

# How Medicine and Surgery Students Learn Human Macroscopic Anatomy

Cómo Aprenden los Estudiantes de Medicina y Cirugía sobre la Anatomía Macroscópica Humana

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**SUMMARY:** The purpose of this research was to understand how second-semester students of the Medicine and Surgery academic program at Universidad del Valle learn about the main ideas of Human Macroscopic Anatomy (HMA). As a methodological proposal, a case study was carried out. Students' knowledge and understanding of HMA was assessed. For this, the Pedagogical Content Knowledge (PCK) model was taken into account, which includes the motivations and interests for learning, as well as the student's previous ideas. A participant observation of the theoretical and practical classes was carried out for 16 weeks, recording observations in a field diary, and obtaining audiovisual material. All the information was organized in an analytical index, creating codes for the analysis. The analysis, interpretation and representation of results were done using the ATLAS.ti 22 software. It was found that students learn the main ideas of HMA through a process that implies commitment to their academic training, where interests, motivations, prior knowledge and participation are involved. It is important that different study methods are used during this process, and that there is the support from the professor and the institution, who should favor the learning and immersion of the students into the academic world and university culture, through the design of proposals that integrate teaching, learning and assessment, and also take into account the social and cultural realities of their students.

**KEY WORDS:** Learning; Human anatomy; Medicine; Education.

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## INTRODUCTION

Learning Human Macroscopic Anatomy (HMA) has been considered fundamental in the training of students in the Medicine and Surgery academic program (Moro *et al.* 2017; Ghosh, 2017). Its knowledge and correct use are necessary for the training of health professionals, to the extent that this learning has been correlated with a safe medical practice, since an inadequate interpretation and anatomical description in the diagnosis and treatment of a patient can cause clinical complications and even death (Rodríguez-Herrera *et al.*, 2019).

McHanwell *et al.* (2007), consider that learning HMA is crucial to achieve diagnoses and carry out clinical procedures safely and effectively. Also, advances in diagnostic tests have increased the importance of anatomical knowledge, since radiological techniques require a deep understanding of the human structure to achieve a complete interpretation. Therefore, it is essential that students recognize the main ideas of human anatomy that include anatomical position, planimetry, terms of reference and

comparison. These insights will enable them to understand the general features of structures, human body systems, and their general function, interpret relevant clinical images, recognize surface anatomy, muscle groups, and basic clinical correlation.

The teaching practiced in most medical schools has been classified as traditional, characterized by a transmissionist conception of knowledge in which the magisterial predominates, with an expository nature, in which what is known is more important than what is discussed, analyzed or inferred, and therefore a sapiential and encyclopedic discourse prevails. Learning through this approach becomes repetitive and by heart, with a professor-student relationship based on authority, verticality, emotionally distant and dependency (Bohórquez & Gutiérrez, 2004). As for the assessment, it is generally summative, aiming to validate what has been learned through multiple-choice tests, in which the accumulation of information is evaluated, and commonly the associative,

explanatory, argumentative, and creative capacity of the student is not taken into account (Brunstein, 2014).

Therefore, it is possible to identify that the teaching, learning and evaluation processes (T-L-Ev, from here on) are disjointed. Students usually collect anatomical terms without judgment, and because they are also not required to develop opinions, knowledge in this area is perceived as a rigid body of terms revealed by the professor and the text, while the student's role is to return their knowledge during the exams (Zibis *et al.*, 2021). Because of this, students are not exposed to new problems and it is not possible for them to develop higher-order cognitive skills, such as inquiry-oriented class discussions, cooperative learning and participation in these T-L-Ev processes (Zoller & Scholz, 2004).

Similarly, illustrative laboratory practices are characteristic in the HMA teaching and learning, in which the professor is the center of attention (Chen *et al.*, 2017; Zibis *et al.*, 2021), limiting the multiple possibilities of learning from these hands-on activities. However, the latter is contrary to what was said by Fernandez (2018), who highlights that the interest and commitment generated by these activities in students are possible as long as the problematizing and investigative approach to them predominates. The objective of this work was to identify the knowledge of the students, their understanding of HMA.

## MATERIAL AND METHOD

This work is framed as a type of qualitative research since it is carried out in a natural environment, in this case, with professors from the HMA area and a group of students from a public university in the city of Cali (Colombia), where the researcher was the instrument of data collection. This paradigm implies an interpretative and naturalistic approach to the object of study, because it was studied in its natural environment, that is, in the classroom, interpreting the T-L-Ev practices based on the meanings given by professors and students (Creswell, 2016). This study was approved by the Health Research Ethics Committee of the Universidad del Valle under act number 057-021 in July 2022.

As a methodological approach, a case study was used following the indications of Yin (2014) who claims that this type of study allows answering questions that inquire about the why and how of social situations, without controlling the events that are being studied, in addition to carrying out a deep approach to a certain process, preserving the total vision of the phenomenon.

