A Case Study on a Novel Teaching Method on Integumentary and Musculoskeletal Anatomy for First Year Medical Students in a National University in the Philippines (University of the Philippines College of Medicine) as a Potential Alternative to Traditional Cadaveric Dissection

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ABSTRACT

Background. The COVID-19 pandemic resulted in the lack of traditional cadaveric dissection among first year medical students in Anatomy courses in the University of the Philippines College of Medicine. The Learning Enhancement in Anatomy Program (LEAP) was implemented as a bridging program to enhance knowledge and understanding of gross anatomy and histology. As part of this program, a novel multi-strategy teaching method was conducted for the Integumentary and Musculoskeletal Anatomy Module.

Objective. This case study described a novel multi-strategy teaching method on Integumentary and Musculoskeletal anatomy for first year medical students which was done after the COVID-19 pandemic wherein there was a shortage of cadavers. By describing this multi-strategy teaching method, this case study aims to present a potential alternative teaching method in a situation where there is an unexpected shortage of human cadavers.

Methods. A retrospective review of documents related to this teaching method among first year medical students at the University of the Philippines College of Medicine was conducted from November 15, 2023, to January 15, 2024. The novel teaching method for the Integumentary and Musculoskeletal station was taught using five different methods: proctor demonstration, a prosected lower extremity with a self-directed manual, dissection education videos viewed on a large screen, skeletons for osteology, and individual light microscopes with a self-directed laboratory histology manual. We described the data and analyzed according to strengths and limitations, and formulated recommendations to improve the module.

Results. The Integumentary and Musculoskeletal Module of the LEAP provided an interactive, hands-on experience in anatomy education. The five-pronged method facilitated a multifaceted approach to learning through cadaveric prosections, self-directed manuals, dissection videos, osteology exercises, and microscopic study. There was active engagement, overall positive student feedback, and increased post-test scores. However, certain limitations, such as the lack of direct cadaveric dissection, potential underutilization of histology components, and reliance on faculty guidance, highlight areas for improvement.

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Conclusion. The Integumentary and Musculoskeletal Module of the LEAP has demonstrated significant strengths in enhancing anatomical education through a multimodal approach that fosters active learning, improves knowledge retention, and provides a structured curriculum adaptable to various resource constraints. Student feedback and test performance support the effectiveness of the module, particularly in gross anatomy. Addressing challenges in future iterations will be crucial in refining the program and expanding its applicability to different educational contexts. By building on its strengths and mitigating its weaknesses, this five-pronged method can continue to serve as a model for innovative and effective anatomy education.

Keywords: medical education, novel teaching method, gross anatomy, integumentary and musculoskeletal anatomy, histology

INTRODUCTION

Anatomy is considered a pillar of medical education that serves as the foundation for future physicians' clinical skills.[1] Dissecting human cadavers has been at the core of anatomy education and is considered the "gold standard" in teaching anatomic structures.[2-6] Following the aftermath of the COVID-19 pandemic, medical schools worldwide shifted to a virtual method of education.[7] In the Philippines, this aftermath was still felt as a shortage of cadavers due to the mandate of burning the dead immediately post-mortem during the pandemic.[8] Instead of medical schools procuring cadavers for dissection of medical students, these bodies were immediately cremated to comply with regulations in the country.

This posed a challenge to medical schools, including the University of the Philippines College of Medicine because even as restrictions were being eased regarding social distancing, the number of cadavers were not enough to allow traditional dissection. As a response, the University of the Philippines Manila College of Medicine Learning Enhancement in Anatomy Program (LEAP) was conducted. LEAP is a novel bridging program for first year medical students aimed to reinforce knowledge and understanding of gross anatomy and histology amidst the lack of traditional cadaveric dissection due to the aftermath of the COVID-19 pandemic.[9] Innovations such as creative teaching techniques, self-directed learning, and educational videos on dissection, were introduced to the students. A previous study by Tecson et al. described the student feedback on the LEAP and showed positive reactions and a significant improvement in test scores.[9] Another cross-sectional study by Rubio et al. compared three different teaching methods for the musculoskeletal gross anatomy module of LEAP and found that the medical students preferred proctor-assisted dissection over dissection educational videos and a prosected cadaver study with a self-directed manual.[10] These studies showed potential alternative teaching methods in a situation where there is an unexpected shortage of human cadavers as part of the navigation during the transition period and easing in of face-to-face learning protocols after a pandemic disruption.

