. In addition, the majority of respondents, 39.3% ($n = 42$), disagreed with having a three-dimensional map of the human body in their mind that they can visualize or recall. Despite being aware of this lack of three-dimensional anatomical knowledge, 42.1% ($n = 45$) agreed, and 21.5% ($n = 23$) strongly agreed, that they felt when working in a clinical area or whilst reading, they can visualize some dissections that they worked on, or on the other hand, they could find it easy to work through a clinical case and pick out the anatomy components (**Table 2**). The same trend was observed, while 63.9% of respondents ($n = 69$) agreed they can visualize some anatomy drawings/diagrams that they used routinely.

Table 3. Students', graduates', and practitioners' perceptions and attitudes related to human gross anatomy education and its clinical practice.

Questionnaires	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	No answer
1. I find it easy to work through a clinical case and pick out the anatomical components.	6 (5.7%)	25 (23.6%)	16 (15.1%)	49 (46.2%)	10 (9.4%)	2 (1.85%)
2. When working in a clinical area or while reading, I can visualize some prosections that we worked on.	1 (0.9%)	4 (3.7%)	4 (3.7%)	69 (63.9%)	30 (27.8%)	0
3. I can visualize some anatomy drawings/diagrams that we used (e.g., the brachial plexus).	4 (3.8%)	17 (16.2%)	10 (9.5%)	48 (45.7%)	26 (24.8%)	3 (2.77%)
4. Please rate how often you use the anatomy you learned at medical school in your current job role.	4 (3.7%)	19 (17.6%)	13 (12%)	52 (48.1%)	20 (18.1%)	0
5. My anatomy education was invaluable to me.	2 (1.9%)	5 (4.7%)	8 (7.5%)	55 (51.4%)	37 (34.6%)	1 (0.9%)
6. My knowledge of and interest in anatomy influenced my chosen career path.	11 (10.8%)	23 (22.5%)	21 (20.6%)	27 (26.5%)	20 (19.6%)	6 (5.55%)
7. I struggled with learning the three-dimensional aspect of anatomy.	11 (10.2%)	36 (33.3%)	25 (23.1%)	20 (18.5%)	11 (10.2%)	5 (4.6%)
8. I found that information was conveyed into understanding when exploring specimens with my hands.	2 (1.9%)	7 (6.7%)	19 (18.1%)	50 (47.6%)	27 (25.7%)	3 (2.77%)

4) Dissection, prosection, self-directed learning, teamwork, and computer-based learning

A variety of benefits have been traditionally ascribed to the use of dissected or prosected materials in anatomy teaching, some of which can be achieved by other means. For instance, self-directed learning and teamwork can be developed in a variety of settings, such as a problem-based group. Manual dexterity can usually be practiced in clinical skill settings [14]. In our study, 33% (n = 35) agreed, and 35.8% (n = 38) strongly agreed that studying human cadaveric prosections was an effective way to learn anatomy (Table 1). In addition to sustaining prosection-based learning, the majority of respondents, 47.6% (n = 50), agreed that information was conveyed into understanding when exploring specimens with their hands (Table 3). Claire Smith and Haydn Socrates Mathias conducted a similar study related to our study design and reported 77% of respondents who agreed that using human cadaveric prosection was an effective way of learning anatomy [15] (Table 4). Thus, the majority of respondents reported they had a neutral review and that they struggled with learning the 3-dimensional aspect of anatomy.

Dissection of the human body raises questions for medical students about the source of the body, bodily trespass and invasion of privacy, death, dying, and their own mortality. Facing and expressing the aversion, fears, and fantasies associated with human dissection help prepare students both for academic work in the anatomy laboratory and for the emotional work implicit in the clinical setting for patient care [22]. Thirty-nine point eight percent (n = 31) had a neutral review, whereas 28.8% (n = 30) agreed the dissecting room experience helped them deal with the issues of death. Anatomy knowledge may improve students' ability in clinical practice. In our study, 33.3% (n = 34) agreed that the dissecting room

helped them learn the language of medicine (**Table 1**). Application of anatomical knowledge is common in the clinical context; our study reported that 62.9% of respondents agreed their gross anatomy daily application was integrated into their clinical practice (**Table 1**). Claire Smith and Haydn Socrates Mathias reported in their study that, as students and clinicians continue their education, not all students and clinicians found it easy to relate the anatomy they have been taught to practice. As individuals begin to relate their knowledge to practice, they are using procedural and conditional knowledge, which requires transformation and integration; the knowledge has to be made into meaningful and useful components. This highlights the need for anatomy to be taught in context, not just in the early years but throughout the curriculum, as carried out at some medical schools [15].

