

## The most effective strategies in teaching theoretical Anatomy in Medical schools, from a student's view

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### Abstract

**Introduction:** The anatomical study cannot be limited to memorization and identification of structures. It is essential that, in a modern and dynamic approach to this discipline, contextualization is adopted, and above all, the clinical applications of what is studied, in addition to other methods such as 3D images. It is necessary to understand the student's conception of such methods – the didactic and scientific evidence at the moment – so that they can make the connection – in the present and the future – with professional life.

**Methodology:** The research, carried out with 163 medical students from two educational institutions in Juiz de Fora, aimed to find out which methodologies were used in their anatomy course; Which one(s) among them is(are) seen as the most effective, and most facilitator(s) of the learning process and approach to clinical practice. The data obtained were processed using the SPSS program, version 20.0.

**Results:** It was evident that the approach to anatomical content based on clinical direction, contextualization of the subject, and use of radiological images is more widespread in Medicine. The application of seminars and clinical debates was scarcely explored. The use of alternative technologies to slides was notable in the Medicine course. Medical students, markedly, advocate for contextualizations and clinical applications.

**Conclusions:** Students, in general, recognize the effectiveness of contextualization, clinical correlations, and the use of images. Few students support the use of seminars. As much as the interviewees do not prefer more summarized theoretical classes, they would like fewer structures to lean about, with more direct books.

**Keywords:** Teaching methodologies; Anatomy; Contextualizations; Clinical application

### 1. Introduction

The challenging complexity of human anatomy and its fundamental importance to the subareas of the major area of health make this science the greatest highlight among the oldest medical sciences [1-6].

The study of Anatomy, even though it is closely linked to the memorization of names of structures, should always be related to an early – and necessary – contact with professional reality, enabling a view on the application of theoretical-practical knowledge in one's life after graduation [7,6]. Collipal [8] points out that the study of the structure and functions of the human body arouses a unique curiosity and draws our attention to the use of renewed, challenging, and effective teaching and learning methods, making it essential to have a close bond between teachers and students, between content and method, as also defended by Montes [9].

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According to Jones [10], anatomical practice cannot be limited to the dissection of cadaveric specimens or the memorization and identification of structures. It is essential that, in a modern and dynamic approach to this discipline, the contextualization and, above all, the clinical applications of what is studied be adopted [11]. Reis [12] reported that for most of the students interviewed in his research, the understanding of Anatomy is essential for the acquisition of clinical knowledge, even if the students have not yet had contact with the clinic.

The contextualizations of the subject discussed in the classroom are also modern strategies to hold the student's attention and direct him in professional and extracurricular life, linking the student's world – in the present and the future – to what is in scientific evidence at the moment. Understanding this connection between anatomy as a science and the professional future and making it concrete, and feasible is a challenge for teachers. New dynamic methodologies and technologies have been employed [6]. Penha [4] describes these new tools as e-learning, audio, videos, games, and three-dimensional reality and how their use has been used to complement the teaching of Anatomy.

According to Collipal [8], new educational trends in Anatomy have been gaining strength, motivated by several factors such as the difficulty of obtaining cadaveric specimens, the excellent quality of synthetic anatomical specimens on the market, and the high costs of preparing and maintaining an anatomy laboratory in which cadavers are used.

Corrêa [13] advocates the incorporation of ultrasonography and imaging exams into anatomy classes for a greater early clinical experience, as well as 3D imaging (computational anatomy). Anatomy-specific videos and software are other important tools available to support the teaching of the human body in colleges and universities [3,4]. Artificial anatomical specimens are also an irreversible and practical reality and are being widely used more and more in higher education institutions with courses in the Health Area [2].

Penha [4], however, raises poignant doubts about the efficacy of these teaching methods, just as Inzunza [14] questions how students see their learning when they have contact with these new technologies and teaching tools, and also questions the impact of these strategies on the teaching and learning process in a medical school.

