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Utilization of Dissection Videos in Graduate-Level Gross Anatomy Education: An Analysis of Student Confidence, Utilization, and Scoring Outcomes

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by co-authors

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Utilization of Dissection Videos in Graduate-Level Gross Anatomy Education: An Analysis of Student Confidence, Utilization, and Scoring Outcomes

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The use of videos in anatomy education has become a potential tool for learning by students. It is currently unclear if using videos that show how to perform a dissection can have an impact on student practical scores. This thesis attempted to address that question as well as address how videos can impact student confidence levels and how students might implement videos into their study strategies. A set of high definition videos was made following the specific steps of a dissector guide and provided to students prior to their third and fourth lab practicals. A series of three surveys was conducted to gauge student experience, learning resource utilization, and feedback for the videos. Student experience had a significant impact on grade outcomes so students were split into groups: students with prior cadaver lab experience and students without. Students used the videos primarily before lab to help prepare for lab and exams. The videos may have had an effect on the final lab practical score for the students who used the videos and may have increased confidence levels in students that used the videos compared to those who did not. This may suggest that dissection video use could have a positive impact on lab practical test scores.

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Chapter 1: Introduction

Gross anatomy is a staple of education for medical students, allied health professionals, and graduate students. The most valuable part of gross anatomy education is the use of cadavers. In the cadaver lab, students dissect their donors and intimately learn about the human body and its tissues. Instructors and students agree that cadaver dissection is vital to learning anatomy but in many programs it is hard to obtain donors. This can lead to a high ratio of students per donor which limits the amount of dissection that students are able to do. While cadaver dissection is the best way to learn and teach gross anatomy, many programs try to use other resources to supplement the laboratory work.

Conventional teaching resources inside and outside of the laboratory tend to be preferred by students, according to Nageswari et. al (2004). These resources usually include the recommended anatomy atlases and textbooks, traditional lectures supplemented with PowerPoint presentations, and dissector guides. The quality of such resources varies by program but Mayfield et. al (2012) looked at the use of online dissector guides during laboratory time versus more traditional paper guides and hardcover atlases. The online dissector guides combined the paper guide and relevant atlas images together. Students that had access to the online dissector guides via iPads were more engaged and active in lab and reported feeling like their time was better managed. It was observed in this study that the students who had the more traditional guides spent more time waiting for instructor assistance and searching through the atlases than dissecting and the students with the iPads were more efficient with their time. While there were concerns that giving students access to iPads would lead to more distractions and inefficiency (using inappropriate apps or using the iPad for irrelevant activities instead of laboratory work), the study concluded that such concerns were likely unfounded, however,

students in this study did not have access to the internet while in the laboratory. There are no studies showing whether internet access increases the amount of distractions during cadaver-based anatomy laboratory courses.

The state of anatomy education is changing, however. More visual resources are being used by students with the rise of social media and huge pools of online resources. Acland's Anatomy Video Atlas and the free Human Anatomy Education channel on YouTube are two very popular video resources that many students have available to them and because anatomy requires a large amount of visual and spatial skills, using videos or other audiovisual resources may help anatomy students learn the material better. With such a large breadth of study options, it is important to look at how students use such resources, if using audiovisual learning resources affects testing outcomes, and what types of limitations or concerns such resources may bring up.

Mahmud et. al (2011) reported that showing videos depicting the dissection of the upper and lower limbs did not have a significant impact on class test scores (the tests consisted of a written multiple choice exam, an oral exam, and a pinned practical of laboratory specimens/donors) but that students did report that they liked the resources and felt they helped them learn the material better. However, Collins et. al (2015) found the opposite of Mahmud's study. Collins showed a group of students at various stages in their medical training an upper limb dissection video before a dissection course. The students that saw the video outperformed their peers at the same level of training who did not see the video. It is possible that these two studies made opposite conclusions because of differences in their methods.

In Mahmud et. al's study, the sample size was significantly larger, but participation for the lower limb dissection videos was voluntary. Additionally, based on timing within the

semester, there is no real control group. In this study the students in group A were shown the videos on the upper limb after they had already been tested over the material and watching the lower limb videos was optional. The students in group B were shown the upper limb videos but had already been tested over the lower limb so it is unlikely that a large portion of the group B students chose to watch the lower limb videos. Test scores from the previous two years were used for comparison to see if the students in Mahmud's study did better, but because of which semester the videos were shown and the fact that only half of them were actually required to be seen (by being shown in lecture twice), the study has some serious flaws.

In the Collins et. al study the students in the variable group were shown a video demonstrating dissection of the upper limb prior to beginning a dissection course. The students in the control group were outperformed by their peers with the same experience in the variable group, which was measured in standardized multiple choice questionnaires with questions specific to upper limb anatomy. While the Collins study had a much smaller sample size, it also had more controls in place: the instructor to student ratio was kept constant (1:2) and the questionnaires the students took were evenly spaced with regard to timing. The students were also tested over the same material at the same time. None of these factors exist or are described in the Mahmud study and do not appear to be taken into account regarding their conclusions. The biggest problem with the Mahmud study, which they acknowledge, is the lack of control over viewing the videos and the minimal monitoring over the pattern of use by students.

Choi-Lundberg et. al (2015) analyzed the type of learning resources students preferred to use while studying anatomy and found that while videos did not outrank textbooks, atlases, or traditional lectures students still rated them very highly. The Choi-Lundberg study did not take into account how these resources affected grading outcomes but they did conclude that a

variety of study resources available for students to use was a “good practice to help students gain a variety of perspectives […] and synthesize information from multiple resources”. This study was not the only one to find that students enjoyed videos relevant to studying anatomy (Mahmud et. al 2011, Wang et. al 2010, Topping 2013, and Mukhopadhyay et. al 2014). Students will use tools they like over others, so if students enjoy the videos and feel they help them learn anatomy or make studying anatomy easier then test outcomes may not be the best way to evaluate whether or not videos should be used as a learning resource.

Video use in learning is not a new concept. In 2010, Wang et. al looked at the use of video-conferencing in medical school lecturing. Concerns that students would not attend lectures if they were available online were shown to be unfounded, however, the students selected for Wang’s study were invited to participate in the study via email and then interviewed to determine their inclusion. Students who attended lectures were probably more likely to volunteer for the study leading to a significant selection bias, a limitation that the authors do acknowledge. At this point, many medical schools record lectures for students to peruse outside of class and use to review contents for exams. The biggest advantage, according to Wang’s study, to video-recorded lectures was the ability to rewind or fast-forward as needed. Denning’s study also highlighted the ability to change a video’s speed as an advantage to videos in his evaluation of video use in the classroom. Dong et. al (2016) agree with Denning that being able to adjust the speed of the video helps learning and should be a major consideration for choosing appropriate videos. Because students can view a video as many times as they need to and can skip over or fast-forward through any redundant or unnecessary lessons, time adjustments can allow students to better focus their study time on more relevant and challenging materials with minimal time inefficiency. Additionally, Denning suggested that video

use may help strong visual learners understand concepts better. Nageswari et. al (2004) also support this concept in their study.