The present study used multiple sources of evidence such as participant observation, field diary, semi-structured

interviews and a survey. The research techniques and the respective analysis were carried out following the guidelines of Hernández (2018), Creswell (2016) and Restrepo (2018), who state that, for the data to be consistent, it is essential that the researcher be accepted by the study subjects, in this case, by the group of professors and students.

**Study population.** The work was carried out with a group of 90 second-semester students of the Medicine and Surgery academic program at Universidad del Valle, enrolled in the Human Macroscopic Anatomy I (HMA-I) course. Four professors from the Department of Morphology in the Human Anatomy area, who have Master's studies in Biomedical Sciences and experience of more than five years teaching HMA, also participated. To have their collaboration, the necessary endorsement was requested from the academic program of Medicine and Surgery and the Department of Morphology of the Universidad del Valle.

**Study phases.** In order to identify the students' knowledge and understanding of HMA, the categories proposed in the hexagonal model of pedagogical knowledge of the content proposed by Park & Oliver (2008), were followed, which include motivations and interests, as well as previous ideas needed to achieve the learning goal. In this study, two additional categories emerged: emotions and study methods. For their identification, a participant observation was first carried out, followed by a field diary and the obtaining of audiovisual material. Each of the phases of this phase are described below:

- **Phase 1.** The principal investigator carried out a participant observation of the theoretical and practical classes of the HMA-I course throughout the semester (16 weeks). This technique allowed for a direct experience to have relevant information in the fieldwork framework, which, in the words of Octavio Cruz cited by Restrepo (2018), mentions that "the participant observation technique is carried out through contact of the researcher with the observed phenomenon to obtain information about the reality of the social actors in their own contexts".
- **Phase 2.** A field diary was used, whose function was to write down the data and allow permanent reflection on the results that the study was producing. This, in order to record and interpret the situations that allow the understanding of how students learn the main ideas of the HMA, and how teaching and assessment can support this process. Likewise, the field diary made it possible to schedule events that were necessary to observe to achieve a better understanding of the study phenomenon (Restrepo, 2018). To keep the field diary, an observation guide was prepared, available in the supplementary material 1.

**- Phase 3.** As a third and last step, photographic material of the activities related to the T-L-Ev processes of the HMA course was obtained. For this, a Huawei Nova 9 cell phone with four high-resolution cameras (108MP) was used. Additionally, audiovisual material was obtained from one theoretical and one practical class of the HMA-I course. For the theoretical class, there was access to a class that was transmitted through the Google Meet video conference platform; this class was recorded and uploaded to the university virtual campus. For the practical class held in the amphitheater belonging to the Anatomy laboratory, the session was recorded using a Canon EOS 70D camera, a tripod Mafroto and a Polsen+ wireless microphone. The recording had the collaboration of two professionals in social communication and journalism from the Communications office of the Faculty of Health of the Universidad del Valle (Fig. 1). These recordings allowed the videos to be watched as many times as necessary to supplement the information.



Fig. 1. Recording of the practical class in the amphitheater of the Universidad del Valle. Image recreated from a real photograph. Here, a camerawoman is recording a group of students who were identifying structures in previously dissected human organs.

**Analysis.** The analysis of qualitative information began with a description of the T-L-Ev processes from the HMA-I course, taking into account the participant observation, the field diary, the transcription of the theoretical class, the

practical class and the interviews conducted to the professors. Graphic representations of each of the processes were made to illustrate the classroom scenario, as well as the actions of the professor and the students. The analysis and representation of the information was carried out following the suggestions made by Creswell (2016) and Restrepo (2018) as seen in the supplementary material 2.

**Definition of codes.** Before beginning to process the transcriptions of texts from the field diary, it was necessary to identify the initial analysis categories. The definition of codes in a specialized software, in this case ATLAS.ti, allowed for a visualization of the aspects that were necessary to take into account during the research, always in light of the theoretical approach of the study. Table 1 presents the codebook following the PCK model proposed by Park & Oliver (2008) and the content representation (ReCo), adapted by Candela (2017).

**Data processing.** The processing of all data coming from the field observations, as well as the entire analysis unit, was done in ATLAS.ti 22.2.4. Once the transcription of the field diary was completed, the documentary review sheets were obtained. All the information was integrated into the program using the option of integrating all the data into a single hermeneutical unit.

ATLAS.ti was designed for the systematization and analysis of qualitative information in any multimedia format (Varguillas, 2006). Its use allowed the unit of analysis to be treated, within the program, as a single project. The program facilitated the organization of the data through the use of codes from the codebook and the new emerging categories, as well as the reading and rereading of transcripts and field diary notes.

The qualitative instrument for data collection, in this case the field diary, was transferred to a framework of categories or codes that served as subsequent support for the integration of the extracted texts in the coding

Table I. Categories used to code the information obtained.

