

Dissection, Prosection, and Holistic Learning: Medical Students' Experiences and Emotions in the Use of Cadavers for the Study of Human Anatomy

Disección, Prosección y Aprendizaje Holístico: Experiencias y Emociones de Estudiantes de Medicina en el Uso de Cadáveres para el Estudio de la Anatomía Humana

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SUMMARY: Cadaveric dissection and prosection have been proposed as pedagogical tools that foster meaningful learning, clinical skills, and empathy in health science students. A mixed-methods, cross-sectional observational study was conducted with medical students in an anatomy course at Universidad de los Andes to assess perceptions of different teaching methods: dissection, prosection, demonstration of dissection, and their combination. A total of 96 valid responses were analyzed using descriptive statistics, correlation analysis, and thematic qualitative analysis. The combined dissection–prosection modality was the most frequently reported (54.2%), while dissection alone showed the highest descriptive mean scores in most evaluated dimensions. The dissection-only group showed the highest approval levels (100 %) in teacher respect and empathy development. The most frequently reported emotions were curiosity, respect, excitement, and awe, located in the high-activation positive quadrant of Russell's circumplex model of affect. No statistically significant differences were found between groups, although positive correlations emerged between enjoyment, anatomical identification, and perceived learning. These findings support the use of active methods such as dissection and prosection in anatomy education, and that these approaches not only enhance structural understanding but also promote respect for the human body and the development of affective competencies. Expanding student participation and strengthening faculty guidance during cadaver-based sessions are recommended to optimize the educational experience.

KEY WORDS: Anatomy; Education; Medical; Dissection; Cadaver.

INTRODUCTION

For centuries, cadaveric dissection has been regarded as the cornerstone of anatomical education. Although it continues to be a highly valued pedagogical strategy, its implementation requires substantial time, financial investment, and logistical infrastructure, prompting alternative approaches such as prosection, plastinated or three-dimensional models, body-painting techniques, and virtual or mixed-reality resources (Estai & Bunt, 2016; Al-Rubaie, 2025). Since the 1970s, studies have yielded heterogeneous findings: while some report superior academic outcomes with dissection, others highlight the efficiency and curricular flexibility with prosection (Alexander, 1970; Yeager, 1996; Dinsmore *et al.*, 1999).

In recent years, the debate on the supposed

“superiority” of one approach over the other has shifted toward broader considerations such as long-term knowledge retention (Koh *et al.*, 2023), emotional and affective responses elicited by cadaver exposure (Lai *et al.*, 2023) and their influence on professional identity formation (Abrams *et al.*, 2021; Walenna *et al.*, 2023). These dimensions matter because students' confidence, expectations, and prior experiences—including encounters with death—shape their engagement in the laboratory and can affect both cognitive outcomes and the meaning they attribute to cadaver-based learning.

The perceived value of dissection and prosection also depends on their timing within the curriculum and how they are aligned with complementary instructional strategies

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(Wilson *et al.*, 2018). This variability indicates that judging their effectiveness solely through objective performance measures, or relying exclusively on expert opinions (Arráez-Aybar *et al.*, 2023), offers an incomplete understanding of how students learn in cadaver-based environments.

Despite extensive international research on cadaver-based learning, empirical evidence from Latin America is scarce. Little is known about student learning perceptions, emotional and identity-related impact of cadaveric exposure, and their view of the quality of these practices. These gaps are notable given the cultural, logistical, and curricular specificities of the region.

Given the foundational role of anatomy in linking basic and clinical sciences and the expectation that anatomical knowledge endures beyond immediate examinations, robust evidence is needed to inform curricular decisions across diverse educational contexts. This study therefore compares cadaver-based teaching-learning strategies in undergraduate medical education at a Colombian medical school, examining associations with theoretical and practical examination performance and exploring students' learning perceptions and emotional responses to cadaveric experiences.

MATERIAL AND METHOD

Study design

A descriptive, observational, cross-sectional study was conducted among undergraduate medical students enrolled in the anatomy curriculum of a Colombian school of medicine between June and December 2024. The study examined students' perceptions of four instructional modalities commonly used in cadaver-based anatomical education: (1) dissection, (2) prosection, (3) faculty-led demonstrations of dissection, and (4) a combined dissection–prosection approach. A mixed-methods design with concurrent quantitative and qualitative components was employed, allowing exploration of students' perceived learning, emotional experience, and appraisal of the pedagogical quality of each modality. Data was collected using a structured, self-administered digital survey.