Table 4. Statement in the 32 questions used to assess students', graduates', and practitioners' perceptions and attitudes toward anatomy education.

1. I personally enjoyed my time studying anatomy.	17. I found it easy to relate the anatomy we had been taught to practice (e.g., why wrist drop is a sign of radial nerve damage).
2. I preferred learning anatomy by having the structures demonstrated to me.	18. I only began to realize anatomy's relevance to clinical practice after I graduated.
3. I preferred learning anatomy by exploring it in my own way.	19. I was concerned that there was still so much anatomy I did not know.
4. We were given advice and instructions on the possible ways to learn anatomy.	20. I felt confident that I could ask for help with my anatomy knowledge if I needed to.
5. My motivation to learn anatomy was primarily related to the examination structure.	21. I was looking forward to learning more anatomy in my future career.
6. The structures and concepts that we were examined on clearly reflected the anatomy that I used as a House Officer.	22. I found that I could not remember details, but they came back quickly and easily with a small amount of study.
7. I saw clearly how anatomy would be part of clinical practice from the beginning.	23. In practice, I do not see or think about anatomy as a separate subject.
8. I applied my basic science knowledge of anatomy while learning it in the first 2 years of the course.	24. I find it easy to work through a clinical case and pick out the anatomical components.
9. Studying human cadaveric dissections was an effective way to learn anatomy.	25. When working in a clinical area or while reading, I can visualize some dissections that we worked on.
10. The dissecting room experience helped me deal with the issues of death.	26. I can visualize some anatomy drawings/diagrams that we used (e.g., the brachial plexus).
11. The dissecting room helped my learning of the language of medicine.	27. Please rate how often you use the anatomy you learned at medical school in your current job role.
12. The curriculum and teaching methods in anatomy suited my style of learning at the time.	28. My anatomy education was invaluable to me.
13. I forgot most of the anatomy I learned in the first couple of years.	29. My knowledge and interest in anatomy influenced my chosen career path.
14. I have a three-dimensional map of the human body in my mind, which I can visualize.	30. I struggled with learning the three-dimensional aspect of anatomy.
15. From what I recall, I did very well in anatomy examinations.	31. I found that information was conveyed into understanding when exploring specimens with my hands.
16. I felt I had learned enough anatomy to practice competently.	32. Please, in a few words, give your feedback and expectations regarding gross anatomy education in our low-income country setting.

In addition to dissection-based learning, other learning modalities such as problem-based learning, self-directed learning, team-based learning, computer-based learning, lectures, and drawing-based learning have been claimed through our findings. Although these modalities have been suggested for improving anatomy teaching, students' opinions were divided, with 31.6% ($n = 34$) disagreeing and 30.6% ($n = 33$) agreeing that the structures and concepts on which they were examined clearly reflected the anatomy that they used as a House Officer (**Table 1**). Anatomy knowledge is demanding for students' memory recall and requires revision for proper clinical practice. The purposes for students to revise anatomy were reported at 51.48% for deepening anatomy knowledge, followed by clinical practice at 18.2% (**Table 2**). The methods our respondents used for anatomy knowledge recall varied, from reading classical anatomy books at 47.84% to computer-based learning at 21.16%. Team-based learning was rare in our study, (e.g.) 4.6%.

According to B.W Turney, the challenge should not be to determine the supremacy of one method over another, but to maximize the learning benefit available from the different methods. Some authors suggested problem-based learning to develop reasoning skills, enable learning within a relevant context, encourage work-related skills, and promote self-directed learning [3]. In our study, our respondents ($n = 37$; 34.6%) only disagreed with self-directed learning. Appropriate use of dissection and prosection can meet many of these aims and have additional benefits. The dissection room should be kept working on when the evidence is that students and trainees who have minimal exposure to dissections often demand dissection/prosection-based teaching at a later date [5]. In our study, 73 (68.8%) required dissection/prosection-based teaching both at an early or late date after having met these methods during their undergraduate period (**Table 1**).