Code	Definition
Learning of HMA	Students' knowledge and understanding of Human Macroscopic Anatomy. How is the learning process of students about the main ideas of Human Macroscopic Anatomy?
Student motivations for learning HMA	Student motivations to study HMA. What motivation and interests do students report regarding studying HMA?
Previous ideas to learn HMA	Previous ideas needed to learn HMA. What previous ideas are necessary to learn HMA?
Study methods in HMA (emerging category)	Methods used by students to study specific HMA content. What study methods do students use to learn HMA?
Emotions reported by students during the learning process (emerging category)	Emotions reported by students during the learning process. What emotions do students report during the T-L-Ev processes?

Note. Information adapted from the PCK hexagonal model by Park & Oliver (2008) and the content representation ReCo (Candela, 2017).

environment. All the data collected during the processing of information was organized by the program, which allowed easily reading text outputs or any of the multimedia sources of data that the program called "primary documents". At the end, outputs were obtained through the creation of conceptual maps called networks, and through the output process in Word files.

The output texts or documents contain the information compressed into packets of references to the texts that were coded by the main researcher. These files contained the information needed to generate a descriptive analysis. The entire process was integrated into the research project using ATLAS.ti; the software supported and guaranteed consistency and reliability in the analysis, as well as the non-loss of information, which is ideal when the goal is to minimize a large investment of time in manually systematizing and analyzing data.

**Interpretation.** With the support of the output material rich in allusions chosen following the categories and subcategories of the study, an analysis plan was carried out following the phases of the investigation. Each output made by each category was transformed into Word documents, which were the initial input to carry out a first analytical sweep of all the documents by the central themes of the study.

Specifically, the ATLAS.ti program facilitated the organization of the data through the use of codes from the codebook and the possible new emerging categories. The software also made it possible to read and reread the transcripts, photos, and conversations with the interviewees, as well as the grouping and regrouping of analysis categories until a better understanding of the data was achieved.

143 documents (62 Word documents and 81 photographs) were included in the ATLAS.ti program, organized by week. Of the 205 photographs taken in total, 81 were included in the ATLAS.ti program. Most of them were about the student's learning methods.

**Representation and visualization.** With the information collected in the ATLAS.ti program, it was possible to identify the most representative speeches for each of the categories and to develop naturalistic generalizations, that is, generalizations from which one can learn.

## RESULTS

**Student motivations and interests for learning HMA.** The motivations that students refer to study and learn HMA are related to their families, to having a better future as health professionals, to acquire knowledge about the human body,

and to being able to reach the clinical practice. These topics are reflected in the following speeches:

*"The main motivations for not giving up have been my family and the dream we all have of me becoming an excellent doctor"*

*"I am motivated to think about the work I can do in future years, so I will try to keep improving and learning more; anatomy and its study is forever, I am sure that I will always return to it"*

*"I am motivated by the idea of making progress and soon reaching clinics"*

(Addresses from interviews with II semester students of the Medicine and Surgery program, obtained during the participant observation - week 15, January 2022)

**Previous ideas needed to learn HMA.** It was found that it is essential that students have basic ideas of geometry, abstract reasoning, mechanical reasoning and a good body schema that allows them to understand how their body is structured and how the body segments are located in space.

Likewise, professors have identified that students use general names to differentiate body structures. For example, they use the term "arm" to refer to the entire upper limb, and "leg" to refer to the entire lower limb. They identify the largest areas such as the head, neck, thorax and pelvis; they know the names of some organs and muscles that are usually referenced especially in the medical service and at the sports level, most of the time the names are used in an abbreviated and incomplete way.

**Study methods used for learning HMA.** This category corresponds to the way in which students organize their study material to learn the topics proposed in the HMA-I course. During the different academic stages (elementary, high school or other technical and/or university courses), students acquire techniques that allow them to control their learning process (Fig. 2). Below are some comments regarding the preferences of the different study methods given by students:

*"I study with the class, with Netter, Prometheus, writing, drawing, making tables"*

*"Drawing, scratching on my own body to understand the innervation and dermatomes"*

*"To study the brachial plexus, I used one color for the sensory nerves, one color for the motor nerves, one color for the prevertebral nerves, one color for the cranial nerves and one color for the phrenic nerves, I started drawing it and I found it so funny afterwards"*