Possessing the knowledge of modern didactic techniques, or knowing their efficiency and effectiveness, the Anatomy teacher develops one of the most important facets of the teaching-learning process: the motivation of his students for a contextualized study, bringing the student reality to the classroom, and can still always apply to future clinical practice. The content covered [11]. But what would be the student's perspective in the face of these novelties? It is the great object and scope of didactics and teaching. How does he see his learning in the face of these strategies? What is the best methodology or the most effective and efficient tools in anatomical teaching? This is from the perspective of the student involved in the teaching-learning process in Anatomy.

That said the objective of this article emerged: to evaluate the perception of Medicine students, in their journey in anatomy laboratories, regarding the methods of study of this science, and its importance and effectiveness in the development of their trajectory as health professionals. Nothing is more legitimate than research to provide us with these answers. We then aim to understand the student's conception of such methods (the greatest didactic and scientific evidence at the moment), if they are essential, and make the connection – in the present and the future – with professional life.

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## 2. Methodology

The research comprised a descriptive and cross-sectional study, in which data from a structured questionnaire (Survey-type) capable of demonstrating the evaluation of students of the disciplines of Anatomy of the Federal University of Juiz de Fora and a private college also in Juiz de Fora, about to the teaching of this science, were evaluated. The application was through *Google Forms* maintaining all the confidentiality of the answers. The present research work does not contain studies performed on animal/human subjects by any of the authors. An informed consent was obtained for all individual participants included in the study.

The inclusion criterion was Medicine students from UFJF and Faculty Suprema, who had taken the discipline of Anatomy in the last 3 years (marking the post-pandemic and the return of face-to-face activities in teaching). The instrument used in the research, applied in simple interviews, was structured with closed questions, previously tested with 12 multiple-choice questions based on the "Liker Scale" with five answer options each: Completely agree; I partially agree; neutrality (neither agree nor disagree); I partially disagree and strongly disagree. To determine the questions that were included in the questionnaire, we referred to the most modern and suggestive articles on the subjects "Teaching Anatomy" and "New Strategies and Methodologies in Anatomical Teaching". The parameters studied will be based on a systematized script, considering the demographic variables: gender; age; marital status, and his/her current academic period, in

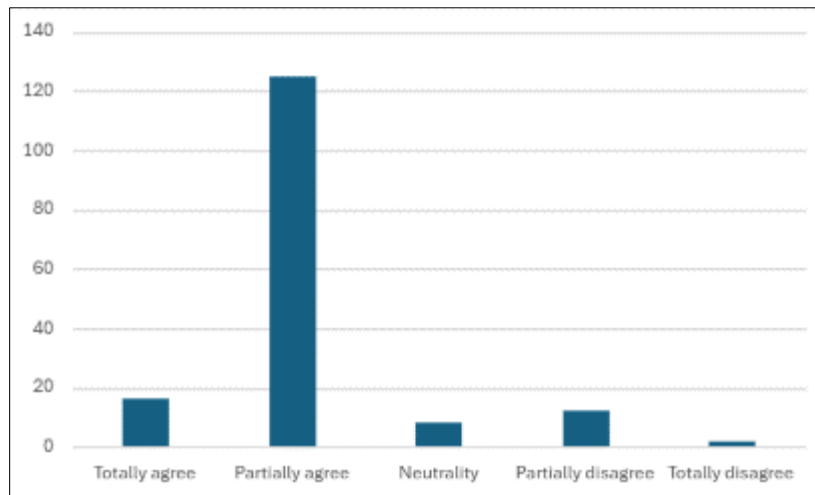
addition to the temporal relationship with the practical teaching of anatomy. He wondered; A) whether, among the didactic materials, the most modern so-called materials were used by the students in their anatomical study, such as contextualizations, clinical applications, 3D material, and image resources - radiographs and tomography, for example; B) Which of these methods facilitate the teaching-learning process in anatomy; C) Which of the methods/strategies and technologies can be considered essential to generate greater confidence of these students about the use and application of their anatomical knowledge in a future professional practice; D) what type of teaching material and class strategy are best evaluated by these students.