5) Students' and practitioners' feedback from gross anatomy education:

Considerable research has focused on how anatomy is taught in the early years of the curriculum, but little on the assessment of anatomical education in LLICs. Anatomy education in LLICs appears vulnerable due to severe economic conditions, weak management, and socio-political pressures. Those who kept teaching showed high levels of motivation to the point of personal sacrifices to make teaching happen creatively [23]. Early teaching in years 1 and 2 is very important and serves as building blocks on which students begin to restore, restructure, and apply this knowledge. Our study reported 53 respondents (49.5%) who agreed that they used the anatomical knowledge they learnt in daily practice (**Table 3**). Thus, the majority of respondents ($n = 48$, 44.4%) agreed there was still so much anatomy they did not know. This data trended the same as reported by Claire Smith and Haydn Socrates Mathias, 68% declared there was so much anatomy they did not know [15]. Therefore, students' satisfaction and expectations were acquired when assessing pedagogical aspects through anatomical education. First of all, 21 (23.3%) out of 89 confirmed they were satisfied with the experiences acquired from anatomical teaching. The lack of practice or inadequate practice setting was

suggested by 24/89 respondents (26.96%), while 11 students (12.35%) agreed that there was more theory than practice. Chang Chan *et al.* reported in their study that the practical use of anatomy knowledge in clinical application, and the structure identification in imaging studies as a didactic approach, does not require significant economic investment and has demonstrated effectiveness and students' acceptance [24]. The time allocated to anatomical education is shortened in many medical schools. Thus, traditionally, anatomy has been delivered at the beginning of medical education to provide a basis for clinical training and practice [22]. The dogmatic support among traditionalists for detailed anatomy courses may have been detrimental to the evolution of anatomy as a subject. Reformers regard these teaching methods as "old-fashioned" and incompatible with modern learning practices, possibly without appreciating the many benefits of the traditional approaches. If some authors suggested "old-fashioned" anatomy teaching is dead, there are new trends which suggest anatomy should reinvent itself as a separate subject [5]. In this context, the majority of our study respondents ($n = 37$; 36.3%) agreed they practically see or think about anatomy as a separate subject (Table 2). There has been a move from passive, didactic, highly detailed courses towards functionally and clinically relevant courses, irrespective of the method of teaching. One quarter of respondents in our series supported functionally and clinically relevant courses compared to only passive and didactic approaches. A small number of students, 5 (5.6%), considered the anatomical program incomplete and unachieved. For further progress to be made, the traditionalists have to concede that learning large quantities of detailed anatomy is unnecessary for the majority of medical careers, whilst a core of knowledge must be covered and assimilated by all students.

When assessing students' perception regarding the number of hours of anatomical programs, a small 4.49% considered the anatomical courses to be voluminous, whereas 21 respondents (22.58%) suggested improving both the quality of the anatomy program delivered and the quality of training.

Regarding the teaching methodologies, the ongoing debate on how best to teach anatomy has raised several questions that have been addressed by authors studying anatomical education. There is little consensus on the best mode of teaching anatomy, while a review of the literature suggests traditional dissection confers a better advantage; therefore, another group of authors advocated that similar knowledge can be imparted by using a variety of modalities, including lecture-based, computer-assisted software, prosected specimens, plastic models, and radiological imaging [24]. In our study, 35/106 (33%) agreed, and 38/106 (35.8%) strongly agreed that dissection-based learning was a valuable method for teaching human gross anatomy (Table 1). Suresh R *et al.* reported in their study that interns considered dissection-based learning as the best tool to study anatomy (82.77%) compared to computer-assisted teaching (17.23%). In contrast, only 17% considered both dissection and computer-assisted anatomy teaching to be useful for understanding the depth of anatomical knowledge.