The Nageswari study looked at different learning opportunities and resources for first year medical students and then asked them to rank the resources numerically based on the overall impact they had on the students' learning. The VARK survey was used to classify the different resources the students were presented with and it was found that many of the resources overlapped over multiple types of learning. For example, cadaver dissection would incorporate kinesthetic and visual learning. The Nageswari study showed that resources that had strong visual learning and overlapped with other types of learning were rated more highly by students. This may be due to the fact that by the time students reach medical school, the vast majority of their education has consisted of visual types of learning (PowerPoint presentations, lectures, diagrams, etc.) and it is what they are most familiar and comfortable with and therefore more likely to use or prefer over other options. This may also be why students ranked more traditional learning resources (lectures, PowerPoint presentations, textbooks, etc.) higher than other less traditional resources (software, websites, videos, etc.) in the Choi-Lundberg study. The fact that many of the less traditional resources in the Choi-Lundberg study required students to pay for them is another possible explanation.

Although students seem to prefer more traditional teaching resources (PowerPoint presentations, lectures, textbooks, atlases), the influence the internet has had on higher education is clear. The majority of studies done to analyze videos in learning anatomy have looked specifically at YouTube, a video sharing website combined with social media networking, and how it can be used to teach anatomy. Mukhopadhyay et. al. (2014) determined YouTube to be used primarily by students in developed countries but highlighted its potential for teaching students in developing countries. The ease of use and accessibility of YouTube makes it an ideal

study resource for students but many studies analyzed for this review (Mukhopadhyay et. al 2014, Azer 2012, Barry et. al 2015, Raikos et. al 2013, and Jaffar 2012) brought up questions about the accuracy of the information within videos students would have access to. Azer's study provided the starkest example of this where 73% of the videos containing relevant information regarding surface anatomy did not meet the criteria to be considered educationally useful. Azer determined whether a video was educationally useful or not based on the major and minor criteria outlined in his study; educationally useful videos had to meet all major criteria (scientifically accurate content, clear images, credit given to creator or organizer of video, topic is presented clearly, and the video uses living bodies, models, or drawings for difficult concepts) and at least three minor criteria (Covers topics identified in search query, designed for undergraduates or medical/health students, sounds are clear with minimal background noise, downloading time is reasonable, creator's information is up to date, and educational objectives are stated in the video). It is important to note that in Azer's study, a video containing inaccurate information could not be deemed educationally useful even if it met all other criteria. The study also demonstrated that of the total videos screened for the study, less than 25% of the videos even met the criteria to be considered relevant to teaching surface anatomy even though they appeared in specific search results regarding the subject. Raikos et. al had similar results for the videos that passed their criteria for usefulness (determined by a numerical score based on criteria defined in their study). The Raikos study determined videos to be useful using three separate scoring criteria categories (Anatomical content score, General quality score, and general data score) with each criteria requirement counting as one point. A score of 13/20 was considered a "passing" score for the videos. Azer suggests that there is not enough of a contribution from medical education institutions and that if more medical institutions or anatomists created content for YouTube it may address the issue of inaccurate information

found within relevant videos and help lower, or at least counter, the high percentage of videos containing inaccurate information.

Jaffar's study (2012) tried to overcome this by having students use a selection of links verified by tutors and chosen because the content of the videos closely matched the learning objectives for their anatomy courses. According to the study, 98% of the students surveyed used YouTube to study. However, it was not possible to prevent students from accessing additional videos outside of those suggested within their curriculum. In fact, the students reported using the Human Anatomy Education YouTube channel which is not explained in the study. It is unclear if the Human Anatomy Education channel was where students were being directed by tutors or via a syllabus to use it, or if students were simply stumbling upon it in their internet searches. It is unclear how the author of the Jaffar study is connected to that channel or why its use was included in the study. Because of this confusion, but also the nature of the internet and the lack of control over the resources used, the students could still have had access to materials with inaccurate information. Jaffar tried to address this by suggesting that faculty members could create their own videos or aggregate videos they approve of onto their own YouTube channels and distribute access to their students. This particular issue should be of some concern because Barry et. al (2015) concluded that a significant percentage of students would prefer to use online resources (which is in direct conflict with the conclusions of the Choi-Lundberg and Nageswari studies), which may be inaccurate or out of scope to their learning objectives, rather than contact their instructors, who are seen as the best source of information and can provide accurate information specific to the students' learning objectives or course goals, for clarification.

The Barry study contained significantly more female participants than male, this could represent a bias in their conclusions, particularly regarding the lack of willingness students

reported for contacting instructors for clarification. Female students may be less confident in approaching authority figures due to socialization or overall lower confidence levels compared to their male peers. Female students may also have a higher interest in visually-stimulating learning resources compared to their male counterparts, which may explain why the conclusions the study draws seem in contention with the Choi-Lundberg and Nageswari studies, both of which have larger sample sizes and more even distribution of genders.

Aside from the issue with inaccuracies in the educational content on YouTube, Barry et. al and Raikos et. al point out that there are ethical questions regarding the use of cadavers or human tissue within YouTube videos. Raikos et. al highlight that medical schools can have social media policies in place that prevent their students from recording or photographing any donors in the laboratory unless permission is granted for research, but there is no way to be sure if videos on the internet were uploaded with the appropriate permissions or protocols. Because of this, using cadaver-based videos may not be ethical, at best, and at worst it could put the schools these videos are connected to in jeopardy of losing their anatomical gift programs. In addition, YouTube's use for teaching relies on the ability students have to search for videos. It is possible to preserve the privacy of the donor in the videos by making the video private or only providing link access (meaning that only people with a specific link invitation can access the video) but doing so will not allow as many students to have access to the material. Making a video private or restricting its availability to linked access limits the availability of any teaching resource to be disseminated to a larger audience but making it widely available brings up ethical issues regarding the privacy of anatomical donors that could affect donation rates worldwide.

Aside from the concerns about ethics and information accuracy, one important factor to consider regarding video use is the quality of the videos being used. Azer et al, Raikos et al, and Jaffar all mentioned some aspect of video quality within their judgment criteria or in their

general discussion of results. This is a simple aspect of videos that can easily be forgotten but is probably one of the more important considerations when choosing a video; after all, if a student can't clearly see or hear what is being taught, the video is pretty much useless in terms of learning from it. Dong et. al (2016) comment on this at length while discussing their "tips" on what makes an effective video. According to their summary videos need high quality images and sound (if applicable) in order for students to utilize such videos effectively. Denning supports this when he points out that illegible or difficult-to-read text or poor design of transitions and graphics are red flags to look for when deciding whether to use a video for educational purposes. Because anatomy is such a visual medium and because many structures are small or difficult to discern, using high quality video equipment, lighting, and editing software, particularly of cadaveric dissections, is a necessity.

Dong et. al and Denning also bring up video length. Videos that are too long may not hold students' interests (Dong et. al) or may bore students if the pace is too slow (Denning). By allowing students to control the speed of a video, the pacing issue that Denning brings up can be resolved since the student can control the pacing of a video themselves, but Dong et. al suggest videos be no more than 10 minutes and longer videos should be broken up into smaller segments in order to "reduce students' cognitive load". They also suggest that the videos be interactive to hold students' interest by incorporating quizzes or annotations within the video that highlight key instructional points or learning objectives.

While the idea that a video's quality must be good in order for a video to be considered as a resource is fairly straightforward and easy to accept, there is a lot of inconclusive data regarding the use of videos in anatomy education. While it appears that students like video resources to help them learn or study for anatomy, there are inconsistencies between studies showing if such videos actually have any influence on institutional test scores. Additionally,

there are no studies that show if watching the videos more often can affect testing outcomes, it is also unclear if when students watch the videos (as a preview, during their laboratory work, or as review material) makes a difference in test outcomes or on information recall once the course is complete. These inconsistencies and gaps within the literature indicate a need for more research.

