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ORIGINAL RESEARCH

# Impact of the COVID-19 Pandemic on Students' Motivation in Relation to Asynchronous Anatomy Video Lectures

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## Abstract

**Objectives** This study aimed to investigate medical students' motivation in relation to asynchronous anatomy video lectures, carried out during COVID-19 remote teaching.

**Methods** Repeated cross-sectional modified Instructional Materials Motivation Survey questionnaire, validated in Brazil, was applied to 255 students attending the first semester of the undergraduate medical course at the José do Rosário Vellano University, in June 2020 and November 2020. The data were analyzed considering the 95% confidence level as significant ($p < 0.05$).

**Results** The overall score of motivation attributed by the students was moderate to high (3.7/5, 74%). The same occurred in relation to all dimensions of the instrument: Interest (3.6/5, 72%), Confidence (3.7/5, 74%), Attention (3.5/5, 70%), and Expectation (3.7/5, 74%). Cluster analysis showed that 78% ($n = 168$) of the students had moderate (72% of the maximum score) or high (86% of the maximum score) degrees of motivation. The influence of social isolation on the students' emotional state did not affect the overall motivation scores ($p = 0.217$) or the dimensions of motivation: Interest ($p = 0342$), Confidence ($p = 0.061$), Attention ($p = 0.625$), and Expectation ($p = 0.094$).

**Conclusions** The students showed high motivation for the asynchronous video lectures of human anatomy. Although the majority of students are highly affected regarding their emotional state, due to the social isolation imposed by the COVID-19 pandemic, this fact did not interfere with the motivation for video lectures, probably due to the high intrinsic motivation that students in the first year have in relation to anatomy. These findings alert to the importance of asynchronous video lectures as an adequate strategy for the teaching and learning of human anatomy.

**Keywords** Motivation · Video lectures · Anatomy · COVID-19 · Remote education

## Introduction

The primary objective of education is to provide an environment that promotes an in-depth understanding of the subjects under study, through the individuals' personal capacities and desires, enhancing their innate skills, as well as those acquired throughout life, resulting in significant learning. Thus, the energy that drives the learning process is motivation [1].

In this environment, motivation is one of the most impactful elements of learning, in a polymorphic context that involves attitudes, strategies, and goals [2]. Among several definitions found in the literature, motivation can be seen as the process in which goal-driven behavior is instigated and sustained [3]. Individuals who are motivated to learn undertake efforts to direct their energy towards attention, concentration, interaction, and development, satisfying their personal motives, values, and expectations [4, 5]. In this sense, Pintrich [6] emphasized the relationship between motivation and cognition in student performance and learning. One approach of achieving an understanding of motivation is the attention, relevance, confidence, satisfaction (ARCS) model proposed by Keller [7]. These four categories promote an overview of the major dimensions of human motivation in the context of learning and how to create strategies to stimulate and sustain motivation [8].

The significant learning of human anatomy, considering the human body structures and their functions, is essential

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for medical students for the structuring of the knowledge that will be used to understand physiology and pathology, as well as for the development of semiology, diagnostic reasoning, surgical techniques, and the interpretation of imaging tests [9]. In recent years, there has been a growing interest in revising the medical school curricula aiming to improve the teaching of human anatomy. Anatomy is seen as an area of knowledge with a high intrinsic cognitive load due to the high volume of information, which often leads to superficial learning due to the wide scope and little depth attributed to the several learning objectives listed in the traditional curricula [10, 11].

Despite the historical importance of traditional methods based on the dissection of cadavers, its use as an isolated teaching strategy has been supplanted in curricula that favor the integration of basic science learning objectives, such as anatomy, with clinical, surgical, and imaging testing aspects, aiming to contextualize learning and motivate students in the initial stages of the course [9, 12–14]. In this scenario, new teaching–learning tools have been used together with innovative curricular principles, which privilege active learning, the rescue of prior knowledge, the horizontal and vertical integration of knowledge, the spiral allocation of learning objectives, and feedback. Therefore, educational resources such as video lectures, virtual reality, augmented reality, gamification, computerized anatomy tables, and computer-based teaching are being tested and implemented in the teaching of human anatomy [15–20].

Estai and Bunt [9], in a critical review of the literature regarding the several resources and learning strategies used for the teaching of human anatomy, emphasized, among other recommendations, that there is no single model capable of meeting all the curricular needs. Therefore, they pointed out that the best way to teach anatomy is through the combination of several mutually complementary instructional tools. This versatility, regarding the combination of teaching–learning resources, can allow the adoption of the most convenient methods for each curricular context, considering the peculiarities of each course, as well as both the economic and social aspects.

