



# “Dissection Educational Videos” (DEVs) and their contribution in anatomy education: a students’ perspective

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## Abstract

**Purpose** The suspension imposed on Universities due to COVID-19 pandemic impeded students’ educational opportunities. Alternative teaching modalities have been used. Substitution of dissection courses on cadavers was a great challenge. Present study investigates students’ view on the efficacy of the “online” pre-recorded “dissection educational videos” (DEVs) in assisting anatomy teaching, aiming to modernize the lectures and reinforce comprehension.

**Methods** The adequacy of the “online” anatomy courses and a possible new teaching modality were evaluated by the 2nd year pre-graduate students, employing an online questionnaire.

**Results** One hundred and ninety-six volunteer students participated. Before the pandemic, 78.1% of the students constantly attended the “auditorium-based” lectures and 73% used self-teaching tools (STTs) for a better understanding of anatomy. During pandemic, a slight lower frequency (76%) attended the “online” lectures and a higher frequency (84.2%) used at least one STT. Up to 59.2% of the students disagreed with the permanent replacement of the “auditorium-based” by the “online” lectures, while 62.8% supported the idea of parallel conduction of the lectures. Combined teaching tools were the most preferred resources. 83.2% of the students stated that the dissection labs’ cancellation negatively affected their education, and 75.5% supported the permanent addition of the pre-recorded DEV series in the lectures.

**Conclusions** COVID-19 pandemic created the temporary need for pure remote education. During lockdown, the use of STTs has significantly increased. A novel teaching modality (DEV series), presented in the study, can be used both as educational material and as a STT.

**Keywords** Online · Anatomy · Remote teaching · COVID-19 · Education · Teaching modality · Dissection videos · Cadavers

## Introduction

The coronavirus SARS-Cov-2 outbreak was followed by a worldwide imposition of restrictive and social-distancing measures. All teaching modalities were re-designed in a

more effective way to meet the need for remote education. A multimodal anatomy education approach was introduced by employing the communication (*video conferencing and digital technologies*) advances [4, 8]. Special efforts were concentrated on the substitution of the anatomy education practical part based on cadaveric dissection. The ‘hands-on’ part on cadavers remains the “key” for exploring the particularly complex subject of anatomy [2, 3, 9, 23].

In our Department, all courses were cancelled after the application of the restrictive measures against pandemic by the Greek Government. The theoretical anatomy education (auditorium-based lectures) was exclusively performed online, similarly to other Universities [11, 22, 26]. Efforts were concentrated on the substitution of the anatomy education practical part, that of cadavers’ dissection. The

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dissection lab courses were offered “online” by creating pre-recorded “dissection educational videos” (DEVs) series.

The current questionnaire-based study aims to evaluate the students’ perspective about the “online” lectures, as well as to assess their viewpoint concerning the DEV series efficacy. Hence, the study aims to optimize anatomy education and to improve the in-depth anatomy knowledge.

## Materials and methods

### Study design and population

The study was held during the 2020–2021 academic winter semester. The participants were 2nd year undergraduate students of the AUTH Medical and Dental School. According to the Anatomy and Surgical Anatomy Department’s current curriculum, the anatomy courses are being delivered to the first 2 years undergraduate students. During each semester, students are gradually being taught various anatomy topics by a combination of face to face (F2F) theoretical and practical courses. In the 1st semester’s theoretical part, students are introduced to anatomical terminology and general anatomy issues and in the 2nd semester they are taught the musculoskeletal system. The 2nd semester’s practical teaching is performed on dried bones and on SOMSO® plastic anatomical models of muscles and joints. The same pattern is applied to the 3rd semester’s theoretical part, which deals with internal organs anatomy, giving special emphasis on the [circulatory, peripheral nervous (*spinal and cranial nerves’ origin, branching pattern and distribution*) and autonomous nervous] systems. However, this semester’s practical part is held at the Anatomy Dissection Hall, including all stages of dissection courses on embalmed cadavers. During each course, the students are being taught about the origin, the branching pattern of various anatomical structures, such as the vessels, cranial, and spinal nerve distribution, as well as the lymphatic system anatomy. Human brain, spinal cadaveric specimens and SOMSO® plastic models of the central nervous system and sensory organs are used during the 4th semester. Moreover, a peer-teaching program (*teaching assisted by adequately trained students*) is used. In the pre-pandemic era, the Anatomy Dissection Hall was open for both students and instructors on a daily basis, and many students (*about 30.6% overall*) were able to study on the cadavers.