In an attempt to fill some of these gaps, this study had several aims. A major goal of this study was to generate a series of “how-to” dissection videos and to determine if these videos, which explicitly show students how to perform a dissection, can affect scores on lab practicals. The videos were specifically designed to follow the dissector guide provided for students online and as a paper manual in lab so students had a way to visualize the steps they would need to complete during each lab. These videos were available before, during, and after lab so students could choose when and how they wanted to use them. The final goal of the project was to gather information regarding how students used the dissection videos and to collect feedback that would enhance the utility of the videos for future students.

Chapter 2: Methods

Study Design

The study utilized videos for thirteen labs (six labs for the thorax and abdomen unit and five labs for the lower limb unit) and a series of three surveys to evaluate student usage of the videos as learning resources for gross anatomy. The videos were made by two second-year students in the Medical Anatomy Graduate Program and were designed specifically to show dissection steps and techniques outlined in the dissector guide used in the gross anatomy laboratory curriculum. All students in the course had access to the videos and participation for the surveys was voluntary. The videos had controlled access and were never available to students not currently enrolled in the course or members of the public in a commitment to respect the privacy of our anatomical donors. This study was approved by the International Review Board (IRB# 733-15 EX), an announcement on Blackboard explaining the study was posted for students to read and is provided in Appendix C. The surveys given to students are provided in Appendix B, the second and third surveys were the same while the first survey was slightly different due to the videos not having been introduced at the time it was provided to students.

The students had a total of four lab units throughout the semester with each unit ending in a practical exam. The videos were available for the last two units of the course and surveys were provided after the second practical, after the third practical, and shortly before the fourth practical. The surveys were designed to gauge student interest in the videos, assess when and how the students chose to use the videos, evaluate student confidence levels in their dissection skills, and experience regarding their lab work. The surveys also collected student feedback about the videos. Students filled out a consent form (provided in Appendix A) for every

survey and were assigned an anonymized code so their grades and demographic information could be analyzed in connection with their use of the videos and their survey responses.

Video Production

The videos were made with a Canon Vixia HF R62 HD Camcorder and an HD Steris block camera mounted on the ceiling with a Steris Harmony© LED Surgical Lighting and Visualization System. They were edited with Adobe Premiere Elements 13 Video Editor software and the videos made with the Steris camera were captured using Viva Station capturing software. The videos were recorded in an .mp4 format and produced/finalized in an AVCHD format before being uploaded to a media library for students to use via links on Blackboard. Because of file size upload limits, the videos were produced in segments exceeding no more than 1000MB and then uploaded to a media library owner by The University of Nebraska Medical Center.

The videos had no sound but did have subtitles describing the actions in the video and used arrows to point out specified structures as needed. Students had access to these videos before, during, and after lab for their perusal via links on Blackboard to a media library. This project was funded with a grant through the University of Nebraska Medical Center's Educational Service Office (grant proposal provided in Appendix D). Two second-year Medical Anatomy graduate students made the videos over a course of several months using a total of three anatomical donors (two females and one male). The students were responsible for all recording set-up and video editing in order to maintain a sense of consistency for the videos.

The videos used for this study were essentially beta-test videos. A finalized, complete series of videos for all dissections and demonstrations in the course will be produced by the same students using the feedback students provided in the surveys for this project in order to enhance the quality and usefulness of the videos they had access to. This finalized and complete

set of videos will be incorporated to the online dissector guide for students to use as a resource in the future. They will have 24/7 access to the videos via the online dissector.

Survey Participants

The students invited to participate in the three surveys included a total of 125 students enrolled in the PAPT CBA 571 gross anatomy course for the 2016 fall semester at the University of Nebraska Medical Center. The group of students consisted of a mix of students in the Physician Assistant Program (N=57), Physical Therapy Program (N=53), and first-year students in the Medical Anatomy Graduate Program (N=15). The students were given a series of three surveys; a total of 87 students filled out the first survey. The second survey obtained responses from 84 students, of those students 55 reported using the videos. The third survey had a total of 65 student responses and of those students 39 reported using the videos. Students were divided into two groups: those with previous cadaver lab experience and those without. A total of 48 students with previous cadaver lab experience filled out all three surveys, of those students 28 reported using the videos. Due to a low number of students without previous cadaver lab experience filling out all three surveys, a significant analysis could not be done for that set of data. The student responses for each survey were entered into a spreadsheet using Microsoft Excel to facilitate use with statistical software.

Chapter 3: Results

Videos

The videos made for this project consisted of 22 total videos. The playing time for all videos combined was 113 minutes and 44 seconds. The videos were made for each lab in the third and fourth units of the course. The third unit of the course included labs on the thorax and abdomen while the fourth unit covered labs for the pelvic cavity and lower limb. A total of twelve videos were created for the third unit with an average running time of five minutes and 18 seconds and a total run time of 63 minutes and 40 seconds for all of the videos combined. A total of ten videos were created for the fourth unit with an average running time of five minutes and six seconds and a total run time of 50 minutes and four seconds. In order to upload the videos to the media library, the file size for each video had to be under 1000MB. This was a challenge as the videos were shot with high-definition camera equipment, which produces very large media files. In order to work around this constraint, many of the videos had to be split into multiple videos per lab. The number of videos, their length, and the lab each video was made for are summarized in Table 3.1.

After the videos were uploaded to the media library for students to use, there were some quality issues that led to graininess, odd or distorted title backgrounds, and some issues with the readability of subtitles on some of the videos. This was due to the files being compressed during the upload procedure for the media library and nothing could be done to prevent it. This issue was reflected in student feedback provided on the surveys and will be resolved once the video files are embedded in the online dissector guide without need for a media library. A media library was used due to the file size limitations on the Blackboard site for the course; web links to the media library were provided on Blackboard for student access.

Table 3.1- Breakdown of videos made available for each lab unit

Unit Three Labs	Number of videos per lab	Video Length (min : sec)	Unit Four labs	Number of videos per lab	Video Length (min : sec)
Thoracic Wall, Pleura, and Lungs	2	10:01 2:15	Pelvic Cavity	2	5:56 4:42
Heart	5	3:54 5:47 4:46 5:15 5:46	Gluteal Region and Posterior Thigh	2	6:05 2:36
Mediastinum	1	4:46	Anterior and Medial Thigh	2	4:54 5:11
Abdominal Wall	2	6:22 3:30	Leg	2	5:58 5:20
Peritoneum	1	5:51	Sole of Foot	2	5:16 4:07
Abdominal Viscera	1	5:28			

Total time of videos: 113 minutes, 44 seconds; Average time of videos: 5 minutes, 12 seconds.

Student Performance

The primary goal of this study was to analyze whether or not dissection videos influence student performance in gross anatomy. We specifically looked at the overall course grade students received and their practical exam scores. Previous experience with a cadaver-based anatomy lab, even if the students did not personally dissect the cadavers themselves, was a significant determinant of the students' performance in the gross anatomy course. The students

that had previous experience performed significantly better in the course than those who did not (P=0.016). These results are reflected in Figure 3.1. Therefore, for all subsequent analyses of student performance, the participants of this study were separated into two groups: those that had previous cadaver lab experience and those who did not.