6. Limitations

Our study, despite being our first experience in the medical education system, showed some limitations. Among these, the single-setting design does not allow us to compare our results with multicentre study reports. The small size of our sample and the discrepancy between our study's groups, in which practitioners included the smallest number compared to students, constituted a real limitation. The answers provided by our participants related to their feelings and were subjective. Therefore, our study showed that perceived competence is not the same as measured anatomy knowledge.

7. Conclusion

This is the first contribution from our medical school to study anatomy education. Data reported in our survey trended the same way as those reported in the literature, with discrepancies commonly related to the low-income country nature of our setting, including the lack of access to technological tools and the decreased time allocated to clinical anatomy and dissection learning. Therefore, our participants' perception sustained anatomy education as being invaluable in their curricula and expected to deepen their anatomical knowledge in the future. The same attitude was observed when considering the method of teaching, while the majority of participants suggested dissection-based learning as the relevant method to teach and understand the depth of anatomical knowledge. When assessing students' perceptions and attitudes about the anatomy program, a few students considered lecture courses to be excessive, whereas one quarter suggested improving both the quality of the anatomy program delivered and the quality of training. Fifty-three participants' perceptions suggested they used the anatomical knowledge they learned in daily practice. Thus, the majority of participants considered there was still much anatomy they did not know.

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Conflicts of Interest

There are no conflicts of interest.

References

- [1] Chang Chan, A., Cate, O., Custers, E.F.M., Leeuwen, M.V. and Bleys, R.A.W. (2019) Approaches of Anatomy Teaching for Seriously Resource-Deprived Countries: A Literature Review. *Education for Health*, **32**, 62-74.
https://doi.org/10.4103/efh.efh_272_17
- [2] Marre, P. and Villet, R. (2020) Anatomy Theaters in the History and Teaching of

- Surgery. *Journal of Visceral Surgery*, **157**, S73-S76.
<https://doi.org/10.1016/j.jvisc Surg.2020.03.005>
- [3] Turney, B. (2007) Anatomy in a Modern Medical Curriculum. *The Annals of the Royal College of Surgeons of England*, **89**, 104-107.
<https://doi.org/10.1308/003588407x168244>
 - [4] Shaffer, K. (2004) Teaching Anatomy in the Digital World. *New England Journal of Medicine*, **351**, 1279-1281. <https://doi.org/10.1056/nejmp048100>
 - [5] Moxham, B.J. and Plaisant, O. (2006) Perception of Medical Students towards the Clinical Relevance of Anatomy. *Clinical Anatomy*, **20**, 560-564.
<https://doi.org/10.1002/ca.20453>
 - [6] Prince, K.J.A.H., Scherpbier, A.J.A.A., Van Mameren, H., Drukker, J. and Van Der Vleuten, C.P.M. (2005) Do Students Have Sufficient Knowledge of Clinical Anatomy? *Medical Education*, **39**, 326-332. <https://doi.org/10.1111/j.1365-2929.2005.02096.x>
 - [7] Waterston, S.W. and Stewart, I.J. (2005) Survey of Clinicians' Attitudes to the Anatomical Teaching and Knowledge of Medical Students. *Clinical Anatomy*, **18**, 380-384. <https://doi.org/10.1002/ca.20101>
 - [8] Bonnel, F., Lavabre-Bertrand, T. and Bonnel, C. (2019) The Teaching of Anatomy in Montpellier University during VIII Centuries (1220-2020). *Surgical and Radiologic Anatomy*, **41**, 1119-1128. <https://doi.org/10.1007/s00276-019-02289-6>
 - [9] Bergman, E.M., Van Der Vleuten, C.P.M. and Scherpbier, A.J.J.A. (2011) Why Don't They Know Enough about Anatomy? A Narrative Review. *Medical Teacher*, **33**, 403-409. <https://doi.org/10.3109/0142159x.2010.536276>
 - [10] Evans, D.J.R. and Watt, D.J. (2005) Provision of Anatomical Teaching in a New British Medical School: Getting the Right Mix. *The Anatomical Record Part B: The New Anatomist*, **284**, 22-27. <https://doi.org/10.1002/ar.b.20065>
 - [11] Marshall, J.G., Fitzgerald, D., Busby, L. and Heaton, G. (1993) A Study of Library Use in Problem-Based and Traditional Medical Curricula. *Bulletin of the Medical Library Association*, **81**, 299-305.
 - [12] Brooks, W.S., Woodley, K.T.C.P., Jackson, J.R. and Hoesley, C.J. (2014) Integration of Gross Anatomy in an Organ System-Based Medical Curriculum: Strategies and Challenges. *Anatomical Sciences Education*, **8**, 266-274.
<https://doi.org/10.1002/ase.1483>
 - [13] McLachlan, J.C. (2004) New Path for Teaching Anatomy: Living Anatomy and Medical Imaging vs. Dissection. *The Anatomical Record Part B: The New Anatomist*, **281**, 4-5. <https://doi.org/10.1002/ar.b.20040>
 - [14] Arráez-Aybar, L., Sánchez-Montesinos, I., Mirapeix, R., Mompeo-Corredera, B. and Sañudo-Tejero, J. (2010) Relevance of Human Anatomy in Daily Clinical Practice. *Annals of Anatomy—Anatomischer Anzeiger*, **192**, 341-348.
<https://doi.org/10.1016/j.aanat.2010.05.002>
 - [15] Smith, C.F. and Mathias, H.S. (2010) What Impact Does Anatomy Education Have on Clinical Practice? *Clinical Anatomy*, **24**, 113-119.
<https://doi.org/10.1002/ca.21065>
 - [16] Amin, A. and Iqbal, J. (2019) Effective Ways to Learn and Retain Gross Anatomy. *Pakistan Armed Forces Medical Journal*, **69**, 708-714.
<https://www.pafmj.org/pafmj/article/view/3059>
 - [17] Arroyo-Jimenez, M.D.M., Marcos, P., Martinez-Marcos, A., Artacho-Pérula, E., Blaizot, X., Muñoz, M., Alfonso-Roca, M.T. and Insausti, R. (2005), Gross Anatomy Dissections and Self-Directed Learning in Medicine. *Clinical Anatomy*, **18**, 385-391.