This variety of teaching–learning resources was crucial for the continuity of human anatomy teaching during the pandemic caused by the new coronavirus (COVID-19), which broke out in the beginning of 2020 [21]. Considering the imminent need for social isolation, the immediate adaptation of medical courses became imperative and, consequently, also of the teaching–learning strategies of human anatomy, on an emergency [22]. Among the several resources that can be integrated into the remote teaching of human anatomy, many medical courses have chosen to use narrated video lectures, included in virtual learning environments, for their asynchronous use by the students [23–27]. The autonomy provided by these video lectures can play an important role in increasing student's motivation as demonstrated by self-determination theory [28, 29]. In turn, the students' perception regarding the teaching of anatomy, in these pandemic times, is a beneficial one and supports the justification for this research [30, 31].

The literature lacks studies that specifically evaluate students' motivation for asynchronous human anatomy video lectures. Therefore, considering its importance for the teaching of human anatomy during the COVID-19 pandemic, this study aimed to assess (1) The motivation of students attending the Medical School at José do Rosário Vellano University (UNIFENAS-BH) for this instructional activity, (2) the influence of sociodemographic factors on students' motivation, and (3) the influence of the students' self-declared emotional state during social isolation due to the COVID-19 pandemic, on their motivation for asynchronous video lectures of human anatomy. The results of the study may pave the way for greater use of this educational strategy and support new studies on the topic.

## Methods

### Subject Recruitment

The target population ($n = 255$) consisted of all students attending the first semester of the undergraduate medical course at José do Rosário Vellano University (UNIFENAS-BH), Belo Horizonte Campus, during the academic year of 2020. The students were invited to fill out the questionnaire, aimed at measuring their motivation regarding the asynchronous video lectures of human anatomy taught during the social isolation period, as well as evaluating the perception of their emotional state at that time. The inclusion criteria comprised being regularly enrolled at the medical school and their wish to participate in the study. The exclusion criteria comprised the wish to leave the study, the lack of adherence to the protocol, and being of foreign origin, which could hinder the interpretation of the questionnaire items.

### Curricular Context

The undergraduate medical course at UNIFENAS-BH, founded in 2003, adopts the problem-based learning methodology. Human anatomy is studied over four semester terms, during the first 2 years of medical school. Synthetic models, a digital anatomy table, imaging tests, videos of surgical procedures, and prosection are used in the teaching of anatomy. The curriculum consists of thematic blocks that carry out the horizontal and vertical integration of knowledge. The undergraduate medical course duration consists of 12 semesters, divided into pre-clinical, clinical, and internship stages.

## Asynchronous Video Lectures

During the social isolation period, which started in mid-March 2020, the medical course at UNIFENAS-BH chose to use asynchronous video lectures to maintain the human anatomy educational strategy.

The teachers of this teaching strategy recorded and made lectures available using the following systems:

- Recording of video lectures in the Open Broadcaster Software (OBS)®, version 25.0.4
- Use of laboratory practice scripts in human anatomy, contained in the student guide, for the standardization of video lectures, as follows:

    1. Introduction
    2. Learning objectives
    3. Checklist of structures for identification
    4. Oral presentation, illustrated by PowerPoint slides, with anatomical atlas pictures, focusing on theoretical and practical aspects in an integrated manner
    5. Closure of the activity with discussion of a clinical, surgical, or imaging case
    6. Recommended bibliography

- Uploading the video lectures to the institutional Google Drive platform and providing the access link, weekly, in the virtual learning environment (Moodle Unifenas), according to the thematic blocks programming

After being uploaded to the institutional Google Drive platform, the video lectures were available to the students for consultation on demand throughout the ongoing thematic block. There was no access control or any type of mechanism that forced students to watch the video lectures. However, the discussions held at the synchronous meetings gave teachers the perception of their use by the students. Moreover, watching the video lectures was important for the learning of the proposed objectives and achieving proficiency in summative exams.

The video lectures were not modified between the first and second semesters of 2020. All students used the same form of access and were able to watch the same recordings. First semester of 2020 students participated in the face-to-face course for 4 weeks, prior to the start of social isolation. In the second semester 2020, until the data collection was carried out for this study, the entire course took place remotely. To continue the anatomy course during social isolation, in addition to these video lectures, students participated in synchronous meetings, carried out weekly through the Google Meet application, with the teachers of human anatomy. These meetings were aimed at solving doubts and discussing clinical cases and imaging tests related to that week's learning objectives.

## Data Collection

The Instructional Materials Motivation Survey (IMMS) questionnaire, based in the ARCS model of motivational design, was developed to measure students' motivation regarding instructional materials that have self-directed characteristics, and it has been used in the assessment of video lectures [32, 33]. Aiming to assess the students' motivation in this study, the translation and transcultural adaptation of the IMMS to Brazilian Portuguese was initially carried out [34]. Subsequently, its psychometric validation generated the IMMS version validated in Brazil (IMMS-BRV), consisting of 25 items divided into four dimensions: Interest, Confidence, Attention, and Expectation (Online Resource 1). The internal consistency reliability, measured by Cronbach's alpha coefficient, for the complete IMMS-BRV instrument, is 0.95, being 0.93 for the Interest dimension, 0.87 for the Confidence dimension, 0.76 for the Attention dimension and 0.78 for the Expectation dimension [35, 36]. Its purpose is to measure the respondent's motivation using the Likert scale, with the following score: (1) I totally disagree; (2) I partially disagree; (3) I neither disagree nor agree; (4) I partially agree; and (5) I totally agree.

