Teaching-Learning Process of Medical Students with Real Anatomical Parts: A Practical Intervention Strategy


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SUMMARY: The COVID-19 pandemic caused several changes in the teaching of human anatomy, among them the use of different teaching methodologies based on E-learning. However, studies evaluating electronic tools have not provided clear evidence of effective student learning. Thus, this was the first study to evaluate medical students after completing human anatomy courses in the E-learning modality. We recruited first term (Group A, n=25) and second term (Group B, n=13) medical students. We applied a practical assessment based on 50 human anatomy markings on real anatomical specimens and cadavers, to be completed in Questionnaire 01 (Phase I). After detecting low scores on Questionnaire 01 by both groups, we applied a practical and face-to-face tutoring system for 14 days (Phase II). Afterwards, we re-evaluated both groups by repeating the same scores (Questionnaire 02, Phase III). According to the paired analysis of questionnaires 01 and 02 by Student's T-test, both groups showed significant increase in the final scores obtained in questionnaire 02 (Phase III). The evidence showed that the remote format lecture system weakened the learning and retention process of basic anatomical knowledge by medical students. On the other hand, in-person practical teaching proved to be efficient in the formative process of the students, a fact proven by the significant increase in the scores of the students in the 02 questionnaire, for both groups.

KEY WORDS: COVID-19; Anatomy Education; Learning; Students; Undergraduate Medical Education.

INTRODUCTION

Practical human anatomy classes are fundamental in medical training, which has been widely discussed by several studies. According Zargaran et al. (2020), even in face of multiple pedagogical and technological tools that are used for learning anatomy, traditional teaching with cadavers remains the first choice for medical students. The successful evidence on practices with cadaver and real anatomical specimens enable better anatomy understanding and superior performance when compared other non-traditional resources (Drake et al., 2014).

Lately, with pandemic COVID-19, the pedagogical gaps inherent in teaching of human anatomy have worsened, especially in access to real anatomical structures (Franchi, 2020). This panorama also shows that other areas of human knowledge have probably been compromised, such as development in ethics and humanity (Souza et al., 2020).

The social distancing caused by the pandemic of COVID-19 proved to be a challenge for medical education in Brazil and worldwide. In this scenario, teaching strategies were used, such as video study and online surveys (Iwanaga et al., 2021) and application of Emergency Remote Learning (Rahiem, 2020). However, there are still no studies ratifying that these teaching methodologies offer greater benefits students when compared to dissection and/or direct

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visualization of real anatomical specimens (Chytas et al., 2021).

However, the insertion of new technologies is fundamental during scenarios of social isolation, although it is imperative the contact with cadaveric practices as soon as possible, because the face-to-face modality aims to ensure skills systematically evaluate the patient and thereby establish most appropriate conduct (Araújo Júnior et al., 2020).

There are few studies evaluating the gaps in the teaching-learning process of practical human anatomy as a result of remote teaching caused by COVID-19 pandemic, as well the repercussion of physical distance from human anatomy laboratories on medical education. This study allowed examining possible gaps left by remote teaching confronting medical students through: (1) practical experiences in anatomy laboratory; (2) direct contact with real anatomical specimens and cadaver; (3) basics on clinical and surgical correlations.

MATERIAL AND METHOD

This is an epidemiological study of quantitative cross-sectional and crossover design with medical students from the State University of Rio Grande do Norte (UERN), Brazil. Based on data provided by the Department of Biomedical Sciences (DCB) the Faculty of Health Sciences (FACS-UERN), we recruited the entire target population of the intervention, that is, all students who completed the subjects Morphofunctional Module I (n=29, Group A) and Morphofunctional Module II (n=29, Group B) in remote teaching modality (no direct contact with real specimens). Included in the study: (1) students regularly enrolled in the UERN medical course; (2) who completed the Morphofunctional Module I or II; (3) and who agreed to participate in the study by signing the Informed Consent Form (ICF). Students enrolled in advanced periods (3rd to 12th periods) and those who gave up on participating in the study at any of the study phases were excluded.

Two questionnaires standardized by authors of this study were applied. Each one was structured with 50 response fields on thematic axes of the subject Morphofunctional Module I and II, applied to Groups A and B, respectively. The questionnaires were applied before and after human anatomy tutoring with real anatomical specimens.