The number of students who answered the questionnaire was 163. The data obtained were tabulated in an Excel spreadsheet, version 21.0, and processed using the SPSS program, version 20.0 (Chicago, IL, USA). The statistical tests applied were: the chi-square test and the Student's t-test. Statistical significance was set at  $P < 0.05$ . The statistical correlation between some answers was verified: 1) Option for more targeted theoretical classes X Importance of clinical applications in the study of Anatomy; 2) more targeted theoretical classes X Importance of contextualizations in the study of Anatomy; 3) more targeted theoretical classes vs. use of direct and concise scripts; 4) Use of more targeted books X Importance of clinical applications in the study of Anatomy; 5) Use of more targeted books X Importance of contextualizations in the study of Anatomy, 6) use of a direct script X more directed theoretical classes and finally 7) more directed theoretical classes X use of more directed books.

### 3. Results

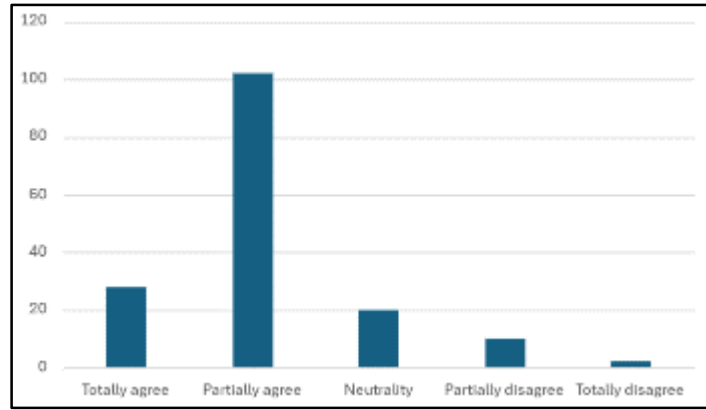
We obtained responses from 162 students, the data was tabulated and arranged as follows.

Importantly, the students of the Medicine course study Anatomy for 4 periods (academic semesters). When analyzing the data, it is clear that (Figure 1) when it comes to addressing the content with clinical direction, the students of the Medicine course strongly informed this type of discussion, with 125 answers "Totally agree", making up 77% of the total number of students.

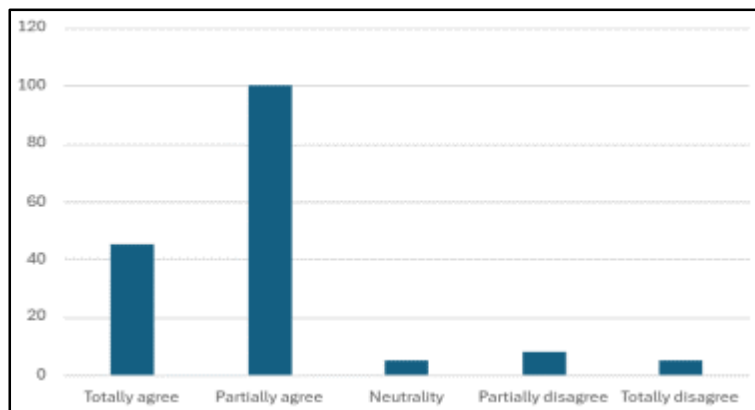


**Figure 1** The numbers referring to the answers to the question: "If the content approached with clinical guidance during the Anatomy classes". The "Y" axis shows the number of students, while the "x" shows the different degrees of agreement with the question.

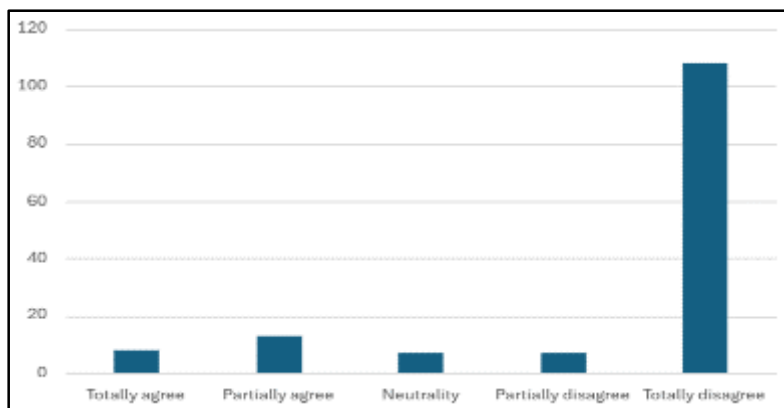
Figure 2 shows the number of opinions regarding the presence of contextualizations in Anatomy classes. Among medical students, the option "partially agree" had 102 options (62%), on the other hand, the option "totally agree" received 28 mentions, equivalent to 17% of the respondents.