In addition to the IMMS-BRV, students answered a complementary questionnaire with two items about their self-perceived motivation for human anatomy video lectures and one item about the influence of social isolation measures on their emotional state. The items were as follows: (1) I feel naturally motivated for video lectures in human anatomy, and (2) video lectures in human anatomy make me motivated (1, I strongly disagree; 2, I partially disagree; 3, I neither disagree nor agree; 4, I partially agree; 5, I totally agree); (3) did the social isolation measures affect your emotional state? (1, They did not affect; 2, They affected a little; 3, They affected moderately; 4, They affected a lot; 5, They totally affected).

Data collection was performed once in the June 2020 and once in November 2020, using the Google Forms, at equivalent stages of the course, so that there was enough time for students to be exposed to human anatomy video lectures prior to their motivation assessment. The students were invited to participate by email and WhattsApp.

## Ethical Approval

The present study was approved by the research ethics committee of José do Rosário Vellano University

(UNIFENAS-BH) (Approval ID: 03,461,718.0.0000.5143). The informed consent form was applied to all research subjects.

## Data Analysis

To describe the results of the assessed variables, the 25th and 75th percentiles, the median, mean, standard deviation (SD), and percentage values were presented. The relationship between two categorical variables was assessed using the chi-square test. Fisher's exact test was used to evaluate the association and comparison of the groups regarding the proportion of occurrence of a certain event of interest (categorical type variable) for small samples. The comparison between two independent groups, in relation to a quantitative variable, was performed using the non-parametric Mann–Whitney test. Under the same condition, the comparison between three independent groups was performed using the Kruskal–Wallis non-parametric test (quantitative variable). The cluster analysis, based on the *K*-means method, was used to determine different profiles of medical students regarding the dimensions of the IMMS-BRV that assess motivation. Statistical significance was set at $p < 0.05$. Statistical analyses were performed using the SPSS statistical package software, version 20.0 (IBM Corp, Armonk, NY).

## Results

Using a convenience sampling method, from the target population ($n = 255$), 98 students were recruited in June 2020, and 117 students were recruited in November 2020, totaling 215 (84.3%) undergraduate first semester medical students, of which 147 (68.4%) were women and 68 (31.6%) were men. Regarding age, 47.4% were aged between 17 and 19 years, 25.1% between 20 and 22 years, 13% between 23 and 25 years, 7.5% between 26 and 30 years, and 7% were at least 31 years old. Most students (83.7%) did not have another higher education degree. Of the ones who had a prior higher education degree, the academic courses comprised the following areas of knowledge: biological sciences/health area in 48.6%; social/human sciences in 28.6%; and exact sciences in 22.8%.

The students' motivation scores, measured by the IMMS-BRV, are summarized in Table 1. It can be observed that the overall score of motivation attributed by the students was moderate to high (3.7/5, 74%), demonstrating the students' good motivation regarding the assessed video lectures. The same occurred in relation to all dimensions of the instrument: Interest (3.6/5, 72%), Confidence (3.7/5, 74%), Attention (3.5/5, 70%), and Expectation (3.7/5, 74%).

**Table 1** Student motivation in relation to video lectures measured by the Instructional Materials Motivation Survey validated in Brazil (IMMS-BRV)

| Motivation dimensions | Descriptive measures | | |
|---|---|---|---|
| | Minimum–maximum | Median ($P_{25}$–$P_{75}$) | Mean ± SD |
| Overall | 1.3–5.0 | 3.8 (3.3–4.3) | 3.7 ± 0.8 |
| Interest | 1.2–5.0 | 3.7 (3.0–4.2) | 3.6 ± 0.8 |
| Confidence | 1.3–5.0 | 3.8 (3.0–4.5) | 3.7 ± 0.9 |
| Attention | 1.0–5.0 | 3.7 (2.7–4.3) | 3.5 ± 1.0 |
| Expectation | 1.2–5.0 | 3.7 (3.3–4.2) | 3.7 ± 0.7 |

Total $n = 215$ students

The influence of sociodemographic data on the motivation and overall motivation dimensions, measured by the IMMS-BRV, can be seen in Table 2. The statistical analysis showed significantly higher scores regarding the Attention dimension in the female group, in comparison to the male group ($p = 0.023$). Similarly, the group that had a prior higher education degree showed higher scores in the Attention dimension ($p = 0.006$) in relation to the group that did not have it. However, there was no difference in the comparison between the area of knowledge of the prior degree and motivation.