Due to pandemic, all auditorium-based lectures were exclusively performed online, via the online communication platform (*Zoom Video Communications, Inc*). The lab courses were substituted by pre-recorded DEV series (*20 videos of 15 min duration each*) regarding various anatomical topics in accordance with the current Anatomy and Surgical Anatomy Department’s curriculum. All videos

were recorded in the Anatomy Dissection Hall on dissected cadavers using an Olympus Corporation Digital Camera E-M10™ (*Tokyo, Japan*). Afterwards, they were edited using the iMovie® software for MacOS (*version 10.1.12*). The editing process included the addition of captions and essential corrections in videos’ image and sound quality. During each video, the dissected muscular, vascular and nervous structures and their relationships with the adjacent structures were presented and explained by the narrating professor (*Fig. 1*). All videos were uploaded before the beginning of the “online” courses and offered free to download through the Department’s official account on the “e-learning.auth” University web-platform (*elearning.auth.gr, Meducator, Thessaloniki, Greece*). During each scheduled online course, the DEVs were used in a non-audio form. Each video was muted by the presenter, who commented on dissection findings and simultaneously answered to students’ questions. Similar DEV series have been used in the Department’s postgraduate program over the past twelve years (2008–2020).

All students were asked to fill in the questionnaire, their perspectives concerning the online anatomy courses format and the usefulness of the “online” pre-recorded DEV series demonstration, as a new teaching modality. The questionnaire of 17 questions (*Table 1*) was divided into a general and a specific part. The general part included questions concerning the demographic data (*students’ age, gender, hometown, and study academic year*). The specific part addressed questions regarding the evaluation of the online teaching method and the students’ opinion regarding the online modality of the pre-recorded DEV series demonstration. In an attempt to assess students’ perspective regarding the pre-recorded DEV series’ usefulness, the *Q13, Q14, and Q17* questions were created. All responses were measured on a Likert-type scale (*grade 1-total disagreement to...grade 5-total agreement*). The grade 3 responses were not included in the analysis (“gray zone”), as they could not be interpreted as positive or negative.

## Results

One hundred and ninety-six (124 female and 72 male) volunteer participants with a mean age of  $20.64 \pm 3.26$  years (43.4% of the Department’s students) filled the questionnaire. Among them, 72.4% attended the Medical and 27.6% the Dental School. 131 respondents (66.8%) studied away from their hometown (Thessaloniki). An overview of the current study’s findings is reported in *Table 1*.



**Fig. 1** Print screens from the pre-recorded “dissection- educational video” (DEV) series used, depicting the dissection area of the: **A** right hand with the superficial palmar arch distribution and related innervation from the ulnar and median nerves, **B** adductor canal and

the obturator nerve’s anterior division (sartorius and adductor muscles are dissected), **C** popliteal fossa with the sciatic nerve division into the tibial and the common fibular nerve, **D** spinal dural sac with the cauda equina depiction and filum terminale

### Attendance of the anatomy courses before and during pandemic

Before pandemic, 153 students (78.1%) attended on a constant basis the “auditorium-based” lectures (Q7) and 132 (86.3%) found these lectures adequate as content and educational value (Q8). During the pandemic, 149 participants (76%) attended the “online lectures” (Q9). Almost half of the students (48.5%) supported that the “online lectures” would not be necessary when the auditorium audience will be available again (Q10). The majority of students (116 participants, 59.2%) were opposite to the permanent replacement of the “auditorium-based” by the “online” lectures (Q15). 123 students (62.8%) supported the idea of parallel conduction of the lectures (both in auditorium and online format) (Q16).