**Figure 2** The numbers referring to the answers to the question: "If the content approached with contextualizations during Anatomy classes". The "Y" axis shows the number of students, while the "x" shows the different degrees of agreement with the question.



**Figure 3** The numbers referring to the answers to the question: "If the content approached with the aid of imaging exams – 3D, CT scans, etc." The "Y" axis shows the number of students, while the "x" shows the different degrees of agreement with the question.

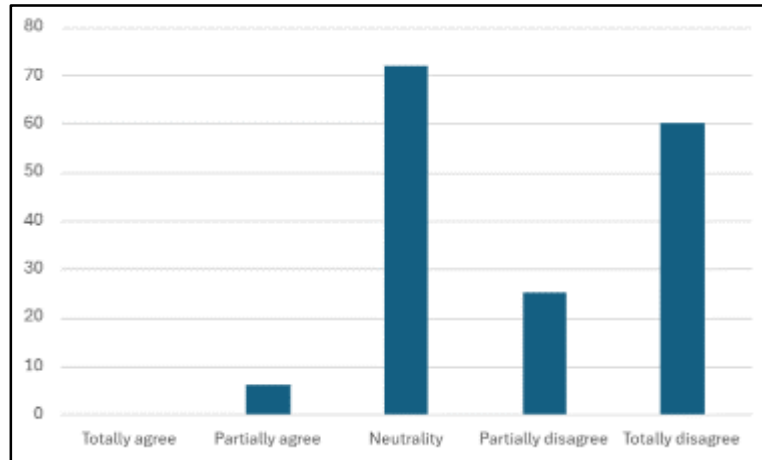


**Figure 4** The numbers referring to the answers to the question: "If the content addressed with the help of seminars and clinical debates by the students". The "Y" axis shows the number of students, while the "x" shows the different degrees of agreement with the question.

When we put Figure 4 in the light of our analysis, becomes clear the fact that in Medicine course seminars and clinical debates present a high volume of "totally disagree" options, totaling 108 students (75%).

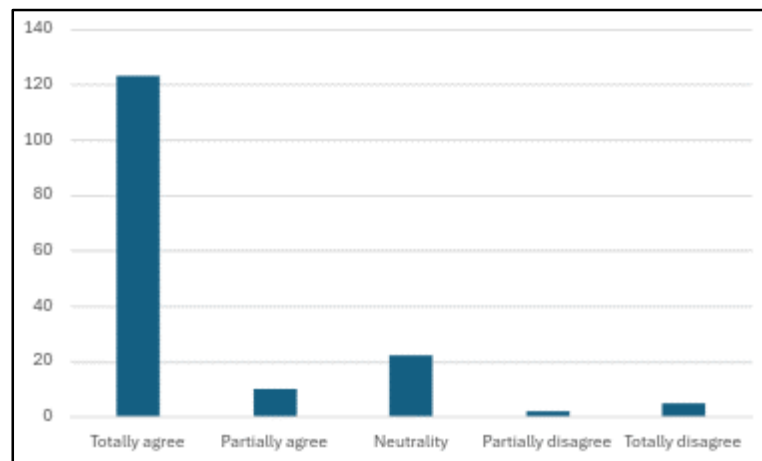
Figure 3, which shows the analysis of the answers regarding the use of imaging exams, makes evident the adherence to this methodology in the Medicine course, in which takes place an almost unanimous response to the options "partially agree" and "strongly agree" (90% of the group).

In the analysis of the answers related to the question of whether there was an approach to the content of Anatomy using technologies such as 3D and computational resources or alternative slides, it is clear the great neutrality of Medicine students.