The influence of self-reported motivation by the students and their emotional state on motivation scores, measured by the IMMS-BRV, is shown in Table 3. The group that did not feel naturally motivated for human anatomy video lectures was the one with significantly lower scores in all dimensions ($p < 0.001$) and overall motivation ($p < 0.001$), and the group that felt naturally motivated for the video lectures in human anatomy was the one with significantly higher scores ($p < 0.001$). A similar result was observed in relation to the fact that video lectures generate motivation in the students. The group that agreed that video lectures generated motivation had the highest values in all dimensions ($p < 0.001$) and overall motivation ($p < 0.001$), and the group that disagreed that video lectures generated motivation had the lowest values ($p < 0.001$). In turn, the influence of social isolation measures on the emotional state, self-declared by the students, did not interfere with the dimensions of motivation and overall motivation for the asynchronous anatomy video lectures.

The cluster analysis, based on the four dimensions of the IMMS-BRV, was carried out to identify different student profiles in relation to the motivation dimensions, with three distinct clusters being identified: cluster 1 (21.9% of students) with low motivation scores (grade I); cluster 2 (41.4% of students) with moderate motivation scores (grade II); and cluster 3 (36.7% of students) with high motivation scores (grade III). The mean overall motivation scores were 2.8 in grade I; 3.6 in grade II, and 4.3 in grade III (Table 4).

**Table 2** Influence of sociodemographic data on motivation measured by the Instructional Materials Motivation Survey validated in Brazil (IMMS-BRV)

| Variables | Motivation factors | | | | Overall motivation |
|---|---|---|---|---|---|
| | Interest | Confidence | Attention | Expectation | |
| Age group | | | | | |
| 17 to 19 years | 3.7 ± 0.8<br>3.9 (3.2; 4.3) | 3.5 ± 0.8<br>3.7 (2.8; 4.2) | 3.6 ± 0.9<br>3.8 (3.0; 4.3) | 3.4 ± 1.0<br>3.7 (2.7; 4.3) | 3.7 ± 0.7<br>3.8 (3.1; 4.2) |
| 20 to 22 years | 3.7 ± 0.7<br>3.7 (3.2; 4.3) | 3.6 ± 0.8<br>3.5 (2.8; 4.2) | 3.6 ± 1.0<br>3.6 (2.8; 4.4) | 3.5 ± 1.0<br>3.3 (2.7; 4.3) | 3.7 ± 0.6<br>3.6 (3.2; 4.2) |
| 23 to 25 years | 3.9 ± 0.7<br>3.9 (3.4; 4.5) | 3.8 ± 0.9<br>3.8 (3.0; 4.5) | 3.9 ± 0.9<br>4.0 (3.3; 4.8) | 3.5 ± 1.0<br>3.7 (2.7; 4.3) | 3.8 ± 0.6<br>3.8 (3.4; 4.4) |
| 26 years or older | 3.8 ± 0.8<br>3.8 (3.3; 4.4) | 3.7 ± 0.8<br>3.7 (3.0; 4.3) | 3.9 ± 0.8<br>4.0 (3.3; 4.5) | 3.9 ± 0.8<br>3.7 (3.3; 4.7) | 3.8 ± 0.6<br>3.8 (3.4; 4.3) |
| *p* | 0.570* | 0.610* | 0.179* | 0.158* | 0.511* |
| Gender | | | | | |
| Female | 3.8 ± 0.7<br>3.8 (3.3; 4.3) | 3.6 ± 0.8<br>3.7 (3.0; 4.2) | 3.8 ± 0.9<br>3.8 (3.3; 4.5) | 3.5 ± 1.0<br>3.7 (2.7; 4.3) | 3.8 ± 0.6<br>3.8 (3.3; 4.2) |
| Male | 3.6 ± 0.8<br>3.8 (3.1; 4.3) | 3.5 ± 0.9<br>3.6 (2.8; 4.3) | 3.5 ± 0.9<br>3.5 (2.8; 4.3) | 3.5 ± 0.9<br>3.7 (2.8; 4.3) | 3.6 ± 0.7<br>3.7 (3.1; 4.1) |
| *p* | 0.143** | 0.273** | **0.023**** | 0.852** | 0.095** |
| Prior higher education degree | | | | | |
| No | 3.7 ± 0.8<br>3.8 (3.2; 4.3) | 3.6 ± 0.8<br>3.7 (3.0; 4.2) | 3.6 ± 0.9<br>3.8 (3.0; 4.3) | 3.5 ± 1.0<br>3.7 (2.7; 4.3) | 3.7 ± 0.7<br>3.7 (3.2; 4.2) |
| Yes | 3.7 ± 0.7<br>3.8 (3.3; 4.2) | 3.6 ± 0.8<br>3.7 (3.0; 4.3) | 4.0 ± 0.8<br>4.3 (3.5; 4.8) | 3.7 ± 0.9<br>3.7 (3.0; 4.7) | 3.8 ± 0.6<br>3.8 (3.4; 4.2) |
| *p* | 0.764** | 0.993** | **0.006**** | 0.284** | 0.574** |
| Area of knowledge of the prior higher education degree | | | | | |
| Exact sciences | 3.6 ± 0.5<br>3.8 (3.1; 4.2) | 3.7 ± 0.9<br>3.9 (3.1; 4.5) | 4.2 ± 0.6<br>4.3 (3.9; 4.7) | 3.9 ± 1.1<br>4.2 (3.4; 4.7) | 3.9 ± 0.5<br>3.8 (3.5; 4.3) |
| Biological sciences/health area | 3.5 ± 0.9<br>3.4 (3.1; 4.0) | 3.5 ± 0.9<br>3.3 (3.0; 4.3) | 4.0 ± 0.9<br>4.0 (3.4; 4.8) | 3.8 ± 0.9<br>3.7 (3.0; 4.7) | 3.6 ± 0.7<br>3.8 (3.2; 3.9) |
| Social sciences/humanities | 4.1 ± 0.5<br>4.0 (3.8; 4.5) | 3.7 ± 0.7<br>3.8 (30; 4.4) | 4.0 ± 0.7<br>4.1 (3.5; 4.8) | 3.2 ± 0.8<br>3.7 (2.6; 3.8) | 3.9 ± 0.4<br>3.8 (3.6; 4.2) |
| p | 0.085* | 0.616* | 0.829* | 0.195* | 0.483* |