In Phase I of the project, before using the mentoring system, we positioned the real anatomical specimens on benches, with 50 highlighted markings to be recognized by students. The pieces were distributed thematic axes (Table I) and on 10 available benches (5 anatomical markings per bench).

This follow-up, the participant started evaluation by the first marking and, after one minute, moved on to second marking; at the end fifth minute (fifth marking), the learner migrated to next bench (questions 6, 7, 8, 9, and 10), so as to follow this same logistics until completing the ten benches.

In Phase II, we performed group tutorials, which took place in the Anatomy Laboratory of FACS-UERN for period of 14 days. Supervised by experts in human anatomy and cadaver dissection, students participated in tutorials with discussion of topics related to disciplines of Morphofunctional Module I and II, with visualization and handling of real anatomical specimens. We ensured all the biosecurity and preventive measures against COVID-19.

Tutorials were taught by senior instructors with teaching experience and the necessary skills to integrate anatomical knowledge with real pieces and correlations with other areas of knowledge, such as physiology, clinical medicine and surgery. Each tutorial was planned with the development of detailed study guide with the main anatomical structures and their respective thematic axes, as well bibliography recommendations for students study before the tutorial.

Table I. Characterization of thematic axes and order of anatomical markings.

<table>
<thead>
<tr>
<th>Thematic Axes</th>
<th>Mark</th>
<th>Thematic Axes</th>
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</thead>
<tbody>
<tr>
<td>Morphofunctional Module I</td>
<td>Mark</td>
<td>Morphofunctional Module II</td>
<td>Mark</td>
</tr>
<tr>
<td>Axial Skeleton I</td>
<td>01-05</td>
<td>Bones, Muscles and Nerves of the ULM*</td>
<td>01-06</td>
</tr>
<tr>
<td>Axial Skeleton II</td>
<td>06-10</td>
<td>Bones, Muscles and Nerves of the LLM*</td>
<td>07-12</td>
</tr>
<tr>
<td>Telencephalon</td>
<td>11-16</td>
<td>Muscles and Nerves of the Head, Thorax and Abdomen</td>
<td>13-18</td>
</tr>
<tr>
<td>Diencephalon and Cerebellum</td>
<td>17-22</td>
<td>Cardiovascular System</td>
<td>19-28</td>
</tr>
<tr>
<td>Brainstem</td>
<td>23-28</td>
<td>Digestive System</td>
<td>29-39</td>
</tr>
<tr>
<td>Cranial Nerves</td>
<td>29-34</td>
<td>Urinary Tract, Pelvic Muscles and Nerves</td>
<td>40-45</td>
</tr>
<tr>
<td>Endocrine and Reproductive System</td>
<td>35-50</td>
<td>Respiratory System</td>
<td>46-50</td>
</tr>
</tbody>
</table>

In Phase III, we repeated the initial evaluation, with same pre-established conditions, such as start and finish time, number of markings, time to solve each question, location and exposure formaldehyde (which could not be avoided, due to direct visualization of the real anatomical pieces), and other environmental conditions.

Evaluations mediated by Questionnaires 01 and 02 were carried out individually and without any kind of consultation by the student. Thus, the application methodology guaranteed the confidentiality, individuality and veracity the data collected. The whole evaluation process was supervised by senior tutors. After completing questionnaire, students were instructed to fold sheets and place them in an urn near the anatomy lab exit.

Regarding correction of the answer keys (template), we assigned a score of two points for each question, according to degree of accuracy the answer: organ (33 % score), marked structure on the organ (33 % score), and antimeria (33 % score). In cases where the answer key did not include antimeria, the score was divided between the organ (50 % score) and the marked structure (50 % score).

The data collected from questionnaires were stored in Excel software file (version 2019) and submitted to descriptive statistical analysis, based absolute and relative frequencies. In addition, upon verification of normal distribution and homogeneous variation through Shapiro-Wilk and D’Agostino-Pearson tests, the data were evaluated using Student’s t-test paired samples, with all the aforementioned tests performed with aid of Real Statistics software. This research was approved by Ethics and Research Committee of State University of Rio Grande do Norte, under opinion number 5.236.796, on February 10, 2022.

