The Value of Traditional Lecture in Medical Gross Anatomy: Student Perceptions and Performance

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The Value of Traditional Lecture in Medical Gross Anatomy: Student Perceptions and Performance

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Abstract
This study examines gross anatomy students' perception of lecture and the value of lecture based on student performance. Following a single lecture, students (n=85) completed a questionnaire asking about their perceptions of lecture using a 1(low) – 10(high) rating scale and a five question, multiple-choice quiz. Students later answered these questions on the block exam. Students rated how much they learned during traditional lecture (m=5.24 ± 1.7), how much lectures guided their study (m=6.78 ± 2.1), and importance of lecture attendance (m=6.48 ± 2.2). Recall on the post-lecture quiz was poor (52.47% ± 26.5) but significantly improved on the exam (85.65% ± 21.7); z= -6.91, p<0.0001. This indicates that students who attended the lecture place intermediate to high value on some aspects of lecture, but do not immediately recall lecture information. This implies a disconnect between students perceptions of lecture and the benefits they may actually receive from lecture attendance.
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Key words: anatomy education, lecture, student perceptions, immediate recall

Introduction
In the most recent AAMC Curriculum Inventory Report on instructional methods used in medical school, lecture was reported as the most commonly used method to present material, accounting for 55% of all medical education events (AAMC). The second most common instructional method, small group discussion, was used for only 5.5% of events. Given that a lecturing instructor is limited only by the speed at which they speak (Di Leonardi 2007), lecture may be perceived as the most efficient way to deliver information to a large group of students (Schwartzstein and Roberts 2017). As the hours allocated to teach medical gross anatomy continue to decrease (McBride and Drake 2018), efficiency remains a priority in anatomical education.

In addition to the perceived efficiency of lecture, some evidence suggests that students generally like lecture and the specific benefits it may provide. In a study that asked how much material should be taught through lecture, approximately 60% of medical students felt that at least 60% of content should be taught using this method (Tsang and Harris 2016). Lecture was also ranked in the top five preferred methods of teaching by 94.5% of first year medical students (Zinski 2017). Another group of preclinical medical students rated lecture and practical notes as the number one self-study resource (Choi-Lundberg et al. 2016). This evidence suggests that medical students continue to perceive value in the lecture method.

While lecture attendance is a major concern for many instructors (Schmidt et al. 2015; Young 2008), students have reported several reasons for wanting to attend lecture. Reported reasons include: lectures provide exam guidance and big picture concepts (Khong et al. 2016), important concepts are emphasized (Bati et al. 2013), there is a social expectation to be present (Eisen et al. 2015), in order to show professionalism (Cardall et al. 2008), and the ability to ask questions in real time (Bati et al. 2013; Cardall et al. 2008). Perhaps most importantly, students have reported that they learn well in the lecture setting and attend lecture for this reason (Eisen et al. 2015).

Despite medical students having positive perceptions of lecture, this method also suffers many criticisms. Lecture is often referred to as a passive method of teaching which encourages memorization and regurgitation of facts, rather than the construction of knowledge necessary for real understanding (King 1993). Lecture is typically characterized as a teacher-centered form of instruction where the teacher is responsible for the learning process (Estes 2004) and students are simply empty containers waiting to be filled with information (King 1993). Critics of lecture claim that it does not promote critical thinking (Schmidt et al. 2015), problem solving skills, communication (Lujan and DiCarlo 2006), or life-long learning (Tsang and Harris 2016), all of which can be critical to success as a future healthcare provider. As far back as 1910, the Flexner Report suggested that the traditional lecture method used in medical education did not allow students to apply information or provide opportunities to develop a professional identity (Irby et al. 2010).

Because of the shortcomings associated with lecture, there is a movement in medical education toward more student-centered classrooms. This approach places students at the center of the learning process (Estes 2004) by using class time for active learning through discussion and practicing the application of information (DiPiro 2009; Prober and Heath

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2012; Schwartzstein and Roberts 2017; Singh and Kharb 2013). Team-based learning (Vasan et al. 2011), problem-based learning (McBride and Drake 2016), and case-based learning (Thistlethwaite et al. 2012) are examples of student-centered teaching methods that have been shown to be effective in medical education and devote much less time to lecture. A meta-analysis of studies comparing student-centered learning to teacher-centered learning in anatomy showed a small positive effect for those in the student-centered conditions (Wilson et al. 2019). Likewise, STEM students in active learning conditions scored 6% higher on exams compared to students in lecture conditions, and those in lecture were 1.5 times more likely to fail (Freeman et al. 2014).