- <https://onlinelibrary.wiley.com/doi/abs/10.1002/ca.20129>
- [18] Abdel Meguid, E.M., Smith, C.F. and Meyer, A.J. (2020), Examining the Motivation of Health Profession Students to Study Human Anatomy. *Anatomical Sciences Education*, **13**, 343-352.
<https://anatomypubs.onlinelibrary.wiley.com/doi/abs/10.1002/ase.1919>
- [19] Clark, M.H. and Schroth, C.A. (2010) Examining Relationships between Academic Motivation and Personality among College Students. *Learning and Individual Differences*, **20**, 19-24. <https://doi.org/10.1016/j.lindif.2009.10.002>
- [20] Burnam, A., Komarraju, M., Hamel, R. and Nadler, D.R. (2014) Do Adaptive Perfectionism and Self-Determined Motivation Reduce Academic Procrastination? *Learning and Individual Differences*, **36**, 165-172.
<https://doi.org/10.1016/j.lindif.2014.10.009>
- [21] Jacob, T.G. (2013) History of Teaching Anatomy in India: From Ancient to Modern Times. *Anatomical Sciences Education*, **6**, 351-358. <https://doi.org/10.1002/ase.1359>
- [22] Bertman, S.L. and Marks Jr., S.C. (1989) The Dissection Experience as a Laboratory for Self-Discovery about Death and Dying: Another Side of Clinical Anatomy. *Clinical Anatomy*, **2**, 103-113.
<https://onlinelibrary.wiley.com/doi/abs/10.1002/ca.980020207>
- [23] Chang Chan, A.Y.C., van Leeuwen, M., Custers, E., Bleys, R. and ten Cate, O. (2024) Anatomy Education in Low-Resourced Countries: What Are Challenges and Effective and Affordable Educational Strategies? A Qualitative Study. *Medical Teacher*, **47**, 883-893. <https://doi.org/10.1080/0142159x.2024.2383373>
- [24] Rao, S.R., Swamy, G. and Thomas, L.R. (2026) Perception of Interns towards Cadaveric Dissection v/s Computer Assisted Anatomy Teaching. *World Journal of Pharmaceutical and Medical Research*, **4**, 264-267.