Participants

The final sample comprised 96 undergraduate medical students who voluntarily completed the survey. All participants were enrolled in required anatomy courses during the study period and had been exposed to at least one of the four instructional modalities as part of the institutional curriculum. No incentives were offered.

The study protocol was reviewed and approved by the Institutional Research Ethics Committee (Evaluation record 2024220203). All procedures adhered to institutional guidelines, Colombian regulatory frameworks, and the principles of the Declaration of Helsinki (1964) and its subsequent amendments. Informed consent was obtained electronically from all participants prior to survey completion. No personally identifiable information was collected, ensuring anonymity and confidentiality throughout the study.

Data collection instrument

A digital questionnaire was developed specifically for this study to assess students' perceptions of the different cadaver-based teaching modalities. The instrument consisted of closed-ended Likert-type items on a four-point scale (1 = totally disagree; 4 = totally agree) and open-ended questions exploring emotions, reflections, and evaluative comments related to each modality.

Items were organized into five analytical dimensions derived from relevant literature on anatomy learning and affective-cognitive engagement:

1. Perceived learning,
2. Enjoyment and teacher–student interaction,
3. Pedagogical quality of the activity,
4. Emotional impact of cadaveric exposure,
5. Perceived strengths and improvable aspects of the activity.

Content validity was established through expert review by two anatomists and two medical education scholars, who assessed clarity, relevance, alignment of items with the intended constructs, and gave feedback. A small pilot test with a group of students (not included in the final sample) was conducted to ensure comprehensibility and functionality of the digital format.

Procedure

The survey was distributed electronically through institutional e-mail accounts and remained open for two weeks. Participants could complete the survey at their convenience, and one reminder e-mail was sent midway through the data collection period. Responses were automatically stored in a secure institutional server and exported into Microsoft Excel for data cleaning and preprocessing. All responses were anonymous, and each participant could submit only one entry.

Data Analysis

Quantitative Analysis. Quantitative data from the Likert-scale items were analyzed using Jamovi version 2.5. Descriptive statistics (means, standard deviations, frequencies, and percentages) were computed to characterize students' perceptions across the modalities. Depending on the distribution of the variables, appropriate correlational tests (Pearson or Spearman) were applied to explore associations among the analytical dimensions. Stratified comparisons were conducted to evaluate differences in perceived learning, emotional impact, and pedagogical quality across modalities. When assumptions were met, parametric tests (ANOVA) were used; otherwise, non-parametric alternatives (Kruskal–Wallis) were applied.

Qualitative Analysis. Open-ended responses were analyzed using an inductive thematic analysis approach following Braun and Clarke's framework (Braun & Clarke, 2006). Two researchers independently coded the dataset using Atlas.ti, iteratively refining codes through constant comparison. Discrepancies were resolved through discussion until consensus was reached. Themes were developed to capture recurrent patterns related to perceptions of learning, emotions, and evaluative appraisals of each modality. To analyze the emotional dimension, all emotion-related responses were categorized according to Russell's valence–

arousal circumplex model of affect (Russell, 1980), enabling classification of emotions into positive/negative valence and high/low arousal states.

RESULTS

A total of 96 students participated in the study, of whom 37.5 % identified as men and 62.5 % as women. The most frequently reported instructional modality was the combined dissection–prosection approach (54.2 %), followed by prosection alone (20.8 %), faculty-led dissection demonstrations (18.8 %), and dissection alone (6.3 %). Weighted means were calculated for nine analytical variables across modalities (Fig. 1).

Comparative Analysis of Instructional Modalities

The heat map in Figure 1 illustrates the relative performance of the four instructional modalities across nine variables related to academic learning, attitudinal development, and emotional impact. Dissection achieved the highest mean scores in eight out of nine dimensions. The strongest domains were empathy development (4.00), respectful teacher–student interaction (3.83), and clarity of information provided (3.83). By contrast, the demonstration of dissection modality yielded the lowest ratings, particularly for cadaveric quality (2.78), ability to identify anatomical