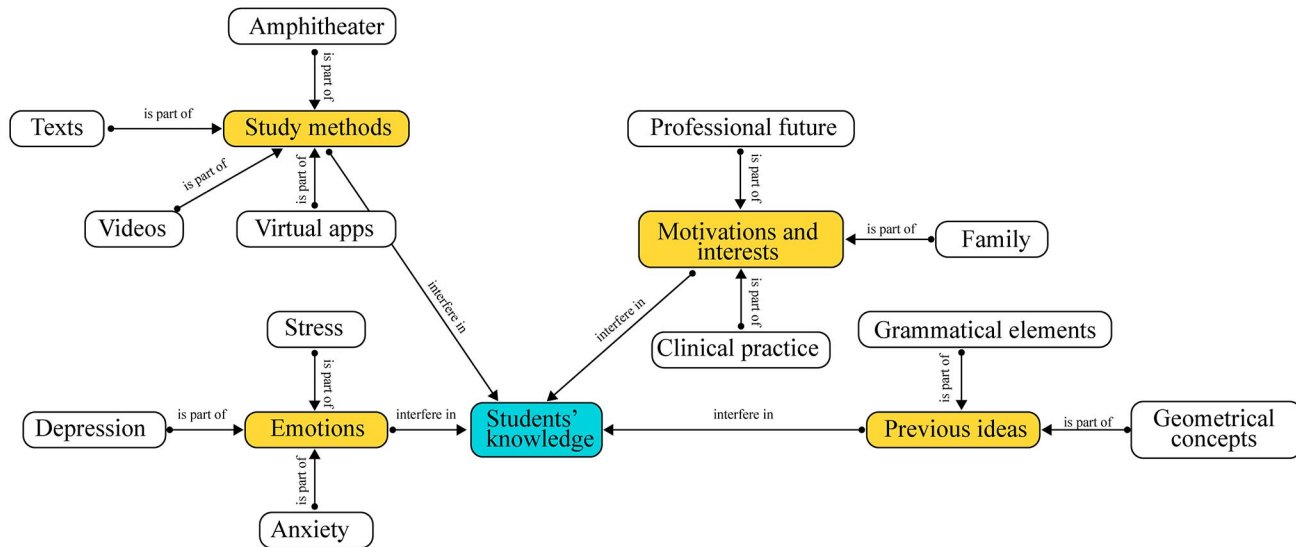


Fig. 2. Students' awareness of their understanding of AMH. Analysis network developed in the ATLAS.ti 22.2.4 program.

*"I make a list of ligaments and their clinical correlations"*

*"Compare knowledge with classmates and discuss the topics studied, as well as solve banks of questions among ourselves"*

*"The professor's explanation is essential to clarify concepts"*

*"I love the Visible Body app, because I can rotate, remove structures, I can see where they are located, I can click and read the innervation, the blood supply, it gives me a description of each structure with a click. I find it very useful, I can leave only muscles, only bones, I can separate what I need to study"*

(Addresses from interviews with II semester students of the Medicine and Surgery program, obtained during the participant observation - week 15, January 2022)

There are other students who state that to study HMA it is essential to use the space of the Human Anatomy Laboratory, since they consider it very important to be able to observe and palpate three-dimensional structures, this is evidenced in the following speeches:

*"The amphitheater is essential to me, as one is more oriented, one gets into the story. If I can identify something in the corpse it is because I am understanding. One thing is a drawing and something different is the real thing. In books everything it is well painted, well drawn and differentiated, on the other hand, in the corpse it is more demanding, one has to look, observe, think, analyze. The fact that there are*

*several bodies is very interesting, if I do not find it in one body, I look for it in another body"*

*"Today when we studied the cervical plexus, we drew, then we went to the amphitheater and we were able to correlate it with the neck muscles; this helped us a lot because we had already studied muscles"*

(Addresses from interviews with II semester students of the Medicine and Surgery program, obtained during the participant observation - week 15, January 2022)

As evidenced in the speeches, students use a variety of study methods including reading texts, using HMA atlases, watching explanatory videos posted on YouTube, creating charts, diagrams, slides, mnemonics and summaries (made in the notebook or digitally), the use of digital applications, class participation, study in the amphitheater, drawing on paper and on one's own body, reviewing class recordings (audio or video, as possible), clinical correlation, group study, peer evaluation, self-assessment, palpation of structures, and observation of one's own body and that of peers.

This is also evidenced from the information processing approach with a discourse analysis made in ATLAS.ti. In the word cloud, the main sources of information are placed in the center, in this case are texts, YouTube videos, digital applications, theoretical class and practice in the amphitheater (Fig. 3).

Similarly, students refer using different study methods, which they combine according to their test results, the available time and their own preferences, as referenced in the following comments:





Fig. 3. Word cloud referring to the study methods used for learning HMA. Word cloud made using the ATLAS.ti 22.2.4 program. Words are in Spanish as they were originally in that language.

“First, I watch the class. Then a textbook with Netter’s atlas next to it and being able to pause the recorded class in zoom, to be able to take notes alongside. I take notes during the class but I do not understand. With the recording of the class I can pause, look in the Visible Body App, in the atlas, and the book”

“First we watch a YouTube video, then we go to the virtual application looking for images of anatomical structures on the internet, trying to represent what I wanted to learn”

(Addresses from interviews with II semester students of the Medicine and Surgery program, obtained during the participant observation - week 15, January 2022)

Some students, like Nancy, create their notes, summaries, and study materials digitally. Figure 4 shows how Nancy, in the material she prepared to study the human macroscopic anatomy of the heart, makes a description of the anatomy of the anterior view of this organ. This allows her to identify some structures that correspond to this view (highlighted in yellow), accompanying the text with an image of a coronal plane anterior view of the human heart taken from the internet. Generally, images from atlases and

textbooks identify all the structures that can be visualized in an organ or anatomical region regardless of the view, this forces students to create their own study material, with a different organization, in a way that it is easier to understand.