Total $n = 215$; the presented values refer to the mean ± standard deviation and the percentiles P50 (P25; P75); the significance probabilities ($p$) refer to the Kruskal–Wallis test (*) and the Mann–Whitney test (**)

The bolded numbers reached statistical significance

The association between sociodemographic data and motivation clusters is shown in Table 5. As observed in the table, there was a significant association between gender and having a previous higher education degree. The female group showed a lower percentage of students with low motivation (grade I) in comparison with the male group ($p = 0.040$). Similarly, a lower percentage of students with grade I motivation was identified in the group with a prior higher education degree ($p = 0.040$). These findings corroborate the ones shown in Table 2.

## Discussion

This study aimed to provide an overview of the students' motivation regarding an instructional tool that was suddenly implemented, in an atypical period and full of uncertainties, having as background a teaching strategy that was very appreciated in the first period of the medical course: human anatomy [37]. This scenario certainly comprised a genuine "trial by fire" for the asynchronous video lectures taught during the assessed period. Although there are studies showing the good acceptance of this tool during the social isolation period, as reported by Srinivasan [31], the students also expressed their concern about the lack of face-to-face practical lectures and their frustration at the loss of the opportunity for dissection and prosection [24, 30].

The study by Sbayeh et al. [37] showed the great importance given by medical students, professors of anatomy, and clinicians of two Irish courses regarding practical lectures and the consequences of the study of anatomy in relation to issues such as professionalism, teamwork, and ethics.

**Table 3** Influence of self-declared motivation and emotional state due to social isolation on motivation measured by the Instructional Materials Motivation Survey validated in Brazil (IMMS-BRV)