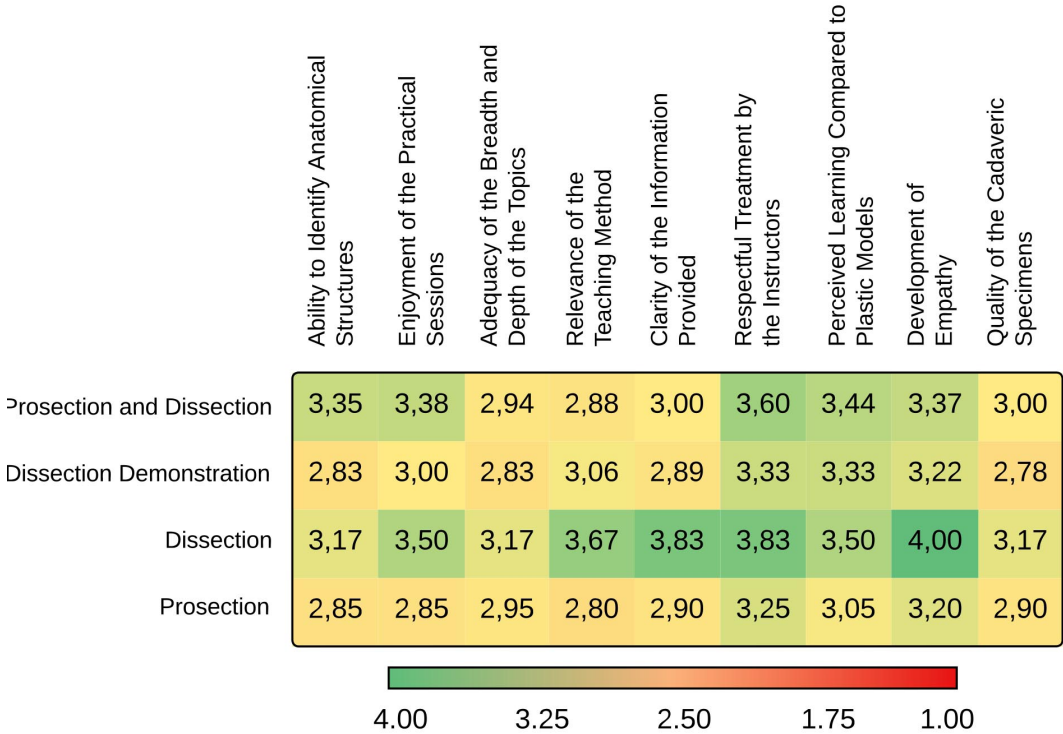


Fig. 1. Heat map showing weighted mean scores for nine variables across four instructional modalities (dissection, prosection, combined approach, and demonstration of dissection).

structures (2.83), and adequacy of topic breadth and depth (2.83). The combined dissection–prosection approach produced intermediate values: scores were relatively high for attitudinal dimensions yet comparatively lower for variables associated with didactic clarity and structural identification.

Correlation Analysis

A correlation matrix was constructed to explore associations among the quantitative variables (Fig. 2). A strong positive correlation emerged between students' perception of the appropriateness of the teaching method and the clarity of information provided by instructors ($r = 0.73$). Several moderate and weak positive correlations were also identified. No negative associations were observed, and all correlations reached statistical significance at $p < 0.01$.

However, when comparing groups by instructional modality using the Kruskal–Wallis test, no variables achieved statistical significance under the $p < 0.05$ criterion. This suggests that, although modalities displayed distinct descriptive trends, variability within groups limited the detection of statistically significant differences.

Emotional Study Results

Through thematic analysis, 29 distinct emotional terms were identified and plotted within the two-dimensional valence–arousal space (Fig. 3). The distribution revealed a predominance of high-valence, high-arousal emotions, including *curiosity*, *enthusiasm*, *fascination*, *happiness*, and *motivation*. These clustered in the upper-right quadrant of the circumplex model, indicating that cadaver-based activities generally elicited a positively activated emotional state.



Fig. 2. Correlation matrix among nine variables assessing students' perceptions of pedagogical and affective dimensions in anatomy learning. Stronger correlations are represented by darker shades of green.