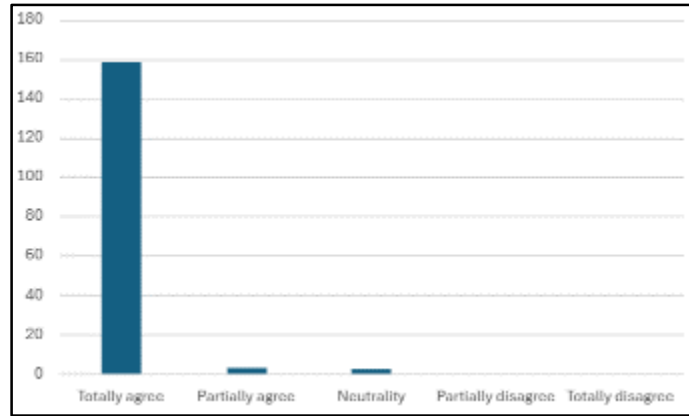
**Figure 5** The numbers referring to the answers to the question: "If the content approached with the aid of some technology other than slides, such as 3D and computational resources". The "Y" axis shows the number of students, while the "x" shows the different degrees of agreement with the question.

When referring to the result referring to the answers to the question "Whether the contextualizations made in the classroom are sovereign for the consolidation of the subject" (Figure 6), it is noticeable the great preference among medical students for the item "I agree" (n=123, 75% of the course interviewees).



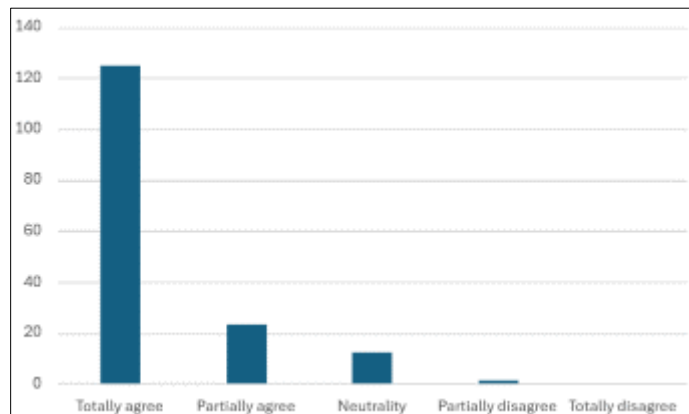
**Figure 6** The numbers referring to the answers to the question: "If the made contextualizations are of great value for consolidation of the subject of Anatomy". The "Y" axis shows the number of students, while the "x" shows the different degrees of agreement with the question.

Proceeding to the question about the importance of clinical applications in the development of a good understanding of the patient and his disease (Figure 7), in Medicine, students opted for the option "total agree" almost unanimously (158 responses, around 96%).

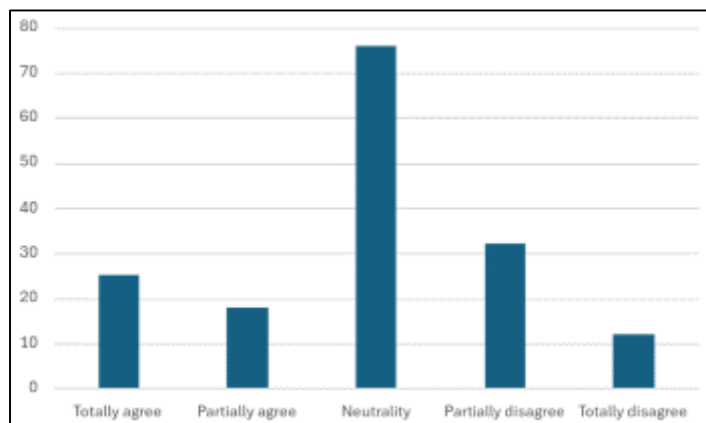


**Figure 7** The numbers referring to the answers to the question: "Whether clinical applications are essential for the development of a good understanding of the patient and his disease in professional life". The "Y" axis shows the number of students, while the "x" shows the different degrees of agreement with the question.

When analyzing Figure 8, regarding whether the use of real images is essential for the student's professional life in Medicine, a total agreement prevailed, being 78% of interviewees (125 students).