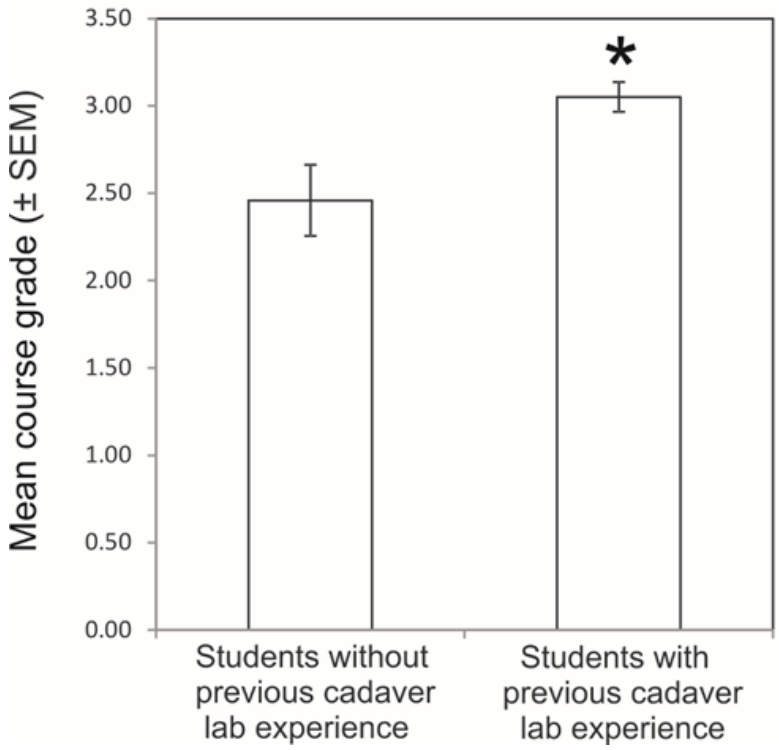

Figure 3.1- Difference in performance based on previous cadaver lab experience. Students with previous experience significantly outperformed students without it (P=0.016). This is on a 4.0 grading scale (A=4.0, B=3.0, etc.).

While students who had previous cadaver lab experience did outperform students who did not in the overall course grades (as reflected in Figure 3.1), the dissection videos the students had access to more similarly reflected what the students would see on their lab practicals, therefore, we analyzed the lab practical scores students received before and after the videos were introduced to see if there was an effect. All 125 students in the PAPT CBA 571 gross anatomy course had access to the videos, we analyzed the information from students who completed all three surveys. The amount of students without prior cadaver lab experience who also completed all three surveys was not large enough for a meaningful analysis. The number of

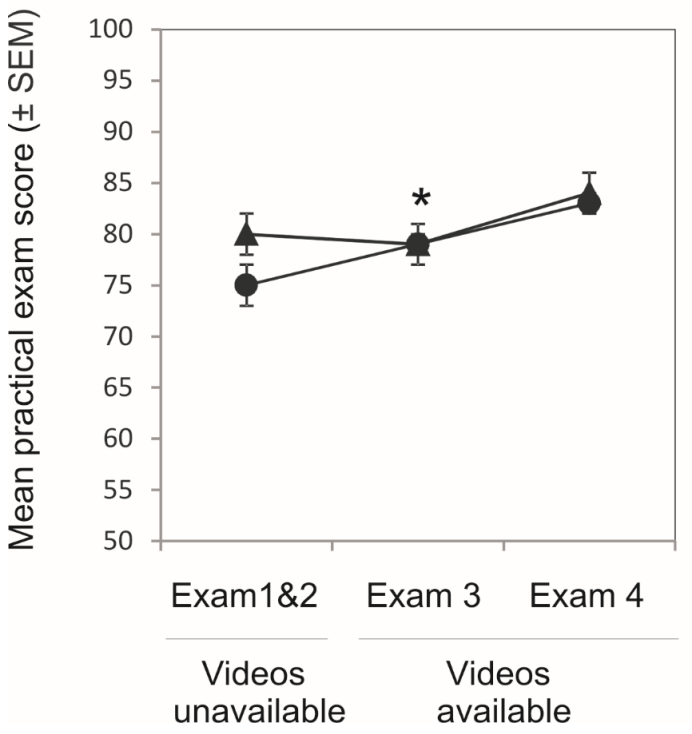

Figure 3.2 Difference in mean practical exam scores (N=48). Students with previous cadaver lab experience significantly outperformed students without previous experience on the first two practical exams (P=0.043) with average scores of 80.3% vs. 75.1%. On the third practical exam, students who did not watch the videos had an average decline in scores by 1.6%, students who watched the videos increased their average scores by 4.3%. This was statistically significant (P=0.013 by paired t test).

students with previous cadaver lab experienced that did fill out all three surveys was 48, of those students, 28 reported watching the videos. In Figure 3.2, the practical scores of these students are represented (N=48); the students with previous cadaver lab experience that filled out all three surveys were split into two groups: those who reported watching the videos (N=28, indicated by circles) and those who did not (N=20, indicated by triangles).

The students who chose not to watch the videos had a higher practical score average (80.3%) for practicals 1 and 2 than the students who chose to watch the videos (75.1%), this difference in scores was statistically significant (P=0.043). However, once this selection of students had access to the dissection videos for practicals 3 and 4 the students who chose to watch the videos increased their scores for both practicals to the point where their scores were virtually identical to the students who chose not to watch the videos.

Figure 3.2 depicts the mean differences of the lab practical scores. On exam 3, the students who watched the videos improved their scores by 4.3%, a statistically significant improvement (P=0.013 by paired t test). The students who did not watch the videos had an average decline in scores for the third lab practical of 1.6%. This information suggests that watching dissection videos may be correlated with better lab practical scores. However, many other factors could explain these outcomes such as the presence of teaching assistants in the lab, student motivation, the familiarity of the material in the third and fourth unit, and student comfort levels approaching faculty for help.

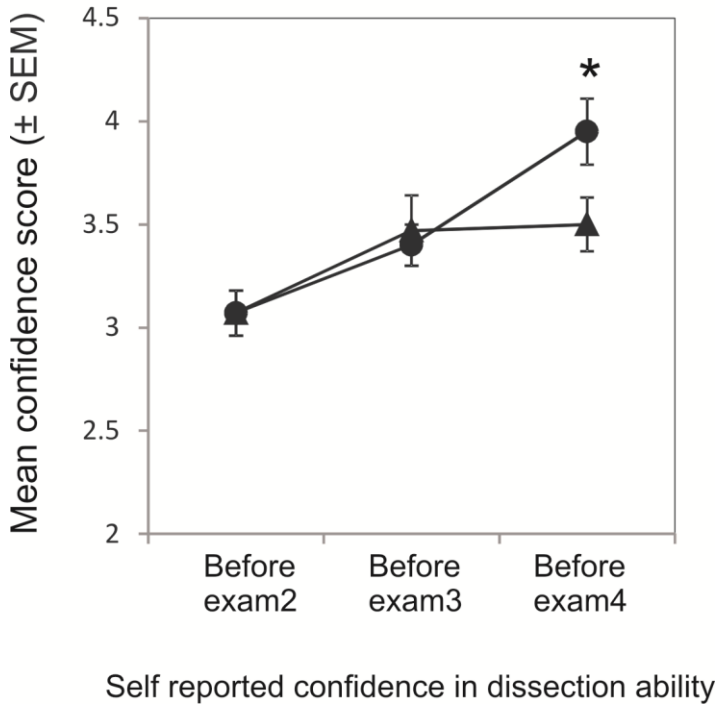

Figure 3.3 Mean Confidence Scores. Students self-reported their confidence levels over the series of three surveys throughout the course. This figure represents only the students who had previous cadaver lab experiences (N=48) and the two groups they comprise: students who watched the videos (N=28, indicated by circles) and those who did not (N=20, indicated by triangles). The students who watched the videos reported higher confidence scores right before the final exam, this was statistically significant (P=0.035).