### Self-teaching resources in anatomy education

In pre-pandemic era, 73% of the participants (143 subjects) used self-teaching tools (STTs) (*electronic atlases, YouTube videos* etc.) for a better understanding of the anatomy (Q5). During lockdown, a notably higher frequency (84.2%, 165 students) used at least one STT (Q6). Combined teaching tools were the most preferred resources in both eras (in pre-pandemic, 65 students—33.16% and during pandemic, 101 students—51.53%) (Q5, 6).

**Table 1** Overview of the questionnaire's results: the most frequent replies of the participant-students are indicated in red

Q1	What is your age?*						
Q2	What is your gender?*						
	<input type="checkbox"/> Males						
	(72/196)	<b>36.7%</b>				Females	<b>63.3%</b>
						(124/196)	
Q3	In which Department of the Aristotle University of Thessaloniki do you study? *						
	<input type="checkbox"/> Medical School						
	(142/196)	<b>72.4%</b>				Dental School	<b>27.6%</b>
Q4	Do you study in your hometown? *						
	<input type="checkbox"/> Yes					No	
	(65/196)	<b>33.2%</b>				(131/196)	<b>66.8%</b>
Q5	Did you use prior to COVID-19 era, any of the aforementioned self-teaching resources to help you out with the understanding of anatomy courses? *						
	<input type="checkbox"/> Online videos (e.g., YouTube videos)						<b>13.27%</b>
	<input type="checkbox"/> E-atlases / E-books						<b>23.47%</b>
	<input type="checkbox"/> Combination of the above						<b>33.16%</b>
	<input type="checkbox"/> Nothing of the above						<b>27.04%</b>
	<input type="checkbox"/> Other (Quizzes, etc.)						<b>3.06%</b>
Q6	Do you use any of the aforementioned self-teaching resources to help you out with the understanding of anatomy courses, during COVID-19 outbreak? *						
	<input type="checkbox"/> Online videos (e.g., YouTube videos)						<b>14.28%</b>
	<input type="checkbox"/> E-atlases / E-books						<b>15.82%</b>
	<input type="checkbox"/> Combination of the above						<b>51.53%</b>
	<input type="checkbox"/> Nothing of the above						<b>15.82%</b>
	<input type="checkbox"/> Other (Quizzes, etc.)						<b>2.55%</b>
Q7	How often (on a scale of 1 to 5) did you attend auditorium-based lectures in pre-pandemic era? *						
(Never)	1	2	3	4	5		(Always)
	(2/196)	<b>1.02%</b>	<b>7.65%</b>	<b>13.26%</b>	<b>26.02%</b>		<b>52.04%</b>
		(15/196)	(26/196)	(51/196)	(102/196)		
Q8	How would you rate (on a scale of 1 to 5) the educational value of auditorium-based lectures? *						
(Insufficient)	1	2	3	4	5		(Sufficient)
	(3/196)	<b>1.53%</b>	<b>5.10%</b>	<b>26.02%</b>	<b>40.31%</b>		<b>27.04%</b>
		(10/196)	(51/196)	(79/196)	(53/196)		
Q9	How often (on a scale of 1 to 5) did you attend online courses during pandemic? *						
(Never)	1	2	3	4	5		(Always)
	(7/196)	<b>3.57%</b>	<b>11.22%</b>	<b>9.18%</b>	<b>25.51%</b>		<b>50.51%</b>
		(22/196)	(18/196)	(50/196)	(99/196)		
Q10	What is your opinion (on a scale of 1 to 5) regarding the educational value of online courses? *						
	<input type="checkbox"/> Online courses are not necessary when auditorium-based lectures are available						<b>48.47%</b>
	<input type="checkbox"/> Online courses are equal to auditorium-based lectures						<b>21.94%</b>
	<input type="checkbox"/> Online courses have advantage over auditorium-based lectures						<b>19.39%</b>
	<input type="checkbox"/> I don't want to reply						<b>4.08%</b>
	<input type="checkbox"/> Other						<b>6.12%</b>

Table 1 (continued)