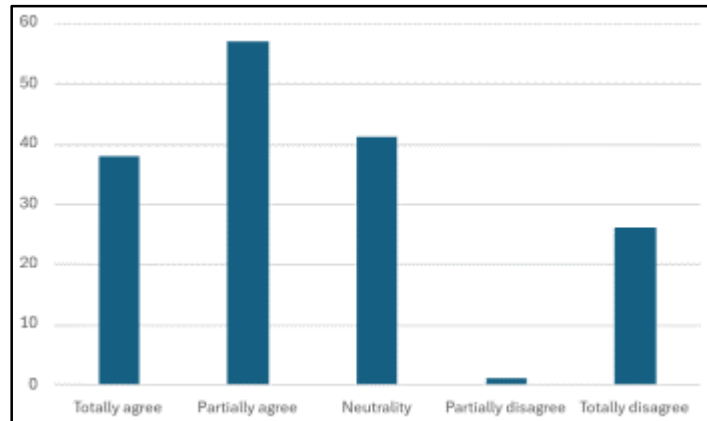
**Figure 8** The numbers referring to the answers to the question: "Whether the use of real images is essential for the student's professional life". The "Y" axis shows the number of students, while the "x" shows the different degrees of agreement with the question.



**Figure 9** The numbers referring to the answers to the question: "Whether clinical seminars are fundamental tools for teaching/learning anatomy". The "Y" axis shows the number of students, while the "x" shows the different degrees of agreement with the question.

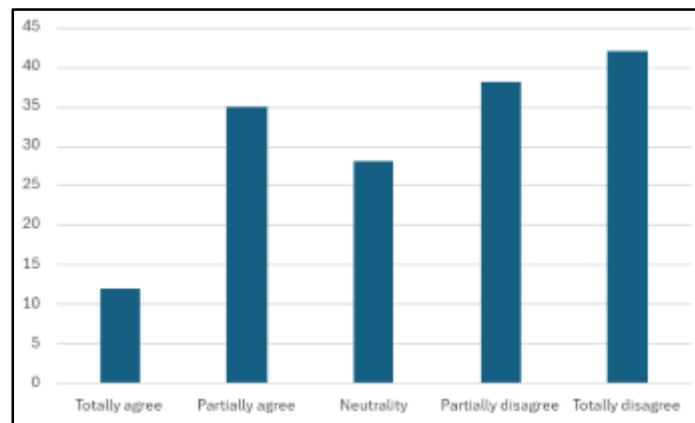
Regarding the use of seminars for clinical development, neutrality was observed, corresponding to n=76 (47%) of the answers.

When we analyze the utilization of a concise textbook, in the student opinion despite the prevalence of agreement (38 students) to the detriment of disagreement (n=27), there is a trend towards neutrality, with 35% partial agreement and 25% neutrality.



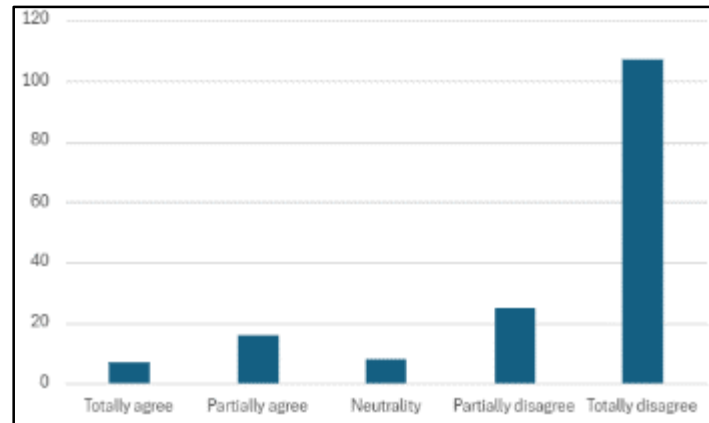
**Figure 10** The numbers referring to the answers to the question: "Whether concise textbooks with fewer anatomical terms, but more contextualized, are sufficient for a good understanding, memorization, and clinical application of anatomy". The "Y" axis shows the number of students, while the "x" shows the different degrees of agreement with the question.