This study described the conduct and evaluation of the Integumentary and Musculoskeletal Module of the LEAP bridging program in the University of the Philippines College of Medicine and analyzed its strengths and limitations. By describing the details of this multimodal teaching method, this case study aims to provide a blueprint of a module that can be emulated if the need arises for a substitute for traditional cadaveric dissection and recommend points for improvement.

METHODS

This was a retrospective study that was exempted from review by the institutional review board of the University of the Philippines Manila (RGAO-2022-0539, UPMREB 2022-0456-EX). A retrospective review of documents related to the conduct and evaluation of the Integumentary and Musculoskeletal Anatomy Module of the University of the Philippines Manila College of Medicine Learning Enhancement in Anatomy Program (LEAP) was conducted from November 15, 2023 to January 15, 2024. LEAP was done from June 13-17, 2022, at the University of the Philippines College of Medicine (UPCM).

During LEAP, students rotated into 14 stations prepared by the anatomy faculty of UPCM. Each station represented a system of the human body. These stations were a combination of prosected cadavers, plastinated cadaver models and organs, anatomic models, bones, histologic specimens for microscopy, and electronic images. Each station was then subdivided into sub-stations to teach specific parts of each station. The authors of this study all teach the Integumentary and Musculoskeletal system, hence the focus of this study on that station.

The Integumentary and Musculoskeletal station was divided into five sub-stations: proctor demonstration with a prosected cadaver, a prosected lower extremity with a self-directed manual, a large screen television for the dissection education videos on the shoulder girdle, skeletons for osteology, and individual light microscopes with a laboratory manual for histology.

Pre- and post-tests were administered to the students, as well as online surveys, to measure their reactions.

RESULTS

The University of the Philippines College of Medicine (UPCM) has been teaching anatomy through the Organ System Integration (OSI) curriculum since its implementation in Academic Year 2004-2005. Some features of this curriculum include: (1) the addition of learning objectives that develop psychomotor skills and attitudes, (2) focus on the must know, (3) competency-based and outcome-based curricular design,

(4) increase in the use of small group discussions vs. lectures, (5) clinical teaching that is complaint-based rather than disease-based, and community-oriented rather than hospital-based, and (6) use of student assessments that are more integrated, emphasize critical thinking and problem-solving, and are criterion-referenced rather than norm-referenced.[11] In contrast to the traditional curriculum where dedicated schedules per department were implemented, under OSI, basic and clinical lectures were calendared based on organ systems (OS). The Learning Enhancement in Anatomy Program (LEAP) was created following this OSI curriculum and its stations were divided accordingly per OS.

Learning Enhancement in Anatomy Program

LEAP was conducted face-to-face and was organized by the Department of Anatomy of UPCM from June 13 to 17, 2022. This activity was intended to be a bridging program to enhance the learning of the students in anatomy by presenting prosected cadavers, plastinated cadavers and organs, anatomic models, specimens, bones, microscopic glass slides, and electronic images for further learning. Virtual dissection tables and headsets were also used by some stations that required them, but not all. The following organ systems (OS) were covered by the 14 LEAP stations: OS 201 (Organ System 201: Human Cell Biology), 202 (Integration and Control System), 203 (Skin, Muscles, and Bones), 204 (Head and Neck), 205 (Thorax), 206 (Abdomen and Pelvis), and HD 201(Human Ontogeny and Parturition). The students were divided into 14 groups of 12-13 members each. The groups were allotted two hours to complete a station. Each station was subdivided into sub-stations to teach specific topics per OS. After each station, the students were provided evaluation forms to solicit their feedback. Pre-test and post-test on gross anatomy and histology were administered. On the last day, students were requested to answer a Google (Google LLC, Mountainview CA, USA) survey form measuring their reaction to the program's administration, content, and teaching methods.

Prior to the activity, students accomplished an informed consent detailing the need for compliance with the Commission on Higher Education (CHED) guidelines on face-to-face learning, assurance of confidentiality, and that responses would not influence their overall grade for the learning activity.

Integumentary and Musculoskeletal Station

The Integumentary and Musculoskeletal station was encompassed by the OS 203 of the OSI curriculum (OS 203: Skin, Muscles, and Bones). The authors of this study all teach this OS 203 to first year medical students at UPCM, hence the focus on this station of LEAP. The Integumentary and Musculoskeletal station was further divided into four sub-stations: proctor demonstration, a prosected lower extremity with a self-directed manual, a large screen television for the dissection education videos, and skeletons for osteology.