Student Confidence

One of the major goals of this study was to look at whether or not watching dissection videos increased student confidence levels with regard to their dissection skills. As a result, students were asked to rank their confidence levels regarding their dissection skills on the

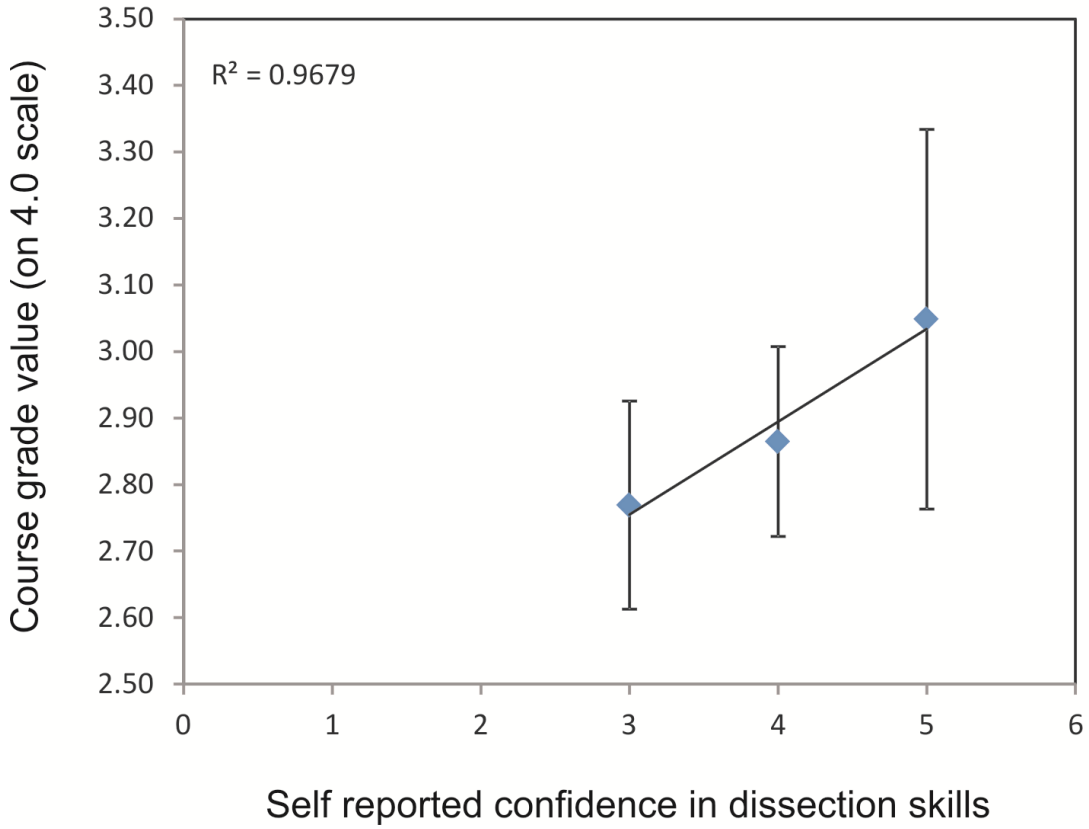

Figure 3.4- Correlation of dissection skills confidence with course grade. R^2= 0.9679, the data fits a linear relationship.

surveys so any changes could be tracked over time. For this analysis, we compared the confidence level ratings of students who had previous cadaver lab experience and completed all three surveys (N=48), the number of students without previous experience and who filled out all three surveys was too small for a meaningful analysis. These students are represented in Figure 3.3; they were divided into two groups: those who reported watching the videos (N=28, indicated by circles) and those who did not (N=20, indicated by triangles). The videos were made available after the second lab practical. The analysis shows that confidence grew with both groups over time. This is expected, the more time and practice students have in the lab, the more confident they will be in their dissection skills. However, the students who reported watching the videos reported higher confidence levels than those who did not just before the

final lab exam (P=0.035), the students who did not watch the videos had a plateau in their self-reported confidence levels. This result supports the hypothesis that the dissection videos helped to increase student confidence but because the students in this analysis self-reported their confidence levels, the data is fairly subjective. To address this, an analysis was done to see if there was a correlation between confidence levels and overall course grade, the results are shown in Figure 3.4. These results reflect a linear relationship between confidence and overall course grade which adds additional support to our hypothesis that dissection videos may impact student confidence levels. Of course, student confidence levels could have been affected by outside factors like comfort levels in the lab, confidence gained through time and dissection practice, course performance, and student motivation as the course went on.

Student Survey Responses

The surveys the students submitted evaluated multiple study resources and how/when the students preferred to use them, including dissection videos. The study resources that were

Table 3.2- Student usage of resources used to prepare for gross anatomy lab

	Percentage of students using each resource type					
Student Experience	Dissector Guide	Atlas	Acland Anatomy Atlas Videos	Other Online Resource	Other	None
Students without previous cadaver experience	96.2%	75%	30.8%	19.2%	3.8%	0%
Students with previous cadaver lab experience	93.4%	60.7%	39.3%	8.2%	4.9%	4.9%

Students were divided into groups based upon previous experience in a cadaver-based gross anatomy course. Students without such experience (N=26) were analyzed separately from those with such experience (N=61). This table analyzes the responses collected from the first survey (N=87).

evaluated to help students prepare for lab were the use of the course dissector guide, use of an anatomy atlas, use of Acland's Anatomy Video Atlas, use of other online resources, and an option of no resources used. Table 3.2 reflects the student preferences for lab preparation. Students preferred to use the dissector guide, followed by an atlas regardless of whether or not they had previous cadaver lab experience. Student preferences for learning resources during lab are depicted in Table 3.3. The resources students had to choose from included the dissector guide, the text books provided in the lab, atlases, the teaching assistants, and the anatomy teaching faculty. 100% of students without cadaver experience reported using the anatomy teaching faculty as a resource during lab while only 88.5% of students with cadaver lab experience reported using the anatomy teaching faculty as a resource. This difference was not statistically significant (P=0.1) but it does highlight a trend that could be significant with a larger sample size.

How and when students chose to use the dissection videos are depicted in Table 3.4. Students were asked to choose when they used the videos and were allowed to choose more than one answer, with the answer choices being "before lab", "during lab", or "after lab".

Table 3.3- Student usage of resources during gross anatomy lab

	Percentage of students using each resource type				
Student Experience	Dissector Guide	Text Book	Atlas	Teaching Assistants	Faculty
Students without previous cadaver experience	100%	23.1%	80.8%	92.3%	100%
Students with previous cadaver lab experience	95.1%	19.7%	77.0%	85.2%	88.5%

Students were divided into groups based upon previous experiences in a cadaver-based gross anatomy course. Students without such experience (N=26) were analyzed separately from those with such experience (N=61). This table analyzes the responses collected from the first survey (N=87).

Table 3.4- How and when students used the dissection videos

	When students used videos			How students used videos		
	Before Lab	During Lab	After Lab	For Review	As a Dissector	As Lab, Exam Prep
Prior to Exam 3	67.9%	64.3%	39.3%	42.9%	10.7%	71.4%
Prior to Exam 4	57.2%	57.2%	42.9%	57.1%	4.8%	76.2%

Primary uses of the videos seem to be before and during lab and as an exam review. Responses from the second and third surveys are represented in this table.