**Emotions reported by students regarding the T-L-Ev process.** This emerging category corresponds to the emotions reported by students during the T-L-Ev process and at the end of the semester. During the participant observations it was possible to show that during the evaluation time of all courses, most students reported tiredness, anxiety, stress, depression and frustration. This situation is evidenced in speeches such as:

*“I think I am starting to suffer from anxiety, I do not know if I will have to go to see a therapist. I feel like I want to vomit when I am about to enter a midterm. Yesterday, I studied a lot for the genetics test, and yet I did poorly. I do not know what to do. The truth is I have never suffered from any of this, I’ve never felt anything like this. I’m worried, right now I feel like I am about to throw up”*

*“At the end of each term, the anxiety that studying is not enough suffocates anyone in this program”*

*"Look at my face [she has an outbreak on her face]. I took a few rescue drops. I feel very sorry to fail a test, I cannot stay calm. It is very difficult for me to locate myself in three dimensions, I do not understand the laterality of the structures in the figures"*

*"My heart is like this [he/she touches herself in the middle of the chest, perhaps indicating tachycardia], I feel like I have gastritis. I can't even stay up all night anymore, yesterday at 3 am I was very sleepy and I had to go to bed. The arteries is a subject that has been very hard for me, you have to integrate them, learn them, that has been very hard for me"*

*"I feel guilty about sleeping "*

(Addresses from interviews with II semester students of the Medicine and Surgery program, obtained during the participant observation - week 15, January 2022)

In order to visually represent the words that express the emotions expressed by the students during

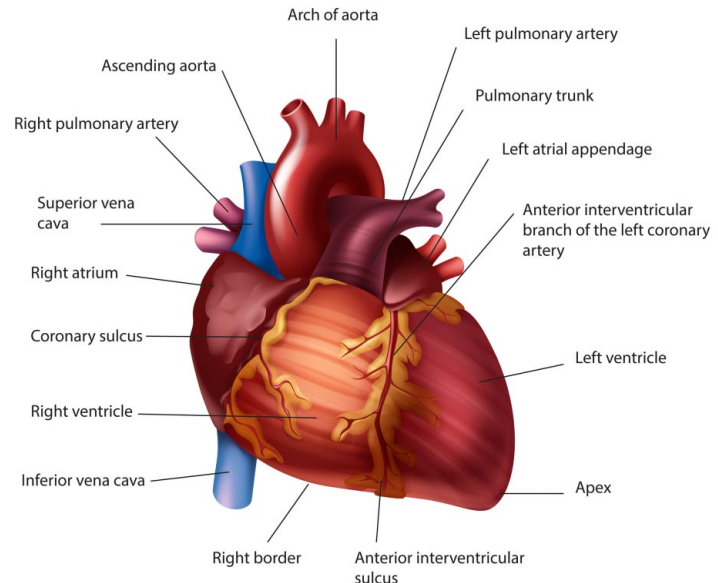


Fig. 4. Digital notes of the student Nancy. Notes for study prepared by a second semester student of the Medicine and Surgery academic program

the T-L-Ev process, a word cloud was made. In the center of it, the words, load, anxiety, nerves, difficulty and stress (Fig. 5).