In a very similar way, in answering the question in which the possibility of a concise and directed script was evaluated to perfectly meet the good study of anatomy, showed that the prevalence of disagreement was 27% (n=42) in total disagreement and 25% (n=35) in partial disagreement.



**Figure 11** The numbers referring to the answers to the question: "Whether a well-directed practical script is sufficient for good anatomy learning". The "Y" axis shows the number of students, while the "x" shows the different degrees of agreement with the question.

Students stand out with the majority of disagreements, represented by 81% of the opinions (with 66% of total disagreement), evidencing the need for clinical correlations about the content addressed.



**Figure 12** The numbers referring to the answers to the question: "It would be possible to have good anatomical learning and a good application of the content in professional life just by attending the theoretical classes on pure anatomy, without clinical applications". The "Y" axis shows the number of students, while the "x" shows the different degrees of agreement with the question.

After all, statistical associations were made, and we can infer the relation between the desire for utilization of books more concise with classes more associative with clinical applications (Table 1).

**Table 1** Statistical associations

Variable 1	Variable 2	P- (parameter $\geq$ 0,05)	Association
More targeted theoretical classes	Importance of clinical applications in Anatomy study	P=2,08	No association
More targeted theoretical classes	Importance of clinical contextualizations in Anatomy study	P= 3,28	No association
More targeted theoretical classes	More concise scripts	P= 0,085	Little association
Use of more target books	Importance of clinical applications in Anatomy study	P= 1,05	No association
Use of more target books	Importance of clinical contextualizations in Anatomy study	P=2,07	No association
More targeted theoretical classes	Use of more target books	P=0,023	Statistical association

#### 4. Discussion

Study methods in Anatomy will always be debated on a large scale. And it is interesting when we cite most of the authors [1, 3, 10, 14, 15, 16, 17, 18, 19]. Kerby [1], for example, interviewing 580 students in the United Kingdom, found that the most effective method of study in Anatomy would be dissections. However, our present research aimed not to highlight this "commonplace" but rather to address the new nuances and didactic tactics used today in this discipline.

The present study was carried out with medical students of the Federal University of Juiz de Fora and of a private college also in Juiz de Fora, Faculty of Medical and Health Sciences of Juiz de Fora (Suprema), with 163 participants.

The importance of the use of radiographic images is widely supported by the literature today. Camilo [20] stated that medical images are crucial for clinical diagnosis, planning, and monitoring of the patient's health, supported by Rathen [21], who points out how the use of images, even amateur production, significantly improves students' understanding of the anatomical content addressed; Rocha [22] indicated that the use of radiological images increased students' interest in the study of anatomy, in addition to improving students' ability to identify structures and increase long-term knowledge retention, including facilitating the use of anatomy in professional practice. Our research is congruent with



these ideas and brought numbers that make the opinion of the absolute majority of the students interviewed coincide with this statement. However, it is necessary to consider the access not only of students, but also of teachers and institutions to the material, which is expensive, as reported by Chang [23], and we could see in our report that most of the students didn't have access to 3D material.

In the interview, we did not distinguish the type of image used in the classes, we only inquired about its use and its importance in Anatomy and the clinic, but Iwanaga [24] concluded, after analyzing several studies that compare the efficiency of using 2D images (and other methods) with 3D models, that students who learned with 3D were more likely to achieve higher scores in knowledge assessments. This was corroborated by Venancio [3]. Nevertheless, our study showed that 3D and other technologies alternative to slides are not very present in anatomic classes in the medical course, differently from the radiographical images, but the students recognize their importance in clinical practice.

The present research showed that the use of real images in classes is very important for medicine students, which is really in line with the professional reality of these students, marked by frequent contact with images of CT scans, MRIs, and X-rays.

In this study, it was demonstrated that when questioning about clinical guidance in the teaching of anatomy, medical students agreed that this type of approach occurred during their anatomical learning, and, in general, this teaching methodology seemed to them to be very important in clinical practice, as well as contextualizations; this is notably important in a scenario in which the value of clinical guidance for the teaching of anatomy is known and reinforced by several authors, such as Vieira [25], who points out that the study of anatomy contextualized with surgical techniques, clinical cases, and radiological images - which can be seen as an anticipation of what students will encounter in their professional lives[26] - is capable of improving the performance of students in the recognition of structures and acquisition of concepts. On the other hand, strangely too many students prefer concise anatomic textbooks, even if they had made options for theoretical classes with clinical applications.