RESULTS

The teaching-learning process was analyzed in thematic axes of the subjects Morphofunctional Module I (Group A) and Morphofunctional Module II (Group B), with a crossover design. 25 students from Group A and 13 students from Group B participated in all phases of study.

In the evaluation of Group A, the mean final score of the students Questionnaire 01 was 36.8 points (SD±13.3), and in Questionnaire 02 was 70.4 points (SD±12.9). Thus, there was an increase in the overall average of 33.6 points (191.3 %) after the tutoring. The analysis by thematic axes showed a varied performance according to theme, with lower scores in Diencephalon and Cerebellum, as well in the Endocrine and Reproductive System scores. There was a higher hit rate in Axial Skeleton I and Telencephalon (Table II).

Other hand, in the evaluation of Group B, average of the students final score Questionnaire 01 was 31.2 points (SD±12.6), while Questionnaire 02 the class obtained an average of 71.0 (SD±10.2). Thus, there was increase in the overall average of 39.8 points (128.0 %) after intervention. Regarding the highest hit rates, these occurred Digestive System in Questionnaire 01 (40.7 %) and Respiratory System in Questionnaire 02 (87.5 %). The lowest hit rate was concentrated in Bones, Muscles, and Nerves Upper

<table>
<thead>
<tr>
<th>Thematic Axis</th>
<th>Points</th>
<th>Hits (%)</th>
<th>Points</th>
<th>Hits (%)</th>
<th>Thematic Axis</th>
<th>Points</th>
<th>Hits (%)</th>
<th>Points</th>
<th>Hits (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Axial Skeleton I</td>
<td>7.9/14</td>
<td>56,1</td>
<td>11.9/14</td>
<td>85,1</td>
<td>Bones, muscles and nerves of the ULM.</td>
<td>1.7/12</td>
<td>14,1</td>
<td>3.3/12</td>
<td>27,4</td>
</tr>
<tr>
<td>Axial Skeleton II</td>
<td>3.9/8</td>
<td>48</td>
<td>6.3/8</td>
<td>76,6</td>
<td>Bones, Muscles and Nerves of the LLM.</td>
<td>4.5/12</td>
<td>37,2</td>
<td>9.6/12</td>
<td>79,9</td>
</tr>
<tr>
<td>Telencephalon</td>
<td>7.6/16</td>
<td>48,5</td>
<td>11.3/16</td>
<td>70,8</td>
<td>Bones, Muscles and Nerves of the Head, Thorax and Abdomen Cardiovascular System</td>
<td>2.9/12</td>
<td>24,0</td>
<td>6.4/12</td>
<td>53,1</td>
</tr>
<tr>
<td>Diencephalon and Cerebellum</td>
<td>1.9/12</td>
<td>15,7</td>
<td>6.3/12</td>
<td>52,6</td>
<td>Digestive System</td>
<td>5.7/20</td>
<td>28,3</td>
<td>15.5/20</td>
<td>77,5</td>
</tr>
<tr>
<td>Brainstem</td>
<td>3.2/10</td>
<td>31,6</td>
<td>6.3/10</td>
<td>62,7</td>
<td>Urinary System</td>
<td>4.3/12</td>
<td>36,2</td>
<td>9.0/12</td>
<td>74,7</td>
</tr>
<tr>
<td>Cranial Nerves</td>
<td>3.5/8</td>
<td>43,5</td>
<td>5.4/8</td>
<td>67,4</td>
<td>Respiratory System</td>
<td>3.2/10</td>
<td>31,5</td>
<td>8.8/10</td>
<td>87,5</td>
</tr>
<tr>
<td>Endocrine and Reproductive System</td>
<td>8.8/32</td>
<td>27,6</td>
<td>22.9/32</td>
<td>71,5</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Score General Average</td>
<td>36.8/100</td>
<td>(SD = 13.3)</td>
<td>70.4/100</td>
<td>(SD = 12.9)</td>
<td>Score General Average</td>
<td>31.2/100</td>
<td>(SD = 12.6)</td>
<td>71.0/100</td>
<td>(SD = 10,2)</td>
</tr>
</tbody>
</table>

Source: Prepared by the authors, 2022. Caption*: ULM - Upper Limb Muscles; LLM - Lower Limb Muscles; SD - Standard Deviation.
Limbs, with 14.1% in Questionnaire 01 and 27.4% in Questionnaire 02 (Table II).