While literature suggests there are alternative teaching methods that are equally effective and address the criticisms associated with lecture, students continue to perceive some value in lecture. This study attempts to better understand both students' perception of lecture and the value of lecture based on student performance by asking the following questions. What value do students place on lecture in terms of learning, exam preparation, and importance of attendance? How much do students recall about a lecture topic immediately after the lecture compared to the course examination? We hypothesize that students who attend a given lecture will highly rate items associated with a perception of value in lecture and report a preference for learning by attending lecture. Secondly, we hypothesize that students that attend a given lecture have poor immediate recall of lecture material but are able to adequately learn the lecture material for course examinations given at a later date.

Methods

Study Context

The University of Mississippi Medical Center (UMMC) is a large academic medical center in the southeastern United States which upholds an educational mission to train future healthcare providers through the schools of medicine, dentistry, pharmacy, nursing, allied health science, and graduate studies. The medical school typically only accepts in-state residents and is the state's only allopathic program. The curriculum includes two years of basic science training followed by a two-year clinical phase. In the first year of medical school Gross Anatomy, Histology and Cell Biology, Developmental Anatomy, Biochemistry, Physiology, Neuroscience, and Introduction to the Medical Profession are taught as separate courses.

In 2017 and 2018, gross anatomy was taught to first year students in the fall semester. The course was taught using a regional approach and was divided into four blocks starting with back and upper limb, then thorax and abdomen, pelvis and lower limb, and head and neck. During the study, gross anatomy was twelve credit hours and consisted of traditional lectures, laboratory dissections, and group activity sessions. During most lectures, basic science faculty presented overview material and discussed complex anatomical areas. Clinicians also presented lectures that focused on connecting anatomical information to clinical practice. Both groups of presenters had fifty minutes per lecture and primarily utilized PowerPoint (Microsoft Corporation, Seattle, WA: Microsoft) to deliver content. Lecture attendance was mandatory when given by clinicians, and encouraged when given by basic science faculty. All lectures were recorded and were available for students to view throughout the year. For dissection laboratories, students were put into groups of eight (2017) or six (2018). Each group was then further divided into group A and group B. Responsibility for completion of the dissection alternated between group A and B. Weekly group activity sessions included worksheets, games, and practice questions to review material covered that week. Students were assigned weekly readings from the required textbook (Gray's Basic Anatomy, Drake et al, Elsevier, 2nd Edition), but there were no checks for completion. Final grades in the course were derived from four block exams that included a multiple choice written exam and a practical exam (80%), radiology quizzes each block (5%), weekly group quizzes (5%), and board exam scores (10%).

During the years of 2017 and 2018, medical school students were invited to participate in the study during the second week of medical gross anatomy after a basic science faculty member delivered a lecture on the spinal nerve. Objectives of the lecture were for students to demonstrate an understanding of:

1. The organization of the spinal cord.
2. Components of a spinal nerve.
3. The functional components of a spinal nerve.
4. The sympathetic innervation to the spinal nerve.

Data Collection

Procedures were carried out according to the protocol approved by the Institutional Review Board of the University of Mississippi Medical Center (IRB # 2017-0201) and informed consent was obtained from all participants. Immediately following the spinal nerve lecture, students were approached by the first author, who was not associated with the course in any way, and asked to participate in the study. After a verbal introduction to the study, students were given a paper packet with an informational letter detailing the requirements of participation, a questionnaire (see appendix), and a quiz. Students that chose not to participate were still given the option to complete the quiz for practice, but were asked not to complete the questionnaire. All questionnaires and quizzes were collected after completion, regardless of student participation. Only students who completed both the questionnaire and quiz were included in analysis.

The questionnaire was used to assess students' perceived value of lecture and to determine how students preferred to learn. Students were asked to rate the first three items using

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a rating scale of 1 (low) to 10 (high). The first item on the questionnaire asked students to rate how much they felt they learned during traditional lecture (1=I learn nothing at all; 10=I learn everything I need to know). The second item asked how much lectures guide their study and preparation for exams (1=Not at all; 10=Very much). The third item asked how important it was to attend lectures (1=Not at all; 10=Essential). The questionnaire also included two open-ended items asking how they preferred to learn about anatomy or a topic other than anatomy when given fifty minutes to do so.