In our analysis, the students of Medicine showed generalized concordance in considering the use of clinical applications and contextualizations in the teaching of anatomy to be important, corroborated by Montes [9], who mentions the engagement of these students in this practice. This is in line with what Maciel [18] writes, defending the everyday and clinical applications in Anatomy didactics, regardless of the course to which the discipline is taught.

Our results showed that among the students of Medicine, it is evident that the seminars and debates are little explored by the professors, and demand little value in the practice of Anatomy in the clinic, according to the students of the course, since here we had high levels of the option "I disagree". Montes [9] brings a suggestion from an extremely pertinent student about the point addressed at this moment, which shows us the level of approval, on the part of the students, of the use of seminars and clinical cases in anatomical teaching: "Holding seminars, I think, is an excellent idea, which will demand more from us students, so that we can integrate more into the content and delve even deeper. The use of clinical cases associated with this procedure helps to make the discipline more dynamic and more centralized in the clinical practice that we will perform for the rest of our lives."

A curiosity was aroused when we analyzed the data regarding the study methods themselves. Most students had no rejections of concise and summarized books, and this almost unanimous behavior among medical students is corroborated by Liew [27], who has researched and described patterns in the methods of study in Anatomy and has written that these tend to be practically identical.

When we associate this option for a more summarized teaching material with the importance of clinical applications, generally absent in this type of book, we see no statistical association, that could be, that the greater the interest in clinical applications in Anatomy, the smaller the need to refer to denser teaching material.

Reinforcing the statement above, the statistical correspondence came when we connected theoretical classes without clinical guidance with concise teaching material ( $p=0.023$ ), showing that the more the student values a more in-depth discussion, the more he strives for more specialized content, and vice versa. The large number of names to memorize in Anatomy is notorious. Salbergo [26] even reports in their research that students' biggest complaint about this science is precisely the number of structures to memorize. Perhaps this anguish is reflected in the numbers we present here and in other works [27]. The student needs strong motivation to study Anatomy efficiently, based on what Sturges [28] said. This motivation largely involves the use of methods such as clinical application with the association of the topic under discussion with the student's future professional life. And once again we draw attention to the significant number of students who do not consider this strategy to be important, although the immense and overwhelming majority of our interviewees tended to attribute great value to it.

When associating the preference for “purely anatomic” theoretical classes with both the importance of contextualization and the clinical direction of the classes, we saw that there was no statistical significance, that is, even recognizing a certain value, importance, and effectiveness in these last strategies mentioned above, the student tended, in a way, preferring more expository and direct classes, with summarized written material (script), even if they recognize the importance of the contextualizations and clinical applications.

Campos [29] suggests active methodologies, those in which in Anatomy, the theory of clinical application comes before the theory itself, therefore, the suggested motivation should be cultivated by the professors of the discipline in this sense [22,26,30]. Finally, in addition to this motivation, and the absence of access to state-of-the-art technologies, the exploration of radiographic and tomographic images is recommended, in addition, of course, the use of contextualizations and clinical guidance, always. In this way, the student's desires and didactic needs will be met.

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## 5. Conclusion

It can be inferred that:

- Students, in general, recognize the effectiveness of contextualization, clinical correlations, and the use of images, despite a large group not seeing as much importance in these methods in building more robust anatomical knowledge.
- Few students supported the use of seminars, which was not a method considered good by the majority of students who opted for greater approval of the use of radiological images in classes, and its importance for professional life.
- As much as the interviewees do not prefer more summarized theoretical classes, they recognize the importance of contextualization and clinical applications in Anatomy. They would like fewer structures to learn about, with more direct books.

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## Compliance with ethical standards

### *Disclosure of conflict of interest*

The authors declare that they have no conflict of interest.

### *Statement of informed consent*

The authors declare that informed consent was obtained from all individual participants included in the study.

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