For both groups, the samples were considered to have normal distribution by Shapiro-Wilk and D’Agostino-Pearson tests. According to paired analysis of questionnaires 01 and 02 by Student’s T test, both groups showed significant increase in the final scores obtained questionnaire 02 (Phase III). In Group A, the data showed statistical significance of \( p = 3 \times 10^{-7} \), while for group B, the statistical significance was \( p = 8.6 \times 10^{-7} \) (Fig. 1).

Evidence found in this study shows that, although students have had contact with the evaluated thematic axes, in E-learning modality, by several remote teaching methodologies, there was intense teaching gap of human anatomy visualized in Questionnaire 01, for both groups. One of the possible factors that may justify such a gap is the lack of manipulation real anatomical parts. Because of this, we conducted an investigation with a crossover design, which showed that face-to-face human anatomy classes were able to increase academic performance of students, presented in the final scores of Questionnaire 02.

Limiting factors of study: (1) level of difficulty the content covered; (2) resolution time; (3) environmental conditions of anatomy lab, such as contact with formaldehyde impregnated in anatomical specimens; (4) emotional factor, seeing real specimens for first time; (5) discrepancies found between structures observed in anatomy atlases and those found in real specimens.

However, a reduction in teaching with cadavers in several medical schools has been evidenced lately; and this is due to increasing number of students, as well decrease in body donation (Saverino, 2021). According to Zhang et al. (2019), the expansion “medical education” limits the time and space of anatomical study laboratories, which can seriously impair teaching human anatomy. This fact has stimulated the insertion of complementary technologies to anatomical teaching; although there are no studies proving a better medical education after substitution of classes with handling of real anatomical parts in detriment study based on technological resources (Chytas et al., 2021).

During pandemic COVID-19, some approaches are shown efficient in the provisional practical teaching human anatomy, such as videoconferences with open board schematics (Kim et al., 2022), gamification (Stambuk-Castellano et al., 2022) and use digital platforms (Rojos et al., 2021; Khasawneh et al., 2021).

However, the perceptions of professors and medical students show that remote teaching with alternative methodologies is not superior face-to-face teaching; and this should be seen essential ensure adequate learning (Rojos et al., 2021; Khasawneh et al., 2021; Rodriguez-Luengo et al., 2022). Such perceptions seem justified lack of personal contact, face-to-face learning between student and faculty, sharing of ideas among classmates, handling real anatomical specimens cadavers, and decreased motivation after one year of exclusive E-learning practice (Martinez et al., 2022).

In the field medical education, studies evaluating alternative teaching methodologies in E-learning modality have not provided clear evidence that effective learning by students; and whether basic concepts about anatomical morphology remain in the short and long term. Thus, this is first study to evaluate medical students after completion of human anatomy courses in E-learning modality. After detecting initial diagnosis of the learning retained by students, seen as insufficient, we applied a system of practical and face-to-face tutoring after the period social distance.

Our results showed encouragement of study guided face-to-face anatomy practical classes allowed students to have a collective formation intrinsic the teaching-learning process, in turn, was based on a systematized clinical vision from practical classes using preserved anatomical specimens. Furthermore, this allowed to partially solve learning gaps left by e-learning, during social distance.

Thus, modern anatomy teaching is more effective when there a combination of pedagogical resources, which complement face-to-face practical teaching, in order

CONCLUSION

Evidence showed that the system of classes in remote format weakened the learning process and retention of basic anatomical knowledge by medical students, a reality perceived in Phase I this study. Other side, face-to-face practical teaching proved to efficient in the students’ formative process; a fact proven by significant increase students’ scores in questionnaire 02, after systematized tutoring. The mentoring scheme adopted allowed greater autonomy of the student in morphological teaching process, as well acquisition of professional skills such teamwork, interpersonal skills, self-awareness, and practice medical ethics with real specimens and cadavers.

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