Q11 (Merely)	In what extent (on a scale of 1 to 5), do you believe that the inability of attending dissection lab courses affects your education? *					
	1 (5/196)	2 (9/196)	3 (19/196)	4 (53/196)	5 (110/196)	(Completely)
Q12	Have you ever followed a cadaver's dissection? *					
	<input type="checkbox"/> Yes					No
Q13 (Merely)	<input type="checkbox"/> No					(164/196)
	16.33%					83.67%
Q14	In what extent (on a scale of 1 to 5), have you watched the pre-recorded "dissection educational videos" (DEV) series after the courses' completion? *					
	1 (23/196)	2 (38/196)	3 (55/196)	4 (56/196)	5 (24/196)	(Completely)
Q15 (Disagree)	What is your opinion (on a scale of 1 to 5) regarding the permanent addition of "dissection educational videos" (DEV) series in the Department's educational resources after the pandemic? *					
	1 (22/196)	2 (22/196)	3 (36/196)	4 (40/196)	5 (76/196)	(Agree)
Q16 (Disagree)	What is your opinion (on a scale of 1 to 5) regarding the permanent replacement of auditorium-based lectures by online lectures after the pandemic? *					
	1 (87/196)	2 (29/196)	3 (31/196)	4 (23/196)	5 (26/196)	(Agree)
Q17 (Disagree)	What is your opinion (on a scale of 1 to 5) about the in parallel online streaming of each auditorium-based lecture? *					
	1 (18/196)	2 (19/196)	3 (36/196)	4 (48/196)	5 (75/196)	(Agree)
	What is your opinion (on a scale of 1 to 5) about the possible enrichment of presentations' content with "dissection educational videos" (DEV) series? *					
	1 (9/196)	2 (10/196)	3 (29/196)	4 (44/196)	5 (104/196)	(Agree)

\*Mandatory field



## Assessment of the value of dissection labs and of the pre-recorded dissection educational videos

The vast majority of participants (163 subjects, 83.2%) supported that the dissection labs' cancellation negatively affected their education (Q11). A significant number of students (164, 83.7%) had never participated in a dissection before (Q12). 116 students (59.2%) were positive to the permanent addition of the pre-recorded DEV series in the Department's provided educational material (Q14), and 148 students (75.5%) were positive about the addition of the DEV in the lectures' content (Q17). 80 students (40.8%) watched the pre-recorded DEV series after the courses' completion (Q13).

## Discussion

The recent COVID-19 outbreak, forced Universities [1, 24, 26] to indefinitely cancel all F2F classes. Rapidly, the necessity of the "online" education increased, and students had to substitute the postponed lessons both by intensifying the use of STTs and by attending remote anatomy education (RAE) lessons.

In the RAE, various teaching methods and immersive technologies, such as online communication tools, online videos, three-dimensional (3D) technology, and virtual reality (VR) have been used [7, 9, 13, 14]. Except for the other benefits [3, 25, 28], these teaching methods provide students the unique opportunity of the *Omni-Learning (ability to learn anywhere, any-time, with anyone)* [24].

Like the conventional "auditorium-based" lectures, the "online" communicational tools have been characterized as a passive form of learning [16, 20, 26]. Consequently, many authors supported that students would benefit more from a blended approach [based on the combination of conventional and digital resources (e.g., 3D models, VR, videos)] [3, 6, 21, 25]. Iwanaga et al. used a free cell phone application to create 3D anatomy models for the "online" lectures [12]. In another study, Iwanaga et al. [11] compared a 3D VR workspace with conventional teaching methods. Chan et al. [4] commented on the advantage of 3D anatomy videos over standard two-dimensional (2D) videos. In all these studies, the cost and required equipment may be "unaffordable" for various Universities.

Several authors commented on the use of "online" videos for anatomy education [15, 25, 29]. Langfield et al. [18] pointed out the videos' auxiliary role in the educational process and Kelsey et al. [15] concluded to the higher efficiency of the "video-assisted" compared to the "video-based" anatomy training. Viswasom et al. [29] concluded the improvement of the efficacy of conventional educational tools (e.g.,

lectures) with their use and Ozer et al. [22] highlighted the improvement of students' exam scores.