| Variables | Motivation factors | | | | Overall motivation |
|---|---|---|---|---|---|
| | Interest | Confidence | Attention | Expectation | |
| I feel naturally motivated for video lectures on human anatomy | | | | | |
| I disagree (1 e 2) | 3.0 ± 0.7<br>3.0 (2.6; 3.4) | 2.8 ± 0.7<br>2.8 (2.3; 3.3) | 3.1 ± 0.9<br>3.3 (2.3; 3.8) | 2.8 ± 0.8<br>2.7 (2;3.3) | 3.0 ± 0.6<br>3.1 (2.7; 3.4) |
| I neither agree nor disagree (3) | 3.8 ± 0.5<br>3.9 (3.6; 4.3) | 3.7 ± 0.6<br>3.7 (3.3; 4) | 3.8 ± 0.8<br>3.8 (3.3; 4.5) | 3.7 ± 0.9<br>3.7 (3;4.3) | 3.8 ± 0.5<br>3.8 (3.5; 4.1) |
| I agree (4 e 5) | 4.1 ± 0.5<br>4.3 (3.8; 4.6) | 4.0 ± 0.7<br>4.2 (3.5; 4.5) | 4.0 ± 0.8<br>4.0 (3.3;4.5) | 3.9 ± 0.9<br>4.0 (3.3;4.7) | 4.1 ± 0.5<br>4.1 (3.7; 4.4) |
| *p* | **< 0.001** | **< 0.001** | **< 0.001** | **< 0.001** | **< 0.001** |
| Human anatomy video lectures generate motivation in me | | | | | |
| I disagree (1 e 2) | 2.9 ± 0.7<br>2.9 (2.5;3.3) | 2.9 ± 0.8<br>2.8 (2.3;3.3) | 3.1 ± 0.9<br>3.0 (2.3;3.8) | 2.8 ± 0.9<br>2.7 (2.0;3.5) | 3.0 ± 0.6<br>3.1 (2.7;3.3) |
| I neither agree nor disagree (3) | 3.8 ± 0.5<br>3.8 (3.5;4.2) | 3.6 ± 0.7<br>3.7 (3.1;4) | 3.6 ± 0.8<br>3.5 (3.2;4.1) | 3.5 ± 0.9<br>3.3 (2.7;4.3) | 3.7 ± 0.5<br>3.7 (3.4;4.1) |
| I agree (4 e 5) | 4.2 ± 0.5<br>4.3 (3.8;4.6) | 4.0 ± 0.6<br>4.2 (3.7;4.5) | 4.1 ± 0.7<br>4.3 (3.5;4.5) | 3.9 ± 0.8<br>4.0 (3.3;4.7) | 4.1 ± 0.4<br>4.2 (3.8;4.4) |
| p | **< 0.001** | **< 0.001** | **< 0.001** | **< 0.001** | **< 0.001** |
| Did the social isolation measures affect your emotional state? | | | | | |
| They did not affect (1) | 4.1 ± 0.6<br>3.9 (3.6;4.6) | 4.1 ± 0.6<br>4.0 (3.6;4.6) | 3.9 ± 1.1<br>3.9 (3.4;4.8) | 3.9 ± 0.7<br>3.9 (3.3;4.7) | 4.0 ± 0.6<br>3.8 (3.6;4.7) |
| They affected a little (2 and 3) | 3.8 ± 0.8<br>3.9 (3.1;4.3) | 3.7 ± 0.8<br>3.8 (3.2;4.3) | 3.7 ± 0.8<br>3.8 (3.0;4.5) | 3.7 ± 0.8<br>3.7 (3.2;4.3) | 3.8 ± 0.6<br>3.9 (3.3;4.2) |
| They affected a lot (4 and 5) | 3.7 ± 0.8<br>3.8 (3.3;4.3) | 3.5 ± 0.8<br>3.7 (2.8;4.2) | 3.6 ± 0.9<br>3.8 (3.0;4.5) | 3.4 ± 1.0<br>3.7 (2.7;4.3) | 3.7 ± 0.7<br>3.7 (3.2;4.2) |
| p | 0.342 | 0.061 | 0.625 | 0.094 | 0.217 |

Total $n = 215$ students

The values shown here refer to the mean ± standard deviation and the percentiles $P_{50}$ ($P_{25}$; $P_{75}$)

The significance probabilities (*p*) refer to the Kruskal–Wallis test

The bolded numbers reached statistical significance

Similarly, a study carried out to assess the motivation of students attending the medical course at Queen's University (Belfast, UK) regarding dissection, using the IMMS as a measuring instrument, found a mean overall score of 4.21 (± 0.99), corroborating the great importance of this strategy for the students [38].

**Table 4** Mean scores of the Instructional Materials Motivation Survey validated in Brazil (IMMS-BRV) in relation to the three student clusters

| Factors | Degree of motivation | | | Analysis of variance | |
|---|---|---|---|---|---|
| | Grade I | Grade II | Grade III | *p* | Conclusion |
| *Interest* | 2.8 | 3.7 | 4.4 | **< 0.001** | *I < II < III* |
| *Confidence* | 2.5 | 3.6 | 4.2 | **< 0.001** | *I < II < III* |
| *Attention* | 2.8 | 3.5 | 4.4 | **< 0.001** | *I < II < III* |
| *Expectation* | 2.3 | 3.3 | 4.4 | **< 0.001** | *I < II < III* |
| *Overall motivation* | 2.8 | 3.6 | 4.3 | **< 0.001** | *I < II < III* |
| *n (%)* | 47(21.9) | 89 (41.4) | 79 (36.7) | | |

Total $n = 215$ students

*n* number of students in the cluster

Cluster analysis

*p* ➔ probability of significance of the Kruskal–Wallis test

The bolded numbers reached statistical significance

On the other hand, remote teaching has also represented an environment of intense development and training of remote teaching–learning skills. Therefore, the assessment of the educational practices implemented during the COVID-19 pandemic must be carried out to correct directions and identify new opportunities that might be useful beyond the social isolation phase, aiming at a possible appreciation of hybrid teaching. A recent study showed that 87.5% of anatomy students at the University of Singapore School of Medicine, assessed through a questionnaire designed to assess their satisfaction with learning through the Zoom platform, were satisfied with remote teaching [31].