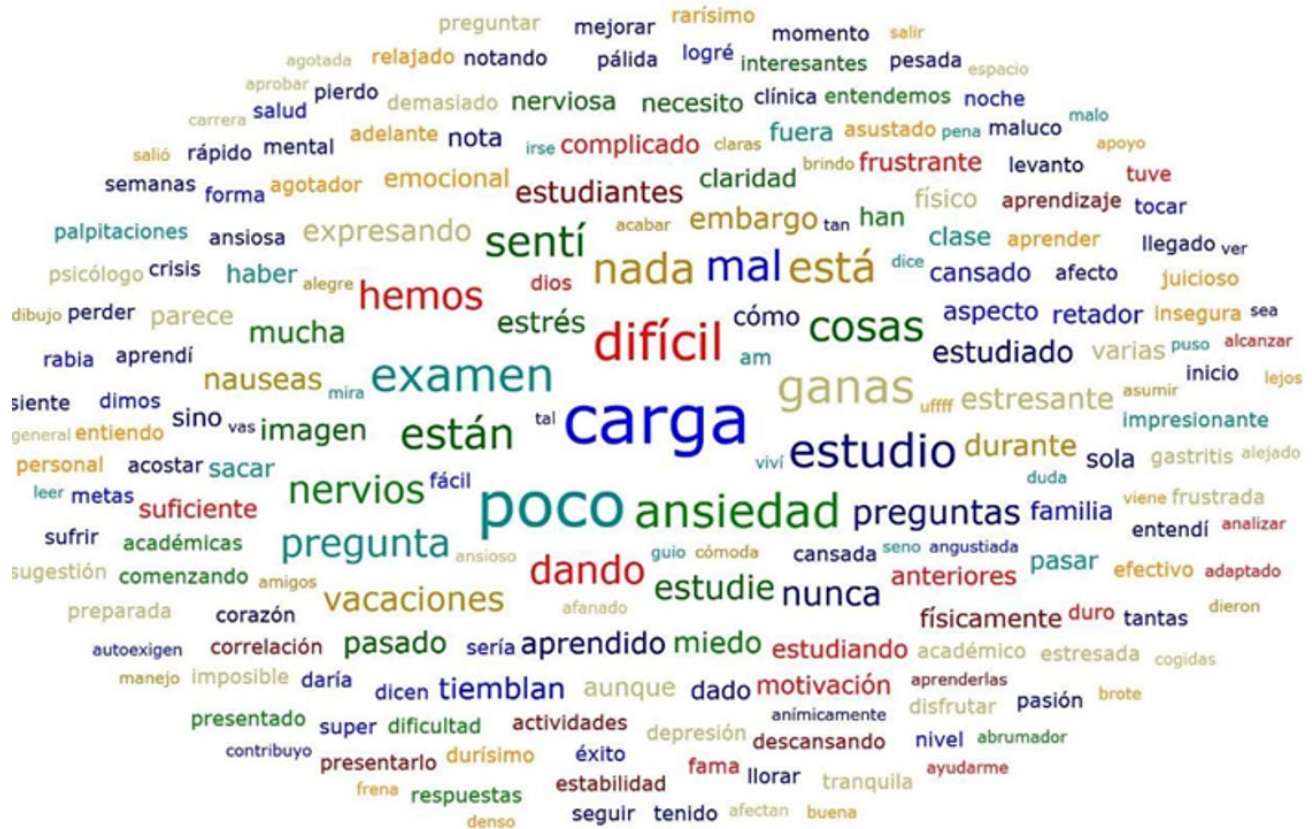


Fig. 5. Word cloud about the emotions reported by students. Word cloud made using the ATLAS.ti 22.2.4 program. Words are in Spanish as they were originally in that language.



During the semester it is common to observe students in the corridors resting on beanbag chairs or on the floor. They try to sleep between classes, and report that it is common to stay up late and drink different

beverages (coffee, Coca-Cola, energy drinks, among others), which they consider allow them to stay awake at night and take the opportunity to study. This behavior can be observed in Figure 6.



Fig. 6. Students resting between classes. Drawing made in the Photoshop program, from a photograph taken in one of the corridors of the university.

## DISCUSSION

### Student motivations and interests for learning HMA.

Students refer as motivations and interests for learning the HMA their family, their professional future, as well as exercising a good clinical practice in the future. The participant observation showed that the students' motivation at the beginning of the semester is high, but it decreases near the end. This goes in line with what was reported by Whitehead & Britson (2022), who found that as students receive negative comments about their performance in the course, their confidence levels decrease. Therefore, it is very important that professors convey to their students the importance of maintaining good motivation to succeed in the course.

Afzal *et al.* (2010), consider that student motivation is the key element that guides their attitude regarding the learning process, consequently, students who are more motivated have a better performance. These authors state that the professor is very important to help students develop a positive attitude towards their learning process.

Pereira *et al.* (2021), report that the integration of activities related to scientific research in Medicine programs can improve scientific thinking, critical evaluation and problem solving, key skills for a future doctor. This can help improve the student's motivation and interest since it promotes learning, leadership, creativity, time management and communication skills.

**Previous ideas needed to learn HMA.** Concerning the previous knowledge of students, results showed that to learn HMA is important that students know about linguistic sequences such as the affixes, since descriptions of anatomical structures in the oral and written language use prefixes and suffixes. It is also important that students understand and identify basic geometric terms because the shapes of anatomical structures are often related and described by comparing them to geometric figures. Lastly, another fundamental prior knowledge is the student's ability to identify laterality in their own body and that of others, as well as spatial visualization.

When tracking the previous skills that students must have by the end of high-school, it was possible to identify that students, before going through a higher educational level, must have skills related to the know and know-how in areas such as language, mathematics and natural sciences according to the basic standards by competencies of Colombia. With language skills, students are expected to produce argumentative texts, understand and interpret texts with a critical attitude, and analyze and criticize different literary manifestations by the end of high-school. Therefore, each year they work on skills that allow them to understand, compare, relate and produce texts.

About the mathematical standards, emphasis is put in the development of competences related to spatial and geometric thinking, that allow the student to represent their surrounding space to establish relationships. Also, to



recognize similarities between figures and apply translations and rotations to them. To develop skills to relate direction, distance, and position in space, to use geometric representations to solve and formulate problems, identify location characteristics of geometric objects, and describe and model real world phenomena using geometric relations and functions.