Figure 1. Proctor demonstration sub-station in the Integumentary and Musculoskeletal station of LEAP.

The students spent 30 minutes on each sub-station. There was also a dedicated histology station where individual light microscopes with a self-directed laboratory manual for histology were provided to students. Histology was a main station in LEAP and students spent two hours in that station. There was an OS 203 sub-station as well in the histology station of LEAP.

Proctor Demonstration

A formalin-preserved human cadaver which was prosected by members of the faculty from the UPCM Department of Anatomy who teach OS 203 was used. It was decided to use prosected cadavers to maximize the students' time in this sub-station since LEAP was timebound. Anatomic structures were identified and labeled by the faculty prior to the start of LEAP. Students who rotated in the station examined the prosected cadaver and attempted to identify as many structures as possible while having a discussion with a faculty who served as their proctor. They were also encouraged to manipulate and touch the cadaver in the process. The faculty proctor was with the students at all times during LEAP to guide the students in identifying the anatomical structures, simulating the traditional laboratory sessions from before the pandemic (Figure 1).

Self-directed Manual

A nine-page laminated manual, prepared by one of faculty who teaches OS 203, was provided in a station with a prosected lower extremity formalinized cadaver. The manual was laminated and bound together with a metal ring to protect it from damage as the students would have to hold it while physically manipulating the prosected cadaver. In the manual, important structures were identified, labeled, and organized into nine regions of the lower extremity: (gluteal, posterior and anterior thigh, medial thigh, pes anserinus, posterior

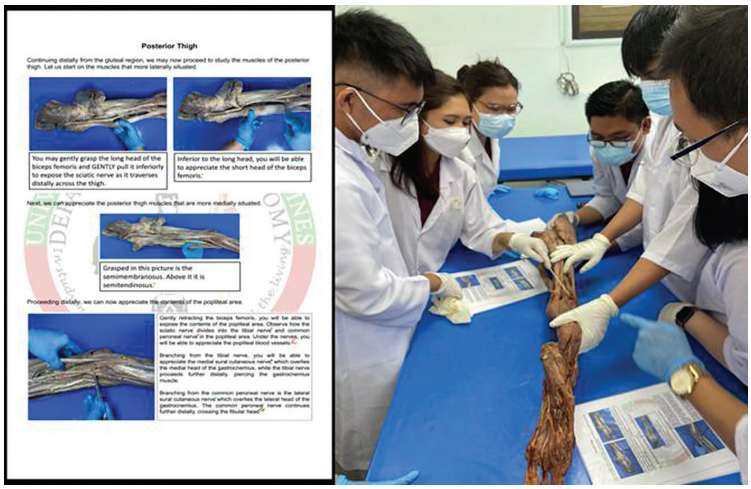

Figure 2. Students studying the prosected cadaver with a self-directed manual in the sub-station. Inlay on the left shows a sample page from the manual.

Figure 3. Students watching dissection education videos at the sub-station.

and anterior leg, lateral leg, and tarsal tunnel). The manual also provided detailed instructions on how to dissect and identify essential anatomical structures in the lower extremity (Figure 2). Students read the manual and followed the steps outlined therein while manipulating the cadaver in the station at their own pace, and their access to the manual was limited to the time allotted for this station.

Dissection Education Videos

High-definition dissection videos focusing on the anatomy of the shoulder girdle, which were divided into four 8-minute segments were shown on large screen televisions in front of the students as they studied the prosected cadavers in this station (Figure 3). These videos were designed to demonstrate the steps of dissection, as well as the essential anatomical structures of the shoulder girdle labeled for clarity. The students were able to control the playback (stop, rewind, or fast forward) of the videos according to their preferences.

Osteology

This sub-station was composed of a disarticulated skeleton of the human body (Figure 4). The bones were then grouped according to the upper and lower extremities, and spine. When the students entered this sub-station, each group of bones were intentionally disorganized, and it was the students' task to rearrange the bones into their correct anatomic position in the human body. Moreover, it was also emphasized to the students to master how to tell the laterality of each bone even as they were disarticulated. The students had 30 minutes to arrange all the bones, and after, they had to disorganize them again for the next group of students.