Cadavers' dissection remains the anatomy's gold standard teaching method for over four centuries and is still considered irreplaceable according to the present and other studies [7, 10, 23, 27] students' perspective. Hence, another well-discussed topic was the creation of audio-visual resources to help students for the dissection course [5, 8, 17]. In our Department, none of these resources was used in pre-COVID-19 era. Nevertheless, due to the inability of conducting cadavers' dissection courses, we came up with the idea of creating the pre-recorded DEV series. The main difference between these aforementioned resources and the DEV series was related to the way each video's content was delivered to students. Specifically, in our series, even though the videos were pre-recorded, they were muted by the tutor and presented synchronously. Their active, conceptual, and interactive way of presentation permitted an open dialogue between students and tutor. Moreover, the pre-recorded (DEVs) were uploaded and remained free to download, serving as self-teaching material.

The utilization of self-teaching materials is not new. In a study before pandemic, Johnson et al. highlighted their use due to the complexity of F2F lectures [14], while during COVID-19 pandemic, Luu et al. pointed out the usefulness of online videos in anatomy learning of the otolaryngology trainees [19]. The current survey findings come in agreement with both referred opinions.

Based on the results of the present survey, the majority of students did not watch the entire DEV series after the courses' completion. A possible explanation would be the lack of practical exams on cadaveric material. Thus, the concept of using them as a self-teaching material can still be viable. Yet, additional studies must be conducted aiming to clarify this gray zone.

Another issue examined in the current study was the auditorium-based lectures' replacement with online lectures. Unlike the study of Yoo et al. [30] the participants of this survey were not in favor of the possibility of this replacement, even though they were positive regarding the parallel lectures' delivery both in physical (auditorium) and in distant (online) form.

## Study limitations

The pre-recorded DEV series was created by the first author of the study. The use of a commercial microphone (*Microsoft Headset Lifechat LX-3000*) and the lack of a soundproof room allowed environmental noise to become audible, thus reducing the recording quality. Two associates of the Department independently assessed and approved all participants of this project, as well as the final videos. Another important limitation was the internet

speed of each participant's internet provider. Students with poor quality internet connection had serious problems in attending the online courses. A few students do not have the appropriate equipment, including internet connection. Another limitation was that the current study was conducted only on the ATh students, thus its findings may have been affected by many factors, such as teaching methods, technical competencies, didactic differences, different anatomy topics, etc. Additionally, no investigation was made regarding the effectiveness of the DEVs on the exam performance.

## Conclusions

COVID-19 pandemic created the need for pure remote education. According to the study, this need may be temporary. During the lockdown, the use of self-teaching tools has significantly increased. A novel teaching modality (DEV series) presented in the study can be used both as an educational material and as a self-teaching tool. Undoubtedly, the COVID-19 pandemic posed a “significant threat” to the status quo of anatomy education. Hopefully, the findings of the current survey may contribute to the reformation of the anatomy educational process.

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**Author contributions** KN: Protocol development, cadavers' dissections, videos' creation, narration and presentation, manuscript final editing. NL: Courses' presentation, data collection and analysis, manuscript editing and final revision. MK: Questionnaire creation, data collection and analysis, manuscript writing; manuscript editing. NA and TT: Courses' presentation, data collection and analysis, manuscript editing. DC: Data analysis, data management, manuscript editing. MP: Protocol design, data analysis, manuscript writing and manuscript final editing.

## Declarations

**Conflict of interest** The authors have no conflicts of interest to disclose.

**Ethics approval** The online questionnaire (<https://forms.gle/5En8JvyUKaESzkF68>) completion, available in Google Forms<sup>®</sup>, was voluntary, highly confidential and anonymous. The questionnaire was sent to two randomly selected members of the Department (not project-participants), to obtain feedback regarding the questions' accuracy and clarity. All participated students gave informed consent before being guided to the questionnaire. Their responses were registered in a Microsoft Excel database and were analyzed using JASP software (0.13.1 version, Amsterdam's University). The protocol's approval was obtained from the ATh Bioethics and Ethics Committee.

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