Students were also asked how they used the videos and were allowed to choose more than one answer, with the answer choices being “as a review”, “as a replacement for the dissector”, and “as preparation for lab or a lab practical”. Student preferences for when they used the videos indicate a preference for using them before lab; they chose to use them to prepare for lab and exams. Finally, students were asked how helpful they thought the videos were for various strategies. The students were given a 5-point scale with one being “Not at all helpful” and five being “the most helpful” and were instructed to assign a number within that scale. Students were asked how helpful the videos were for “prepping for lab”, “reviewing material”, “understanding the material”, and “guidance during lab”. Table 3.5 depicts the results. Students gave the highest rating to “guidance during lab” rating it between “somewhat helpful” (3) and “very helpful” (4), which was the originally designed purpose of the students who produced the videos.

Table 3.5- Student assessment of utility of how to dissection videos

	When students used videos		How students used videos	
	Prepping for Lab	Reviewing Material	Understanding Material	Guidance During Lab
Prior to Exam 3	3.24	3.14	3.24	3.69
Prior to Exam 4	3.47	3.40	3.38	3.48

In both surveys, students gave the highest rating to “guidance during lab”. Responses from the second and third surveys are represented in this table.

Chapter 4: Discussion

Student Perceptions

Overall, the students rated the videos between “somewhat helpful” and “very helpful” across all study strategy choices (as depicted in Table 3.5), they provided helpful feedback for future video creation. The students were able to write in their own feedback on the second and third survey and it was constructive and positive. Student comments such as, “Great videos! Very helpful” and “Loved this resource” were among the many requests for audio narration and videos of the demonstrations done by faculty during lab. The feedback collected through the surveys will be implemented in the finalized set of videos created for future classes.

Student Confidence

With regard to student confidence levels, all students gained confidence in their dissection skills as the course went on. This result was expected because, as the course continued, students became more comfortable working with cadavers and ultimately logged more practice time dissecting on cadaveric tissue and working on various dissection techniques. However, the students who used the videos had a statistically significant higher confidence rating before the final lab practical than those who did not. This seems to indicate that dissection videos may increase student confidence when it comes to their dissection skills. However, there are many other factors that could have affected this result. One such factor could be the use of teaching assistants available during lab. There were four teaching assistants in the lab for this particular class and part of their responsibilities included providing assistance during dissections specifically by providing help with dissection techniques. Their presence in the lab could have affected the results of this study. It is possible that the students who watched the videos were more receptive to help from the teaching assistants because they had lower

score averages prior to the introduction of the videos. However, the teaching assistants were present for the entire semester and the increase in confidence we recorded was specifically after the videos were introduced prior to the third exam. It is hard to gauge how much of an effect the teaching assistants may have had on student confidence levels.

Student Utilization of the Videos

According to the feedback collected by the surveys, students used the videos primarily to help prepare for lab or lab practicals. The videos were specifically created to follow along with the dissector guide the students have access to for the course. The students reported using the dissector guide as the most common resource they used to help prepare for lab. Because the videos were made to reflect the steps in the dissector guide, the reported student preferences may indicate that future students might use the videos in tandem with the dissector guide to help prepare for lab. Students also reported that they found the videos the most helpful when using them for guidance during lab, although very high percentages of students reported using the dissector during lab. This may indicate that the videos have a large amount of value in helping students navigate dissections when written instructions in the dissector guide are vague, unclear, or difficult to understand spatially.

Student Performance

Quite possibly the most important finding of this study is the impact that watching the videos had on student practical scores. The students that watched the videos had a lower average of scores on the first two lab practicals. As a result, these students may have been more open to incorporating a new study tool (the videos) than students that had a higher average of scores. The students who watched the videos increased their scores for both the third and fourth lab practicals resulting in their scores after introduction of the videos being nearly the

same as the students that did not watch the videos. However, many factors could have influenced this result. Because the students who chose to watch the videos had a lower average of scores, they may have sought out more help. For example, the teaching assistants in the lab provided private tutoring to students outside of class, students with lower scores may have been more likely to seek private tutoring, which could have influenced their practical scores. Additionally, students with lower average exam scores may have been more motivated to do better on the last two practical exams of the course and increased their study time and learning strategies. Finally, it is possible that the students with lower scores just took longer to feel comfortable or become familiar with the testing format of the lab practicals or that it took them longer to understand what was expected of them at the graduate level since all but a select few were first-year students in their specific programs.

Research Limitations

Unfortunately, a major limitation for this study was the sample size, particularly for the students with no prior cadaver lab experience. The sample size for that group was too small to have any statistical significance. One way to address this in the future would be to continue to survey students in future classes. Asking the students to fill out a pre- and post-survey at the beginning and end of the course instead of three surveys throughout the course may also increase the response rate. Of course, providing some incentive (extra credit, not releasing grades until the survey is submitted, etc.) to students to fill out the surveys will increase the response rate but that could also affect the responses obtained.

Another limitation of our research is that the surveys did not ask students how often they used the videos. More research needs to be done to see if watching the videos multiple times a week impacts scoring outcomes. Finally, our study was not able to control for outside

factors on student grading outcomes. Student motivation throughout the course was not a variable we took into consideration; this could be addressed in future studies by having students rank their motivation levels throughout the course on surveys given at regular intervals. We also did not control for any influence having the teaching assistants available to students during class and outside of class (for students who chose to use them for private tutors) may have had on exam scores.

In the future, more studies should look at levels of experience between students and how these levels can affect the use of learning resources. In our study, previous cadaver lab experience was a major determinant of student performance. Future studies could explore how having previous cadaver lab experience may affect grading outcomes compared to the grading outcomes of students with previous human anatomy courses that were not cadaver-based as well as students with no human anatomy experience at all. The results of those studies could help guide future approaches to teaching anatomy particularly when teaching to students with a wide variation of anatomy experience.

Conclusions

The videos used by the students in this study were part of a beta-testing series of videos created by the co-authors. The feedback and comments provided by students on the surveys will be used to create a finalized set of videos for use by students in the gross anatomy lab in future classes. The videos will be available on the intranet used by students and embedded within the online dissecting guide the students have access to. Student feedback from the surveys included in this study will be used to create a set of videos that are interactive and can be used across a variety of study strategies in addition to being a visual companion for the dissector guide.

The results from this study, particularly the influence the videos may have had on practical exam scores, add to the breadth of literature on this subject, however, many of the results cannot provide definitive conclusions regarding the effect the videos may or may not have had. More work will need to be done in the future, but hopefully this study has highlighted the direction that anatomy education has taken and how incorporating new and innovative learning resources for students can improve learning experiences and outcomes.

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Appendix A: Student Consent Form

"**Evaluation of High-Definition "How-To" Dissection Videos for Gross Anatomy".**

The goal of this research is evaluate the benefit of a series of high definition "How To" dissection videos that will be available to students 24/7 and will provide the students with visual guidance, showing students *how to* perform the dissections. These videos will complement the written instructions and static images in the interactive dissection guide. We hypothesize that these videos will enhance students' preparation for gross anatomy lab sessions, promote efficient and effective use of laboratory time, and improve students' confidence in their dissection skills.

You were selected as a possible participant in this study because you are enrolled in either CBA 571 or GCBA 908/909 Gross Anatomy courses in the fall of 2015. Your participation in this research study is voluntary.