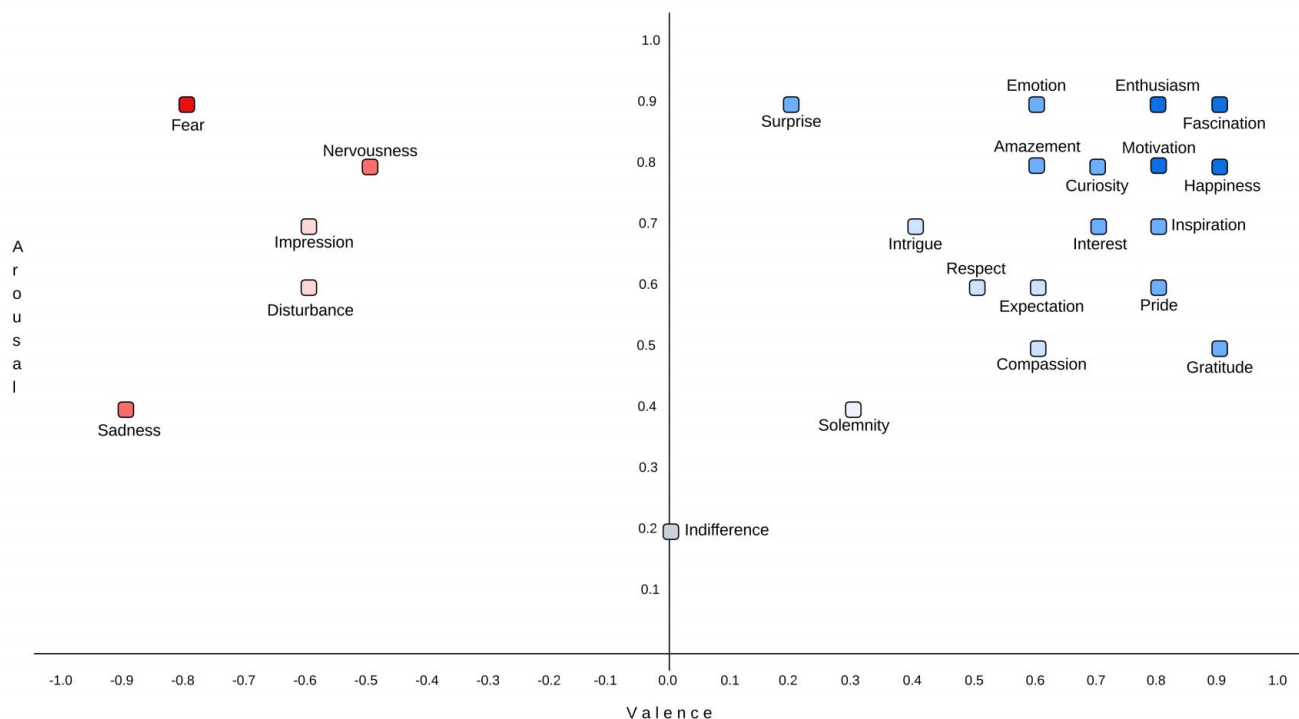


Fig. 3. Distribution of 29 emotional terms reported by students, represented within the two-dimensional valence–arousal model of affect proposed by Russell.

Negative, high-arousal emotions (*fear*, *nervousness*, *impression*, *disturbance*) appeared in the upper-left quadrant, reflecting initial tension and heightened alertness commonly associated with first-time exposure to human cadavers. Only one low-valence, low-arousal emotion (*sadness*) was identified, located in the lower-left quadrant. In contrast, *gratitude*, *compassion*, and *solemnity* were situated in the lower-right quadrant, representing positive, low-arousal emotions linked to reflection and respect for the human donor.

Emotion Frequency

Curiosity emerged as the most frequently mentioned emotion, followed by *emotion*, *respect*, and *impression*. Less frequent yet notable terms included *fear*, *nervousness*, and *disturbance* (Fig. 4). Overall, the most prevalent emotions corresponded to those mapped in the high-valence, high-arousal quadrant, reinforcing the predominance of positive, activating emotional responses among participants.

General Impressions of Cadaver-Based Activities

Students' overall impressions of the cadaver-based activities revealed both logistical challenges and positive learning experiences. The most frequently reported difficulty concerned the large number of participants, which often limited visibility and individual engagement during prosection sessions, emphasizing that the exercise would be



Fig. 4. Word cloud depicting the relative frequency of emotional terms reported by participants in response to their first contact with a cadaver. Word size is proportional to frequency.

improved with “small groups” and that only those directly in front of the instructor had adequate visibility of the cadaver.