The results of the present study, regarding the students' overall motivation, showed that the mean score measured by the IMMS-BRV was 3.7, which corresponds to 74% of the total possible score. Hence, it can be considered that students expressed a good motivation mean in relation to

**Table 5** Association between sociodemographic data and motivation clusters

| Variables | Grade | | | *p* |
|---|---|---|---|---|
| | I | II | III | |
| Age group | | | | |
| 17 to 19 years | 25 (24.5%) | 41 (40.2%) | 36 (35.3%) | 0.361* |
| 20 to 22 years | 15 (27.8%) | 22 (40.7%) | 17 (31.5%) | |
| 23 to 25 years | 5 (17.8%) | 12 (42.9%) | 11 (39.3%) | |
| 26 years or older | 2 (6.4%) | 14 (45.2%) | 15 (48.4%) | |
| Gender | | | | |
| Female | 25 (17.0%) | 65 (44.2%) | 57 (38.8%) | **0.040*** |
| Male | 22 (32.4%) | 24 (35.2%) | 22 (32.4%) | |
| Prior higher education degree | | | | |
| No | 45 (25.0%) | 71 (39.4%) | 64 (35.6%) | **0.040*** |
| Yes | 2 (5.7%) | 18 (51.4%) | 15 (42.9%) | |
| Area of knowledge of the prior higher education degree | | | | |
| Exact sciences | 1 (12.5%) | 3 (37.5%) | 4 (50.0%) | 0.781** |
| Biological sciences/health area | 1 (5.9%) | 9 (52.9%) | 7 (41.2%) | |
| Social sciences/humanities | 0 (0.0%) | 6 (60.0%) | 4 (40.0%) | |

Database: 215 students

The *p* value refers to the probability of significance of the chi-square test (*) or Fisher's exact test (**)

The bolded numbers reached statistical significance

asynchronous video lectures in the current social context, as also demonstrated in other studies [39]. Likewise, the mean scores in the four dimensions of motivation homogeneously varied between 3.5 (Attention) and 3.7 (Confidence and Expectation). These findings agree with the results of the study by Huang and Hew [33], which measured, using IMMS, the motivation of students participating in massive online courses (Coursera, Open2study, and Khan Academy), which also used asynchronous video lectures. In their study, the overall motivation score was 3.6, and in the Attention and Confidence dimensions, it was 3.5 and 3.7, respectively.

This good motivational behavior is even more evident in the analysis of clusters, where 78.1% of students showed moderate (grade II) or high (grade III) degrees of motivation. A total of 41.4% of students were in the cluster comprising students with grade II motivation (moderate), whose mean overall motivation score was 3.6 (72% of the maximum score), whereas 36.7% of students were in the cluster comprising students with grade III motivation (high), whose mean overall motivation score was 4.3 (86% of the maximum score). Only 2.9% of students were in the cluster with grade I motivation, in which the mean overall score was 2.8 (56% of the maximum score). In this sense, Singh and Ming [40] carried out a study to investigate the attitudes and learning of first-year medical students regarding video lectures used to teach macroscopic anatomy. One cohort of students was submitted to face-to-face classes and the other to asynchronous video lectures, which had the same content. The video lectures group performed significantly better in the tests and evaluated the tool positively.

The adequate motivation observed for the anatomy video lectures can also be analyzed in the light of the characteristics of the current generation of students. Barry et al. [41], in the article *Anatomy education for the YouTube generation*, observed that 78% of the included medical students used YouTube video lectures as a study source, with 50% of the students using them weekly. Similarly, 78% of students reported that the videos were useful, very useful, or extremely useful in helping them understand anatomy. In the present study, all subjects are from Gen Y and Gen Z. This fact may explain the good motivation founded in the target population and the non-difference in the comparison between the age and motivation.

When the motivation was analyzed from the perspective of sociodemographic data, regarding the Attention dimension, the scores were significantly higher in the female gender ($p=0.023$) and in the group that had a prior higher education degree ($p=0.006$). These results were corroborated by the cluster analysis, which showed a lower percentage of students with low motivation (grade I) in the female group than in the male group ($p=0.040$). Similarly, a lower percentage of students with grade I motivation was identified in the group with a prior higher education degree ($p=0.040$). It is noteworthy that the Attention dimension has items that directly assess the instructional activity (asynchronous video lectures) and its strategies to obtain and maintain attention based on curiosity, with this dimension being considered a personal characteristic and a prerequisite for learning. Therefore, it is necessary that the interface of the video lectures stimulate and sustain the students' attention [42, 43].

Indeed, the role of the individual's gender in shaping motivation for learning has been widely discussed in the literature. In a fruitful review article on gender differences regarding motivation, focusing on the expectancy-value theories, causal attribution, self-efficacy, and achievement goals, Meece et al. [44] concluded that the differences are domain-specific, which allows us to highlight the significantly positive result found in the present study, only in the Attention dimension of motivation, in relation to the female gender. Several empirical studies on motivation and learning, in foreign language online courses, have also observed greater motivation in female groups [45].