If you volunteer to participate in this study, you will be asked to do the following:

- Complete 3 brief surveys (before Lab practical 2, 3 and 4 in fall 2015). Survey questions will focus on if/when/how you used the videos and your perceptions regarding the value of the videos
- Participate in a focus group in which student experiences with the videos will be discussed in more detail and ideas for possible improvements to the videos will be explored.

Completing any portion of one or more of the surveys and/or attending a focus group meeting constitutes implied consent to participate.

Participation to complete the surveys will take a total of about 30 minutes spread out over approximately 8 weeks. Each of the three surveys will require about10 minutes to complete. Surveys will be administered before Lab practical 2, 3 and 4 in fall 2015.

Focus group meetings will require an additional 30-45 minutes. Focus groups will be held early in 2016 in interaction rooms in MSC.

There are no anticipated risks.

You will not directly benefit from your participation in the research. However, the results of the research may benefit future students by providing a rationale to generate and a comprehensive set of instructional “how to” videos for a larger audience of gross anatomy students.

Any information that is obtained in connection with this study and that can identify you will remain confidential. Confidentiality in the surveys will be maintained by means of a coding system. Participants will write their name on the cover sheet only. After participants complete the survey, Dr. Gould will remove the cover sheets and store these in a locked file cabinet to which only she and Dr. Splittgerber have access. Number coded survey pages (no participant names) will be analyzed by graduate students Jessica Gamerl and Kevin Selting as part of their thesis research.

A subset of students who complete all of the surveys will be asked to participate in a focus group. The list of focus group participants will only be known to Dr. Gould, Dr. Splittgerber, Miss Gamerl, and Mr. Selting (and other focus group participants). A list of focus group participants will be stored in a locked file cabinet to which only Dr. Gould and Dr. Splittgerber have access Comments and suggestions regarding the videos that are expressed during the focus group discussions will be written down but will not be attributed to any specific participant.

- You can choose whether you want to be in this study, and you may withdraw your consent and discontinue participation at any time by simply electing not to complete the surveys.
- Whatever decision you make, there will be no penalty to you.
- You may refuse to answer any questions on a survey and still remain in the study.

If you have any questions, comments or concerns about the research, you can talk to the one of the researchers. Please contact: Karen Gould at 402-559-2456 or kagould@unmc.edu or Ryan Splittgerber at 402-559-2712 or ryan.splittgerber@unmc.edu.

Appendix B: Student Surveys

Survey 1

1. Have you ever taken an anatomy class prior to this one? Y N

2. If you answered yes to question 1, did that anatomy class involve a cadaver-based lab?
   Y N

3. If you answered yes to question 1, did you personally dissect the cadaver during the lab?
   Y N

4. Do you have experience dissecting a cadaver, at all? Y N

5. How would you rate your confidence in your dissecting ability, 1 being the LEAST confident and 5 being the MOST confident:

Least Confident	Not Very Confident	Somewhat Confident	Very Confident	Most Confident
1	2	3	4	5

6. How do you generally prepare for lab every day? Please choose ALL the options that are applicable:

- ☐ Pre-reading the Dissector Guide
- ☐ Looking at an atlas
- ☐ Watching Ackland Anatomy Videos
- ☐ Using an other Online Resource; please specify: _____
- ☐ Other; please specify: _____
- ☐ I don't use any resources to prepare for lab

7. How prepared do you feel for lab everyday; 1 being NOT AT ALL prepared and 5 being the MOST prepared:

Not At All Prepared	Not Very Prepared	Somewhat Prepared	Very Prepared	Most Prepared
1	2	3	4	5

8. What do you use in lab to aid your dissections? Please choose ALL the options that are applicable:

- ☐ The online dissector guide

- ☐ The COA textbook
- ☐ An Atlas
- ☐ The TAs
- ☐ The Faculty

Second and Third Surveys

1. How would you rate your confidence in your dissecting ability; 1 being LEAST confident and 5 being MOST confident:

Least Confident	Not Very Confident	Somewhat Confident	Very Confident	Most Confident
1	2	3	4	5

2. How would you rate the quality of your dissections, 1 being LOWEST quality and 5 being HIGHEST quality:

Lowest Quality	Low Quality	Average Quality	High Quality	Highest Quality
1	2	3	4	5

3. Have you utilized the instructional dissection videos? Y N

4. If you answered yes to question 3, when did you use the videos? Please select ALL the choices that apply:

- ☐ Before lab
- ☐ During Lab
- ☐ After Lab

5. If you answered yes to question 3, how did you use the videos?

- ☐ As a review
- ☐ As a replacement for the dissector
- ☐ As preparation for lab or a lab practical

6. If you answered yes to question 3, how helpful were the videos for the following categories, 1 being NOT AT ALL helpful and 5 being MOST helpful:

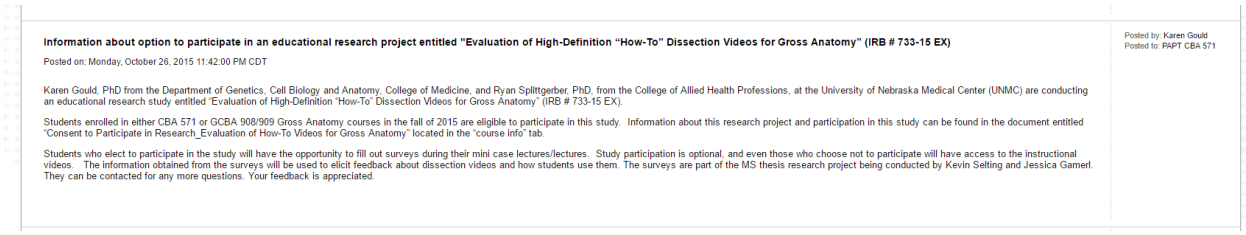
Category	Not At All Helpful	Not Very Helpful	Somewhat Helpful	Very Helpful	Most Helpful
Preparing you for lab	1	2	3	4	5
Helping you review the material	1	2	3	4	5
Understanding the material	1	2	3	4	5
Using it in lab	1	2	3	4	5

7. How would you rate your confidence in dissection, 1 being the LEAST confident and 5 being the MOST confident:

Least Confident	Not Very Confident	Somewhat Confident	Very Confident	Most Confident
1	2	3	4	5

8. Do you have any feedback or comments for the videos and how to make them better?

Appendix C: Blackboard Announcement



Information about option to participate in an educational research project entitled "Evaluation of High-Definition "How-To" Dissection Videos for Gross Anatomy" (IRB # 733-15 EX)

Posted by: Karen Gould
Posted to: PAPT CBA 571

Posted on: Monday, October 26, 2015 11:42:00 PM CDT

Karen Gould, PhD from the Department of Genetics, Cell Biology and Anatomy, College of Medicine, and Ryan Splittgerber, PhD, from the College of Allied Health Professions, at the University of Nebraska Medical Center (UNMC) are conducting an educational research study entitled "Evaluation of High-Definition "How-To" Dissection Videos for Gross Anatomy" (IRB # 733-15 EX).

Students enrolled in either CBA 571 or GCBA 908/909 Gross Anatomy courses in the fall of 2015 are eligible to participate in this study. Information about this research project and participation in this study can be found in the document entitled "Consent to Participate in Research_Evaluation of How-To Videos for Gross Anatomy" located in the "course info" tab.