In both dissection and prosection, students expressed the need for a larger teaching team to ensure closer supervision and individualized guidance, due to a lack of availability of the primary instructor or the difficulty of the instructors in handling the number of students in the course though they as students had access to study with the cadavers as needed.

Despite these limitations, students consistently highlighted the positive role of instructors as facilitators of the learning process and mediators of the emotional experience. Particular instructors were signaled out as great educators who “truly show interest in helping students” and students expressing that they learned a lot.

Additionally, students emphasized that both dissection and prosection were perceived as valuable pedagogical tools that enhance understanding and retention of anatomical knowledge, sometimes valuing one above the other as personal preference.

DISCUSSION

The findings of this study offer a multidimensional perspective on the pedagogical value of dissection and prosection in undergraduate anatomy education. While previous research has predominantly focused on students' academic performance, the present results underscore the importance of integrating cognitive, emotional, and perceptual dimensions when evaluating the effectiveness of cadaver-based learning experiences. This broader approach provides a more comprehensive understanding of how anatomical education contributes not only to knowledge acquisition but also to the development of empathy, emotional regulation, and professional identity formation.

Quantitative data indicated that dissection was consistently rated as the most effective instructional modality across multiple dimensions, particularly in relation to respectful teacher–student interactions, clarity of information, and the development of empathy. These findings are consistent with previous studies reporting that active engagement with cadaveric material fosters deeper learning, critical thinking, and the establishment of meaningful emotional connections (McLachlan *et al.*, 2004; Estai & Bunt, 2016). In contrast, demonstration-based approaches yielded the lowest ratings—especially regarding specimen quality and the ability to identify anatomical structures—suggesting that passive observation may constrain learning depth and reduce opportunities for experiential understanding.

The correlation analysis further supports the interdependence between pedagogical and affective factors. A strong positive correlation was identified between students' perceptions of the appropriateness of the teaching method and the clarity of information provided, indicating that learners consider didactic coherence a key component of effective learning. Moderate positive correlations were also observed between the ability to identify anatomical structures and both enjoyment of the activity and the

perception that cadaveric work enhances learning. These associations suggest that positive emotional engagement and perceived relevance are closely linked to cognitive and motivational outcomes, reinforcing the view that affective factors play a central role in the learning process (Immordino-Yang & Damasio, 2007).

Although no statistically significant differences were detected between groups in the Kruskal–Wallis analysis, this outcome may reflect the limited sample size in certain instructional modalities. Nevertheless, the presence of consistent trends—such as higher scores for dissection and combined approaches—suggests that future studies with larger and more balanced samples could yield more robust and generalizable comparisons.

The emotional analysis revealed a predominance of high-valence, high-arousal emotions such as *curiosity*, *respect*, and *enthusiasm*—affective states associated with motivational conditions conducive to learning (Russell & Barrett, 1999; Silvia, 2008). This pattern reflects an affective climate characterized by a high hedonic tone and elevated activation, which the literature links to approach-oriented and exploratory motivational states (Russell, 1980; Feldman, 1995). Similar patterns have been described in anatomical education contexts, where emotional engagement with cadaveric material enhances empathy, ethical awareness, and learning motivation (Korf *et al.*, 2008; Arráez-Aybar *et al.*, 2023). Although *fear*, *nervousness*, and *discomfort* were also reported, these emotions were less frequent and likely reflect the natural tension of confronting human mortality rather than pedagogical shortcomings. Less frequently, *gratitude*, *compassion*, and *solemnity* emerged, representing affective states associated with calmness, reflection, and emotional regulation (Fredrickson, 2004).

Qualitative comments emphasized logistical challenges, particularly in prosections with large groups, where visibility and individual guidance were limited. Students repeatedly expressed the need for smaller group sizes and increased instructional support, underscoring the importance of structural adjustments to optimize the learning environment. Similar findings have been reported in previous studies, where overcrowded anatomy laboratories were associated with reduced engagement and diminished learning outcomes. Despite these limitations, both dissection and prosection were consistently recognized as valuable learning tools, notably contributing to anatomical knowledge, empathy development, and professional identity formation.