Laboratory Manual for Histology

There was a dedicated histology station during LEAP where individual light microscopes with a self-directed laboratory manual for histology were provided to students. Histology was a main station in LEAP and students spent two hours in that station. There was an OS 203 sub-station in the histology station of LEAP. No particular time allotment was enforced per sub-station in the histology sub-stations, students can study each sub-station at their own pace. The Integumentary and Musculoskeletal chapters of the laboratory manual for histology were prepared by faculty who teach OS 203. The Integumentary and Musculoskeletal chapters consisted of 11 pages, divided into three chapters: skin, muscle, and bone/cartilage. It delved into microscopic structures, cellular compositions, and tissue characteristics related to the musculoskeletal components. It provided a complementary perspective to the macroscopic understanding gained through cadaver dissection. Students were given hard copies of the manual which they used simultaneously while viewing glass slides under light microscopes (Figure 5). Each student was given their own light microscope as well. On each copy, a QR code could be scanned if the student preferred a soft copy.

Evaluation

Pre- and post-tests on gross anatomy and histology were administered which consisted of 55 items per test. Of these items, 10 were about the integumentary and musculoskeletal system. Three out of the 10 were histology questions, while the rest were gross anatomy.

At the end of the program, the students were also made to answer a Google (Google LLC, Mountainview CA, USA) survey form measuring their reaction to the program administration, content, and teaching methods. Majority (65%) of students rated the OS 203 module as 5, which was the highest score for the gross anatomy aspect of OS203 while less students (40%) rated the histology aspect of OS203 with a 5.[9]

Figure 4. Students arranging bones according to their correct anatomic position in the human body in the osteology sub-station.

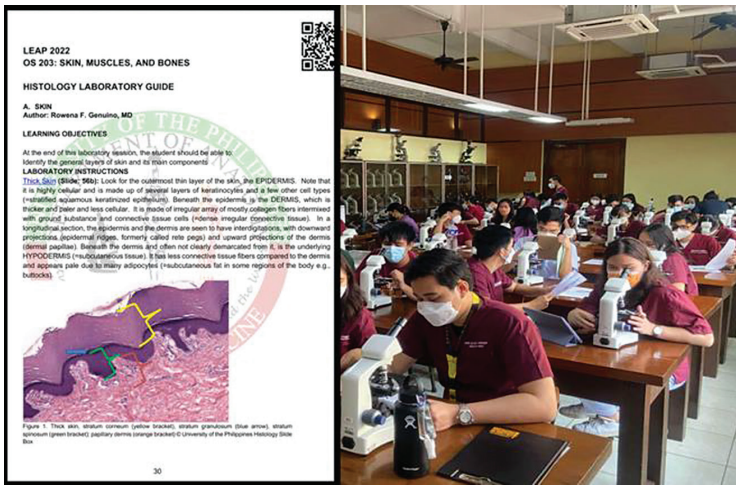

Figure 5. Students studying histology with the laboratory manual. Inlay on the left shows a sample page from the manual.

Strengths and Limitations of the Integumentary and Musculoskeletal Module of the LEAP

Strengths

The LEAP demonstrated several notable strengths in its approach to anatomy education. One of its key advantages is its multimodal learning approach, which integrates various teaching methodologies such as prosected and plastinated human cadavers, dissection education videos, and osteology exercises. This diverse instructional design enhances student engagement and comprehension by catering to different learning styles. Furthermore, the positive student reception of the program underscores its effectiveness. Survey results indicated high levels of satisfaction, with many students expressing a preference for gross anatomy sub-stations, reinforcing the program's appeal. Additionally, the improvement in knowledge retention is evident through pre- and post-test comparisons, which suggest enhanced student performance in the Integumentary and Musculoskeletal systems. By employing active learning strategies, LEAP facilitates hands-on engagement, peer collaboration, and self-directed study, fostering critical thinking and problem-solving skills. Another major strength is the program's adaptability to resource constraints; it provides a viable alternative to traditional cadaveric dissection, which can be especially beneficial in institutions with limited access to human cadavers. Lastly, LEAP's structured and comprehensive learning format, with clearly defined stations, ensures that students receive systematic exposure to various anatomical concepts, maximizing efficiency within the time constraints of the curriculum.