Students who elect to participate in the study will have the opportunity to fill out surveys during their mini case lectures/lectures. Study participation is optional, and even those who choose not to participate will have access to the instructional videos. The information obtained from the surveys will be used to elicit feedback about dissection videos and how students use them. The surveys are part of the MS thesis research project being conducted by Kevin Selting and Jessica Gamerl. They can be contacted for any more questions. Your feedback is appreciated.

(Screenshot taken from PAPT CBA 571 Course Blackboard Announcements)

Text Reads:

Karen Gould, PhD from the Department of Genetics, Cell Biology and Anatomy, College of Medicine, and Ryan Splittgerber, PhD, from the College of Allied Health Professions, at the University of Nebraska Medical Center (UNMC) are conducting an educational research study entitled “Evaluation of High-Definition “How-To” Dissection Videos for Gross Anatomy”.

Students enrolled in either CBA 571 or GCBA 908/909 Gross Anatomy courses in the fall of 2015 are eligible to participate in this study. Information about this research project and participation in this study can be found in the document entitled “Consent to Participate in Research_Evaluation of How-To Videos for Gross Anatomy”

Students who elect to participate in the study will have the opportunity to fill out surveys during their mini case lectures. Study participation is optional, and even those who choose not to participate will have access to the instructional videos. The information obtained from the surveys will be used to elicit feedback about dissection videos and how students use them. The surveys are part of the MS thesis research project being conducted by Kevin Selting and Jessica Gamerl. They can be contacted for any more questions. Your feedback is appreciated.

Appendix D: Educational Service Office Grant Proposal

Development of High-Definition "How-To" Dissection Videos for Gross Anatomy

Applicants:

Ryan Splittgerber, PhD – Assistant Professor, School of Allied Health Professions.

Dr. Splittgerber currently serves as the M1 Neurosciences director and contributes to gross and neuroanatomical instruction to SAHP and graduate students. Dr. Splittgerber will oversee the new gross anatomy lab located in the UNMC Health Sciences Education Building on the University of Nebraska-Kearney campus in June, 2015. Dr. Splittgerber will train students to use the high definition surgical camera, oversee all dissections, and evaluate/provide video and voice-over content.

Karen Gould, PhD – Associate Professor & Vice-Chair for Graduate Education, Department of Genetics, Cell Biology & Anatomy. Dr. Gould oversees all graduate programs in the department. Furthermore, she trains graduate students in her laboratory, lectures in multiple graduate and medical school courses, and directs several graduate courses. Dr. Gould has also developed multiple graduate courses. Dr. Gould has extensive experience mentoring students (undergraduates & medical students) participating in summer research opportunities at UNMC. Students will perform video editing and assembly at UNMC, and Dr. Gould will oversee this portion of the project.

Project Description:

While learning human gross anatomy, medical, physician assistant (PA), physical therapy (PT), and graduate students spend a considerable amount of time in the anatomy lab dissecting cadavers under the guidance of multiple anatomy faculty. To provide the students with consistent, clear instructions for these dissections, students are provided with an interactive dissection guide (IDG). The IDG includes instructions and images for the various structures and terms used in the dissection guide. Written instructions in the IDG can only describe what dissections steps are required; unfortunately, such written instruction cannot demonstrate how to perform the required steps. For instance, "dissect the facial artery from angle of the mandible where it is located deep to the platysma…" This step, taken from the IDG, dictates what to do, but not how to do it. Although faculty members are available to provide guidance during class time, faculty must divide their time between 4-6 tables, which means that only one table of students receives initial guidance and that the other tables must proceed on their own. Frequently, students must wait 50-60 minutes before initial guidance arrives at their table. Also, students are expected to spend a considerable amount of time outside of class in lab to study the cadavers and complete their dissections. During this unsupervised time, students have no guidance other than the written instructions in the IDG. Consequently, students cannot use this time very efficiently or effectively. **To address this problem, we propose to develop a series of high definition "How To" dissection videos that will be available to students 24/7 and will provide the students with visual guidance, showing students how to perform the dissections.**

Currently, the video resources available to students for gross anatomy are limited to videos highlighting structures on previously-dissected cadavers. Such videos allow students to visualize what the structures will look like in the cadaver. However, these videos show the illustrated structures after the dissection has been completed off-screen and do not show students **how to** get to that endpoint. Thus, our **"How To"** dissection videos, which will illustrate all steps in a

comprehensive anatomical dissection, will be a unique and valuable resource for students at UNMC.

Dissection Videos: This project will result in a series of short videos that correspond to the individual labs compiled in the existing IDG. The dissections videos will be recorded using a high definition camera system integrated into a ceiling-mounted surgical lighting boom. The camera design will provide superior clarity, adjustable zoom, and adjustable perspective of the dissection field.

Part I: Cadaveric Dissection

a. Students will perform all steps, for each of the 35 IDG dissections, under continuous video recording.
b. The continuous recording will allow the capture of all procedural steps, including steps not explicitly stated in the IDG, such as limb positioning and fat and fascia removal in the dissection field.
c. Sound will not be recorded during the dissection process. Voiceover instructions will be added during the video editing process.
d. After dissection instructions are complete, dissectors will manually identify anatomical structures, facilitated by the camera's moveable arm and zoom functions.

Part II: Video Editing

a. Using the available video editing software, raw footage will be processed to clean up recording flaws such as unintended camera movement and extraneous footage.
b. This video series is intended to include the assumed and tedious steps between explicit IDG instructions. To optimize viewing of this information in a timely manner, video editing software will be used to accelerate playback of the procedural steps.

c. During manual identification of structures, the playback will return to real time.
d. The overall duration of each video will range from 5-10 minutes, depending on the magnitude of the dissection.
e. Voice over instructions will be included after the video is cut and re-assembled. Special care will be given to coordinate verbal instructions with performance of the explicit written instructions from the IDG. Additionally, descriptive verbal instructions will accompany the non-stated procedural steps, such as fat and fascia removal.
f. Voice over will be real time speed even during the accelerated playback of fat and fascia removal.

Budget: total requested: $5000

1) Male cadaver for the video dissections = $1200. A video will be prepared using a female cadaver at a later date.

2) Student stipend support= $3800. Stipend support will be provided to two students to conduct and record the dissections and edit the videos.

Measures of Success: All students taking gross anatomy in the fall of 2015 (first year medical students, PA students, PT students, masters in medical anatomy students) will have access to dissection videos via blackboard (videos will be produced in the summer of 2015). We will track the number of views of each video by students in each gross anatomy course (Med, PA/PT and graduate). We will also track when students access the videos. Since the videos are optional, sustained (or increased) usage of the videos throughout the semester would provide an objective indication that students find the videos helpful. We will also compare laboratory practical grades of students in fall 2016 to those from the previous year attempt to assess the

impact of the videos of student learning and performance. We will also conduct student and faculty evaluations of the videos at the end of the semester to assess more subjective measures of success of the videos. Also, focus groups will be convened throughout the fall to gather student feedback on the videos.

Benefits: The development of a comprehensive series of "**How-To" Dissection Videos for Gross Anatomy** has the capacity to impact medical students (N=~135), PA/PT students (N=~100), and MS Medical Anatomy students (N=~16). These videos will allow students to come to lab fully prepared---knowing not just what to do, but also how to do it. Such preparation will allow students to use their time in the lab more effectively. Furthermore, these videos will allow students to more effectively use unsupervised time in the lab as well. Finally, we are optimistic that by enhancing the students' ability to perform the dissections independently and properly, the students will more effectively master the material in the gross anatomy course.