The quiz consisted of five multiple choice questions about material from the spinal nerve lecture and was identical for the 2017 and 2018 classes. These questions were selected from gross anatomy exams from previous years. Four of the questions were considered first order and one was considered second order. Students were made aware that the quiz had no effect on their course grade but were asked to give their best effort. Three weeks later, students took the block one gross anatomy written exam consisting of approximately 80 single answer multiple choice questions. Of the 80 questions, five were spinal nerve questions relating to content from the spinal nerve lecture. For the 2017 class, four questions were identical to the questions on the post-lecture quiz while one was on the same content area. For the 2018 class, all five spinal nerve questions on the block examination were identical to the post-lecture quiz.

Analysis

Demographic data and student ratings were reported using descriptive statistics including mean, median, and standard deviation. A one-sample t-test was used to analyze if there was a significant difference between the average student rating for each item and a hypothetical mean of the 1-10 scale (5.5 out of 10). Wilcoxon signed-rank tests were used to determine if there were any significant differences between performance on the post-lecture quiz and performance on spinal nerve questions on the block one exam. Significance for all analyses was set at $p<0.05$ and all statistical analysis was completed using Stata (StataCorp. 2017. *Stata Statistical Software: Release 15*. College Station, TX: StataCorp LLC).

For the open-ended items, the first author assigned codes by identifying the activities that students reported as their preferred method of learning. For example, a response stating, "I would look over PowerPoint slides and then read the book", was coded as "PowerPoint" and "Read". These codes were tallied to obtain frequency counts.

Results

Of the 160 medical students in the 2017 class, 72 (45.0%) students attended the spinal nerve lecture and 49 (30.6%) students completed the questionnaire. There were 167 students in the 2018 class with only 48 (30.0%) attending the spinal nerve lecture and 41 (24.6%) completing the questionnaire. Three students in 2017 and two students in 2018 had incomplete data and were excluded from analysis, leaving a combined total of 85 students with complete data (Table 1).

Table 1. *Demographic information for all students included in analysis. Participants are reported as the number of students that took part in the study and as a percentage of total medical students in the given year.*

	2017	2018	Combined
Participants, n (%)	46 (28.8)	39 (23.4)	85 (26.0)
Gender			
Female, n (%)	20 (43.5)	13 (33.3)	33 (38.8)
Male, n (%)	26 (56.5)	26 (66.6)	52 (61.2)
Age (years)			
Mean ± SD	23.46 ± 2.6	23.77 ± 2.5	23.60 ± 2.6
Range	21 – 34	21 – 31	21 – 34

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Table 2. *Student ratings of questionnaire items. a = how much you learn during a traditional 50 minute lecture; b = how much lectures guide your study and preparation for course exams; c = how important it is to attend lectures. All items were rated on a scale of 1-10, with 1 being low and 10 being high.*

	Learn During Lecture [a]	Lecture Guides Study [b]	Importance of Attendance [c]
2017 (M±SD)	4.89 ± 1.7	6.40 ± 2.2	6.04 ± 2.3
2018 (M±SD)	5.67 ± 1.6	7.30 ± 1.9	7.00 ± 1.8
Combined (M±SD)	5.24 ± 1.7	6.78 ± 2.1	6.48 ± 2.2

Student perceptions concerning the value of traditional lecture are shown in Table 2. One-sample t-tests show there was not a significant difference between students rating of how much they learn during lecture and the midpoint of the scale; $t(84) = -1.39$, $p=0.1676$. However, ratings for how much lecture guides study and preparation for exams and ratings for the importance of attendance were both significantly higher than the midpoint of the scale (hypothetical mean of 5.5); $t(84) = 5.61$, $p<0.0001$ and $t(84) = 4.21$, $p<0.0001$, respectively.

For the open-ended items, the highest number of students indicated a preference for reading to learn a topic in anatomy (40 out of 85 respondents, 47.8%) or a topic other than anatomy (38 out of 85, 44.7%). Only four (4.7%) of the respondents indicated that they preferred to attend a lecture in order to learn about a topic in anatomy. Additional responses to these items are shown in Table 3 and Table 4.