Weaknesses

Despite these strengths, certain weaknesses can be addressed for further improvement. One concern is the limited generalizability of the study's findings. Since UPCM has a specific student demographic and educational infrastructure, its results may not be directly applicable to other medical schools with different resources and curricula. Additionally, the underutilization of histology components was noted, as students rated the histology sub-stations as less effective compared to gross anatomy stations, suggesting a need for refinement in this area. Another significant limitation is the absence of direct cadaveric dissection experience. Although LEAP offers an alternative method for learning anatomy, it does not fully replicate the tactile and spatial learning opportunities that traditional cadaveric dissection provides. Furthermore, time constraints within the station-based format may limit the depth of exploration into each anatomical feature, potentially restricting students' deeper learning. The dependence on faculty guidance also presents a challenge, as some stations rely heavily on faculty involvement, making scalability difficult in institutions facing faculty shortages. Lastly, the variability in student learning preferences suggests that no single instructional strategy is universally effective. Since students have diverse learning styles, further exploration of personalized instructional methods may be necessary to optimize the program's impact.

Addressing these challenges in future iterations of LEAP will be crucial in refining its structure and expanding its applicability. By enhancing weaker areas while maintaining its strengths, the program can continue to evolve as a sustainable and adaptable anatomy learning model.

DISCUSSION

This study aimed to describe the Integumentary and Musculoskeletal system (OS 203) station of the LEAP as a novel bridging learning program for first year medical students as a potential alternative to traditional cadaveric dissection.

There was a positive overall reaction to LEAP as shown in a study by Tecson et al.[9] General reactions to LEAP were positive, where majority of students rated "5", corresponding to "Strongly Agree" to positive statements on the online survey that they accomplished after the program. Another general trend observed was that students gave higher ratings for the gross anatomy sub-stations compared to the histology sections. This may point to a potential direction for improvement for histology stations in the future to probably incorporate aspects of the gross anatomy stations that garnered highly positive results. No consistent preferences of students were noted across the various teaching methods, and each method had their own weaknesses and strengths. Test scores also improved after LEAP. In the same study by Tecson et al., it was observed that students scored higher in the post-test for the OS 203 items.

The positive impact on student overall reaction and test scores has been observed in previous studies on multimodal learning methods. A study by Sugand et al. on the effectiveness of various teaching methods in anatomy education suggested that integrating different learning modalities could enhance the learning experience and knowledge acquisition.[12] Another factor potentially contributing to the increased test scores is the collaborative learning environment that was encouraged by LEAP. In a study by Johnson and Johnson, they showed that cooperative learning strategies have the potential to enhance student engagement, motivation, and knowledge retention.[13] By working in groups, students would most likely benefit from peer teaching, discussion, and collective problem-solving, which can potentially reinforce their understanding of the material. This case study may suggest that LEAP's multimodal approach not only facilitated a deeper understanding of anatomical concepts but also promoted active learning and critical thinking among students, evidenced by their overall positive reaction to the program.

Despite these, we are not suggesting that the methods discussed should completely replace cadaveric dissection but rather serve as a complement or alternative method when traditional dissection is not possible. As mentioned by Ghosh, cadaveric dissection offers irreplaceable hands-on experience and a deep understanding of spatial relationships in human anatomy.[14]

CONCLUSION

This case study described a novel teaching method on Integumentary and Musculoskeletal anatomy as part of the University of the Philippines Manila College of Medicine Learning Enhancement in Anatomy Program for first year medical students, which incorporated multimodal learning methods that resulted in increased test scores and an overall positive response.

The Integumentary and Musculoskeletal Anatomy module of LEAP has demonstrated significant strengths in enhancing anatomical education through a multimodal approach that fosters active learning, improves knowledge retention, and provides a structured curriculum adaptable to various resource constraints. Positive student feedback and improved test performance support the effectiveness of the program, particularly in gross anatomy. However, certain limitations, such as the lack of direct cadaveric dissection, potential underutilization of histology components, and reliance on faculty guidance, highlight areas for improvement. Addressing these challenges in future iterations will be crucial in refining the program and expanding its applicability to different educational contexts. By building on its strengths and mitigating its limitations, this module can continue to serve as a model for innovative and effective anatomy education.

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Statement of Authorship

All authors certified fulfillment of ICMJE authorship criteria.

Author Disclosure

All authors declared no conflicts of interest.