Nonetheless, in a study involving the assessment of motivation in an online learning environment, it was also verified that motivation was significantly higher in females, assessed by the IMMS dimensions, including Attention [46]. In this study, the author lists several works supporting the fact that women are more engaged and have better learning results than men in the online learning environment. Similarly, a study assessed the behavior of 2927 students regarding 18,144 video lectures related to 13 online modules, from Yasar University, in Turkey. In this study, a significant difference was observed ($p < 0.001$), in favor of women, in relation to the variable that evaluated whether students fully watched the videos [47]. This finding is completely in agreement with the IMMS-BRV Attention dimension, which verifies whether the instructional material, in the case of this research the asynchronous video lectures of human anatomy, can arouse the students' curiosity and sustaining their attention throughout the activity.

The higher score in the Attention dimension, found in the group of students with a prior higher education degree, may reflect their deeper perception regarding the value of anatomy for their careers, due to their greater maturity and the practical experiences they had in their previous graduation.

Aiming to verify the association of the students' perception of their motivation regarding asynchronous human anatomy video lectures and the motivation measured by a validated instrument (IMMS-BRV), two items were included in the complementary questionnaire, both to be answered using the Likert scale: the first one had a phraseology aimed at detecting intrinsic aspects of motivation (I feel naturally motivated for video lectures on human anatomy). The second item aimed to capture extrinsic aspects of motivation (human anatomy video lectures generate motivation in me). Although they are simple items, which were not submitted to the evaluation of their psychometric properties, the students' responses showed total agreement with the scores measured by IMMS-BRV. These findings can be seen, a priori, as confirmation of the validity of IMMS-BRV for the measurement of motivation in the studied population.

In turn, the influence of social isolation on the emotional state did not affect the overall motivation scores ($p = 0.217$) and the dimensions of the IMMS-BRV: Interest ($p = 0.342$); Confidence ($p = 0.061$); Attention ($p = 0.625$), and Expectation ($p = 0.094$). These findings are in agreement with studies of which results showed that although the medical students demonstrated a high degree of anxiety during remote emergency teaching, this behavior, related to the emotional state, is not indiscriminately perceived in relation to all the strategies used in online study. In this sense, asynchronous video lectures and synchronous meetings are being well rated and have not been affected by the emotional state [25, 48, 49]. Still in this regard, a study that included medical and dentistry students attending the first year of the course showed that although 69% of the students felt a lack of "self-motivation," the anatomy video lectures were appreciated by most students, who felt free to learn at their own pace, taking advantage of the possibility to pause, go back and watch again, as many times as necessary. In this study, only 9% of the participants said they were dissatisfied with the anatomy video lectures. In conclusion, the authors emphasized the gain that remote education is generating in terms of self-directed learning, which can also be highlighted in relation to self-determination [50].

It is interesting to note that, despite the "damage" caused by the impediments to practical face-to-face study, the emergency model adopted by UNIFENAS-BH also had positive and motivating aspects. Therefore, one can affirm that the asynchronous video lectures, available for study prior to synchronous meetings, mimicked the flipped classroom methodology, widely used and well rated in online courses, as it is able to promote aspects of the students' intrinsic motivation and self-determination [40, 51–53]. This online hybrid anatomy curriculum was viewed as the most effective method because it incorporates the best features of synchronous and asynchronous components [54]. Indeed, intrinsic motivation is related to positive learning environment perceptions and is positively correlated with perceived academic rank [55].

## Limitations of the Study

The main limitation of this study is related to the studied population. For the motivation assessment to be carried out during the two semesters of 2020, without including the same students again, the study considered only the students attending the first semester of the medical course. In addition, the evaluation of the emotional state through a single question, instead of a validated measurement instrument, also constituted a limitation of the study. However, this strategy was chosen because the primary objective was to assess motivation through the application of IMMS-BRV, and the incorporation of another questionnaire with several items could cause exhaustion in the students and impair the quality of responses.

## Conclusions

This study evaluated an important factor related to meaningful learning of human anatomy. The main conclusions from the study are:

- The students showed high motivation for the asynchronous video lectures of human anatomy.
- Although the majority of the participants were very affected by their emotional state due to the social isolation imposed by the COVID-19 pandemic, this fact did not interfere with the motivation for the video lectures, probably due to the intrinsic motivation that students attending the first year have regarding the study of anatomy, as they value its importance for good medical training and due to their curiosity regarding the in-depth knowledge of the human body.
- The autonomy given to students to watch the asynchronous video lectures, managing the pace of their own study, revising it, when necessary, is probably associated with their motivation for the asynchronous video lectures.
- These findings alert to the importance of asynchronous video lectures as an adequate strategy for the teaching and learning of human anatomy, suggesting the need for further studies to develop motivating formats adapted to each educational context.

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## Declarations

**Ethical Approval** The research ethics committee of José do Rosário Vellano University (UNIFENAS-BH) approved this study (Approval ID: 03461718.0.0000.5143).

**Consent to Participate** Implied consent was obtained from all individual participants included in the study.

**Conflict of Interest** The authors declare no competing interests.

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