Beyond their educational and emotional impact, cadaver-based learning experiences also play a formative

role in the early development of professional identity. The encounter with the human body in the anatomy laboratory represents one of the first authentic experiences of medical socialization, fostering ethical sensitivity, respect for human dignity, and reflective awareness of professional responsibilities (Dyer & Thorndike, 2000; Hilton & Slotnick, 2005; Lempp, 2005). Recent literature frames this process as a rite of passage that enables students to move from perceiving the cadaver as an object of study to recognizing it as their first patient, emphasizing its symbolic and emotional significance in professional formation (Eckert *et al.*, 2020; Ong *et al.*, 2023). Such experiences strengthen the humanistic and ethical foundations of medical education, nurturing empathy, emotional maturity, and moral awareness—core attributes of professional identity development.

Taken together, these findings suggest that dissection remains a highly effective and emotionally meaningful strategy, especially when complemented by prosection and supported by appropriate instructional design. Curricular decisions should therefore account not only for efficiency and available resources but also for the overall impact on students' learning, affective development, and professional identity formation.

CONCLUSIONS

This study provides evidence on students' experiences regarding the use of dissection and prosection as pedagogical tools in anatomy education. The findings indicate that dissection is perceived as the most effective modality, both in terms of practical learning and in fostering empathy and clarity of the information delivered. The combination of dissection and prosection was also positively valued, although some limitations were noted in its perceived didactic quality.

Correlations among variables revealed that pedagogical quality is closely linked to students' emotional and attitudinal experiences. In particular, clarity of information and teaching methods were strongly associated with enjoyment, identification of anatomical structures, and perceived learning with real cadavers.

From an emotional standpoint, there was a predominance of high-activation positive emotions such as curiosity, respect, and enthusiasm, suggesting an environment conducive to meaningful learning. Nevertheless, students also pointed out logistical limitations, including group size and the need for greater faculty guidance—factors that should be addressed in curricular design.

Although the educational and emotional relevance of cadaveric exposure has been extensively documented in international contexts, Latin American anatomy education still lacks empirical evidence that comprehensively captures students' cognitive, emotional, and ethical experiences. The present study contributes to filling this gap by providing context-specific data that link learning perceptions, emotional engagement, and professional identity formation. Future research across other Latin American institutions could strengthen comparative insights and guide curricular adaptations sensitive to regional conditions and resources.

Overall, the findings support the importance of maintaining and strengthening hands-on experiences with human cadavers, ensuring proper conditions for active participation, instructional guidance, and emotional support. A comprehensive evaluation of these methodologies should consider not only academic performance but also students' perceptions, emotions, and the contextual conditions that shape learning outcomes. Beyond their cognitive and technical impact, cadaver-based experiences nurture empathy, ethical awareness, and the early development of professional identity—reinforcing the humanistic foundations of medical education.

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RESUMEN: La disección y la prosección de cadáveres se han propuesto como herramientas pedagógicas que fomentan el aprendizaje significativo, las habilidades clínicas y la empatía en estudiantes de ciencias de la salud. Se realizó un estudio observacional transversal con métodos mixtos con estudiantes de medicina de un curso de anatomía en la Universidad de los Andes para evaluar las percepciones de diferentes métodos de enseñanza: disección, prosección, demostración de disección y su combinación. Se analizaron un total de 96 respuestas válidas mediante estadística descriptiva, análisis de correlación y análisis cualitativo temático. La modalidad combinada de disección y prosección fue la más frecuente (54,2 %), mientras que la disección por sí sola presentó las puntuaciones medias descriptivas más altas en la mayoría de las dimensiones evaluadas. El grupo que solo realizó disección mostró los niveles de aprobación más altos (100 %) en cuanto al respeto del profesor y el desarrollo de la empatía. Las emociones más frecuentemente reportadas fueron curiosidad, respeto, entusiasmo y asombro, ubicadas en el cuadrante positivo de alta activación del modelo circumplejo de afecto de Russell. No se encontraron diferencias estadísticamente significativas entre los grupos, aunque surgieron correlaciones positivas entre el disfrute, la identificación anatómica y el aprendizaje percibido. Estos hallazgos respaldan el uso de métodos activos como la disección y la prosección en la enseñanza de la anatomía, y demuestran que estos enfoques no

solo mejoran la comprensión estructural, sino que también promueven el respeto por el cuerpo humano y el desarrollo de competencias afectivas. Se recomienda ampliar la participación estudiantil y fortalecer la orientación del profesorado durante las sesiones con cadáveres para optimizar la experiencia educativa.

PALABRAS CLAVE: Anatomía; Educación; Medicina; Disección; Cadáver.

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