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REFERENCES

1. Roy SF, Cecchini MJ. Implementing a structured digital-based online pathology curriculum for trainees at the time of COVID-19. J Clin Pathol. 2020 Aug;73(8):444. doi: 10.1136/jclinpath-2020-206682.
2. Byrnes K, Kiely P, Dunne C, McDermott K, Coffey J. Communication, collaboration and contagion: "Virtualisation" of anatomy during COVID-19. Clin Anat. 2021 Jan;34(1):82-9. doi: 10.1002/ca.23649. PMID: 32648289; PMCID: PMC7404681.
3. Iwanaga J, Loukas M, Dumont AS, Tubbs RS. A review of anatomy education during and after the COVID-19 pandemic: Revisiting traditional and modern methods to achieve future innovation. Clin Anat. 2021 Jan;34(1):108–14. doi: 10.1002/ca.23655.
4. Evans D, Bay B, Wilson T, Smith C, Lachman N, Pawlina W. Going virtual to support anatomy education: a STOPGAP in the midst of the COVID-19 pandemic. Anat Sci Educ. 2020 May;13(3):279-83. doi: 10.1002/ase.1963.

5. Chen S, Zhu J, Cheng C, Pan Z, Liu L, Du J, et al. Can virtual reality improve traditional anatomy education programmes? A mixed-methods study on the use of a 3D skull model. BMC Med Educ. 2020 Dec;20(1):395. doi: 10.1186/s12909-020-02255-6.
6. Constantino CS, Bundoc RC, Tecson III J V, Rubio DAT. Evaluation of Modified Thiel Soft-embalmed Cadavers as a Novel Teaching Model for Musculoskeletal Ultrasound and Anatomy among Rehabilitation Medicine Residents. Acta Med Philipp. 2023 October; 57(10). doi: 10.47895/amp.v57i10.7150. PMCID: PMC11522339 PMID: 39483182.
7. Harmon D, Attardi S, Barremkala M, Bentley D, Brown K, Dennis J et al. An analysis of anatomy education before and during COVID 19: May-August 2020. Anat Sci Educ. 2021 Mar;14(2):132-47. doi: 10.1002/ase.2051.
8. Go MC, Docot D. Fire and fear: Rapid cremations in the Philippines amidst COVID-19. Forensic Sci Int Synerg. 2021 Dec;3:1-4. doi: 10.1016/j.fsisyn.2020.100132. PMID: 33392492; PMCID: PMC7770472.
9. Tecson III JV, Bundoc RC, Abdulla AJA, Baticulon RE, Carillo RJD, Constantino CS, Dumlao KJP, Genuino RF, Mantaring BSS, Pascual JLR, Rubio DAT, Seng K S, Taladtad FF, Alip SKL, Asis JLB, Villacorta PRF, Chiong CM. Student Evaluation of a Learning Enhancement in Anatomy Program (LEAP) during the COVID-19 Pandemic: A Retrospective Study. Acta Med Philipp. 2023 October; 57(10). doi: 10.47895/amp.v57i10.7300. PMCID: PMC11522334 PMID: 39483179.
10. Rubio DAT, Tecson III JV, Bundoc RC, Constantino CS. Learner Preference on the Teaching Modalities in Musculoskeletal Anatomy in the New Normal: A Cross-sectional Study Comparing Dissection Educational Videos and Self-directed Manual to Proctor-assisted Cadaver Dissection. Acta Med Philipp. 2023 October; 57(10). doi: 10.47895/amp.v57i10.7519. PMCID: PMC11522361 PMID: 39483186.
11. Dioquino-Dimacali C. The University of the Philippines College of Medicine: Pioneer in medical education innovations in the Philippines. Acta Med Philipp. 2017 Dec;51(4):360-5. doi:10.47895/amp.v51i4.526.
12. Sugand K, Abrahams P, Khurana A. The anatomy of anatomy: a review for its modernization. Anat Sci Educ. 2010 Mar-Apr;3(2):83-93. doi: 10.1002/ase.139.
13. Johnson D, Johnson R. An educational psychology success story: social interdependence theory and cooperative learning. ER. 2009 Jun;38(5):365-79. doi: 10.3102/0013189X09339057.
14. Ghosh SK. Cadaveric dissection as an educational tool for anatomical sciences in the 21st century. Anat Sci Educ. 2017 Jun;10(3):286-99. doi: 10.1002/ase.1649.