Table 3. *Top 10 reported methods of learning about a topic in anatomy when students are given 50 minutes. Open ended items were coded and reported as frequency counts.*

Top 10 Reported Methods of Learning Anatomy	n
Read	40
Study Diagrams/Charts/Tables	14
Study PowerPoint Slides	12
Watch Videos/Animations	11
Study an Atlas	11
Self-test/Practice Questions	11
Create Outline/Take Notes	6
Draw	6
Use Flashcards	5
Attend a Lecture	4

Table 4. *Top 10 reported methods of learning about a topic other than anatomy when students are given 50 minutes. Open ended items were coded and reported as frequency counts.*

Top 10 Reported Methods of Learning a Topic Other Than Anatomy	n
Read	38
Study PowerPoint Slides	21
Self-test/Practice Questions	13
Create Outline/Take Notes	9
Watch Videos/Animations	9
Use Flashcards	6
Attend a Lecture	6
Study Diagrams/Charts/Tables	5
Use Repetition Techniques	5
Discuss with Others	5

The 2017 class scored an average of 48.26% ± 28.8 on the post-lecture quiz with a median score of 40%. The average exam score for the five spinal nerve questions was 89.13% ± 18.2 with a median score of 100%. Compared to the post-lecture quiz, exam scores for the five spinal nerve questions were significantly higher ($z= -5.56$, $p<0.0001$). The 2018 class scored an average of 57.44% ± 23.0 on the post-lecture quiz with a median score of 60%. The average exam score on the five spinal nerve questions was 81.54% ± 24.9 with a median score of 100%. Compared to the post-lecture quiz, exam scores for the five spinal nerve questions were significantly higher ($z= -4.05$, $p<0.0001$). The combined average for the two years on the post-lecture quiz was 52.47% ± 26.5 with a median score of 40%. Performance on the spinal nerve exam questions was significantly improved with an average of 85.65% ± 21.7 and a median score of 100% ($z= -6.91$, $p<0.0001$).

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Discussion

This study attempts to better understand both gross anatomy students' perception of lecture and the value of lecture based on student performance. Our first hypothesis was that students who attend a given lecture will highly rate items associated with a perception of value in lecture and report a preference for learning by attending lecture. The results from the questionnaire indicate that this was only partially correct. The first item asking how much students felt they learned during lecture was not significantly different from the midpoint of our scale, indicating that students had an intermediate opinion as to the amount they actually learn in a given anatomy lecture. This is somewhat surprising since studies have reported that students feel they learn a great deal from lecture (Covill 2011) and even reported learning more in lecture than in active learning sessions (Lake 2001).

The second item asking students how much lecture guides their study and preparation for examinations was rated significantly higher than the midpoint of the scale. This suggests that students see some value in the lecture for this purpose. This is in line with prior studies that emphasize using lectures as a guide for study. For example, Choi-Lundberg et al. (2016) found that first year medical students rated lecture notes as the number one resource for studying. Some students have reported that they attend lecture because lectures emphasize important topics (Bati et al. 2013; Brawer et al. 2015) and provide exam guidance (Khong et al. 2016).

The final item rated by students was concerning the importance of lecture attendance. Students rated this item significantly higher than the midpoint of our scale. However, it is also important to note that between the two years, only 37% of enrolled students actually attended the spinal nerve lecture, which took place in the second week of the first year of medical school. While attendance at other medical schools may vary substantially, some have reported that it begins high and then declines. Mattick et al. (2007) found that medical student attendance dropped steadily throughout the first semester and then leveled off at about 57% halfway through the first year. Gupta and Saks (2013) reported that first year medical students attend 75% of lectures but by the second year students attended only 50% of lectures. Second year medical school attendance has even been reported as low 33% (Eisen et al. 2015). For the current study, it is surprising that only 37% of students attended a lecture that took place so early on in the first year, potentially indicating that the students overall had a low perception of the importance of lecture attendance.