Despite the fact that professors expect students to have some prior knowledge that allows them to understand the anatomical descriptions of the texts, as well some basic skills that should be obtained prior to higher education, students upon completion of high-school do not necessarily have enough skills that allow them to fully understand the information presented in the texts they face in the new level of higher education. Especially to the extent that most of those texts are expository and present information without further explanation or in conjunction with additional activities that allow the student's knowledge construction to be favored.

**Study methods used for learning HMA.** Results of this research show that students use different methods for learning, especially reading textbooks, attending classes, watching videos on platforms such as YouTube with explanations on the subject they require, practicing in the amphitheater, and the use of digital applications. In addition, during the participant observation it was possible to see that students prefer to have different types of representations to understand the shape, location, relationship and function of the different structures. The latter agrees with Fu *et al.* (2022), who report that to learn, students need anatomical models that can be visible and tangible, as well as promote student-centered teaching proposals. This makes sense insofar as learning anatomy in a corpse involves visualizing structures in a three-dimensional space, visualizing structures in different planes, needing to create mental images and imagine abstract functions (Na *et al.*, 2022). So that in the future they can mentally represent the physical structures, and have the ability to rotate the images in the three spatial planes, and imagine movements and functions during their clinical activities (Pujol *et al.*, 2016; Chaker *et al.*, 2021).

According to research such as that of Kalthur *et al.* (2022), some of the methods mentioned, such as videos, simulation or virtual reality, are essential to complement activities like dissections in order to learn human anatomy. However, among some of the contemporary challenges, there have been reports of a shortage of corpses, insufficient funds for the maintenance of anatomy laboratories, as well as obsolete facilities and equipment, which make dissection difficult. Therefore, it is recommended to favor the voluntary donation of corpses, project laboratories that include

plastination, to include anatomical techniques that allow anatomical specimens to be available, and increase funding for the human anatomy laboratory (Chia & Oyeniran, 2019).

The anatomy laboratory is seen as a rite of passage for medical students. Learning to dissect and becoming familiar with bone structures, muscles, organs, nerves and their relationship to each other can be difficult and time consuming. That is why students diversify their study methods to understand the structures. When leaving the classroom, they rely on drawing and writing to build texts represented in images or in the written code that allows them to summarize, highlight or remember information of interest.

**Emotions reported by students regarding the T-L-Ev process.** Students report high levels of stress, depression and anxiety, especially during midterms and at the end of the semester, which is attributed by most of them to the high academic load. This is similar to what was described by Pascoe *et al.* (2020), who, in their study on the impact of stress on high-school and college students, found that students report constant levels of stress related to their education; this stress is defined as academic stress, and is attributed to the pressure to get good grades and concern with failing the courses. Students report anxiety about school tests, even when they are well prepared. Therefore, Pascoe *et al.* (2020), concluded that the constant stress related to education has been shown to have a negative impact on the students' learning ability, their academic performance, the quality and quantity of sleep, and their physical health and mental health, thus they recommend promoting stress management skills in students.

Other studies involving medical students have reported a high prevalence of moderate and severe stress, especially during the first three years, which has been found to have a negative effect on their learning (Alhussain *et al.*, 2023). Among the causes found, there is the authoritarian, rigid and exhausting educational system that encourages competition instead of cooperation among students (Abdulghani *et al.*, 2011). Also, it is thought that suicide in medical students is caused by many factors, including excessive academic stress (Mamun *et al.*, 2020). In this sense, medical students present symptoms of emotional exhaustion, associated with a 2- to 3-fold increase in suicidal thoughts, feelings of dropping out of school, and use of harmful substances (Greenmyer *et al.*, 2022).

These harmful thoughts can be perpetuated by students who undergo unhealthy levels of comparison, particularly in the early semesters when they are adjusting to a demanding and fast-paced environment (Hu *et al.*, 2019). According to Whitehead & Britson (2022), the anatomy

course contributes to this problem by being considered by students as difficult and discouraging, which is reflected in a high repetition and withdrawal rate. This could be due to the unmanageable and specific amount of information they need to learn and understand, as well as the pressure to succeed to obtain their career goals. Similarly, Brown & Leigh (2018), report low student morale and an increasing number of mental health problems, burnout, and stress-related illnesses within academia, attributed in part to a normalized overload in the university academic environment.

Zeng *et al.* (2019), in their meta-analysis on the prevalence of health problems in medical students, report depression and anxiety as the most frequent disorders, the first being the most frequent and can lead to negative consequences in students such as high rates of use of harmful substances. Researchers link the high rate of depression in medical students to academic pressure, since the content of the courses is rarely related to what students have previously learned, making their learning more difficult. The second most frequent mental health problem in medical students was anxiety. This emotion is associated with the long-term and heavy academic load, complex personal relationships and uncertainty regarding the future. This condition can influence academic performance and impaired cognitive function; therefore, the authors recommend paying attention to the signs and symptoms of these disorders and intervening promptly.

## CONCLUSIONS

The motivations and interests of students to learn HMA include becoming a good professional in order to help financially and make their family proud, as well as to be able to carry out a good clinical practice. It is important that both the institution and the professors consider the needs of the students, which include support and guidance in the study methodology, and having a support network that help prevent emotional and health crisis, and offers care when needed. Understanding the complexity of the learning process can favor the planning and development of teaching and evaluation, since that is its goal.

On the other hand, among the previous ideas needed to learn HMA are included basic geometric concepts and grammatical elements. The HMA course is a pillar for the Medicine and Surgery academic program, since it allows students to recognize, locate, name, identify, differentiate and relate all the structures of the human body. This knowledge is fundamental for their clinical practice. For students who take the class for the first time, the start can be complex since there usually is variability in the content of textbooks. The learning difficulties that students face

correspond to a poor conceptualization of the previous ideas with which they arrive. Therefore, it is important that professors in the HMA area reconsider the objectives, strategies and methodologies of their T-L-Ev proposals in such a way that correspond to the cultural differences of the students.

Specifically, for a thorough understanding of the content, students must first comprehend the anatomical position, the planimetry and the terms of relation and comparison. These topics, despite being the most important, are covered in a superficial and general way. HMA borrows terms from other areas of knowledge and involves the use of grammatical elements such as prefixes and suffixes; therefore, for its learning it is essential to have some prior knowledge to understand this new language.

The study methods most commonly used by students include textbooks, professor's explanations on virtual platforms, classes, study on corpses, virtual applications, and self-assessment. Emotions reported by students during the T-L-Ev process include depression, anxiety and stress, so it is essential to have an interdisciplinary network that provides specialized support to students during the university transition period. Additionally, for students to learn it is fundamental they are in good health (physical and mental), and that they have family and institutional support.

Regarding the evaluation process, both students and professors must reflect on the reason for assessment, understanding that its goal is to identify any adjustments needed to facilitate the learning and teaching processes, not only to put a score. Evaluation allows obtaining metrics on the advancement and difficulties of student learning, and at the same time, students gain awareness of the process. We propose to treat the evaluation process designed for learning, by including a preliminary assessment at the start of the course that allows adapting the activities to the needs of students. We also propose the implementation of a formative evaluation, applied throughout the course so that the teaching proposal is adapted to the observed learning problems, responding to the challenges of the students.

The present investigation proposes that second semester students of the Medicine and Surgery academic program learn about the main ideas of the HMA through a process that implies a commitment to their academic training. Starting with their interests, motivations, previous knowledge and constant study they manage to understand the main ideas of HMA, comprehend the lectures and texts addressed in the course. The use of different study methods and support from professors is fundamental. Professors should favor the learning process and allow the immersion of students in the

academic world and the university culture through the design of proposals that integrate the T-L- Ev and take into account the sociodemographic characteristics and social and cultural realities of their students.

**Limitations.** This study has limitations since it does not delve into the complex relationships that influence E-A-Ev processes at the family, social and political level.

**Ethics approval statement.** This study was approved by the Health Research Ethics Committee of the Universidad del Valle under act number 057-021 in July 2022

**ZÚÑIGA, J. R.; OSORIO-TORO, S. & PÉREZ, L. E.** Cómo aprenden los estudiantes de medicina y cirugía sobre la anatomía macroscópica humana. *Int. J. Morphol.*, 42(5):1382-1393, 2024.

**RESUMEN:** El propósito de esta investigación fue comprender cómo los estudiantes de segundo semestre del programa académico de Medicina y Cirugía de la Universidad del Valle aprenden sobre las ideas principales de la Anatomía Macroscópica Humana (AMH). Como propuesta metodológica se realizó un estudio de caso. Se evaluó el conocimiento y comprensión de los estudiantes sobre la AMH. Para ello se tomó en cuenta el modelo de Conocimiento Pedagógico del Contenido (CPC), que incluye las motivaciones e intereses por el aprendizaje, así como las ideas previas de los estudiantes. Se realizó una observación participante de las clases teóricas y prácticas durante 16 semanas, registrando las observaciones en un diario de campo y obteniendo material audiovisual. Toda la información se organizó en un índice analítico, creando códigos para el análisis. El análisis, interpretación y representación de los resultados se realizó mediante el software ATLAS.ti 22. Se encontró que los estudiantes aprenden las ideas principales de la AME a través de un proceso que implica compromiso con su formación académica, en donde se involucran intereses, motivaciones, conocimientos previos y participación. Es importante que durante este proceso se utilicen diferentes métodos de estudio, y que se cuente con el apoyo del docente y de la institución, quienes deben favorecer el aprendizaje y la inmersión de los estudiantes en el mundo académico y la cultura universitaria, mediante el diseño de propuestas que integren la enseñanza, el aprendizaje y la evaluación, y que además tengan en cuenta las realidades sociales y culturales de sus estudiantes.

**PALABRAS CLAVE:** Aprendizaje; Anatomía humana; Medicina; Educación.

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