Our second hypothesis was that students that attend a given lecture have poor immediate recall of lecture material but are able to adequately learn the lecture material for course examinations given at a later date. This hypothesis is supported by students' performance on the post-lecture quiz and spinal nerve questions on the exam. Between the two years, average immediate recall on the post-lecture quiz was 52.5% (2.62 out of 5). This is comparable to other studies which have reported immediate recall scores on post-lecture quizzes at 53.8% (Wong et al. 2007) and 66.7% (Alluri et al. 2016). However, performance on the exam was significantly improved, indicating that with the current traditional lecture much of the content learning occurs outside of class between the lecture and exam. While it is outside the scope of this study, it may be important to determine how students use the lecture to guide their preparation for course exams. While students may not have learned directly from attending a lecture, it may have put them in a better position to learn outside of lecture when compared to classmates who did not attend.

Results of this study suggest a disconnect in student perceptions of the value of lecture. Students gave intermediate to high ratings of items associated with a perception of value in the lecture method but when asked for a preferred method of learning, few students actually reported that they would like to attend a lecture. Coupled with poor recall immediately after a given lecture, these findings indicate a possible need for change in the traditional lecture method. Many sources offer advice on ways to improve the traditional lecture and potentially increase knowledge retention (Matheson 2008; Singh and Kharb 2013; Wolff et al. 2015). Some suggestions include incorporating opportunities for students to process information by introducing questions to stimulate small group discussions (Di Leonardi 2007) or integrating activities such as think-pair-share, concept mapping, or guided reciprocal peer questioning (King 1993). Alternatively, flipping the classroom may offer another approach to improving perceptions and performance. This method facilitates initial content learning outside of class, while scheduled class time can be used to discuss difficult concepts and practice the application of information (Schwartzstein and Roberts 2017).

There are several limitations of the current study. Only students who attended the spinal nerve lecture were invited to participate in the study. Students who did not attend may have rated questionnaire items differently and performed differently on the post-lecture quiz. However, the ratings of items concerning student perception of lecture were not high and immediate recall was poor, even by those who valued lecture enough to attend. Secondly, no baseline quiz was given prior to the lecture. This was in an effort to maintain an authentic lecture experience and avoid cuing students to attend to certain information from the lecture. Because of this, we are unable to determine the amount of knowledge increase that occurred during the lecture. Students were also made aware the post-lecture quiz had no effect on their grade, while the exam questions did, meaning that students may not have attended to the post-lecture quiz in the same way. Additionally, the current study considered just one lecture topic presented by one faculty member for two

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consecutive years. There are a number of factors that vary across traditional lectures and therefore these results may not be generalizable across all lectures. Future research should consider student perceptions and outcomes over a range of topics and lecturers. Finally, while there was a significant improvement in scores between spinal nerve questions on the post-lecture quiz and the block exam, it remains unknown what specific resources and techniques these students used to improve their performance and further research may explore these questions.

Conclusion

Literature indicates that students maintain a positive perception of lecture, however there are many critics of this method. The current study found that while students attending a medical gross anatomy lecture gave intermediate to high ratings of items associated with placing value on lecture, they did not often report lecture as their preferred method of learning. Additionally, students that attended a given lecture had poor immediate recall of material covered in lecture, but were able to perform adequately on spinal nerve questions on the block exam. This suggests a possible need for change in the traditional lecture method. By identifying the actual benefits of lecture, instructors may be able to move away from using lecture only as a content delivery method and focus more using lecture as a guidance tool that helps students learn outside of assigned contact hours.

About the Authors

Sara Klender, BS, is currently a third-year graduate student in the Clinical Anatomy program at the University of Mississippi Medical Center (UMMC) in Jackson, Mississippi. Her research interests include the evaluation of lecture as a teaching method and the impact of fear of death on performance in gross anatomy courses.

Andrew Notebaert, PhD, is an assistant professor at the University of Mississippi Medical Center (UMMC). He also serves as the Program Director for the PhD in Clinical Anatomy at UMMC. He teaches education-based courses to graduate students and conducts research on student perceptions of learning in anatomy and in medical school.

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– APPENDIX –

Participant Survey

Name: _____

Age: _____

Program of Study: _____

Sex (circle one): M F

In regards to what you need to know for course exams, please rate (on a scale of 1-10) how much you learn during a traditional 50-minute lecture.

1 = I learn nothing at all 10 = I learn everything I need to know

On a scale of 1-10, please rate how much lectures guide your studying and preparation for course exams.

1 = Not at all 10 = Very much

On a scale of 1-10, please rate how important it is to attend lectures.

1 = Not important at all 10 = Essential

If you are given 50 minutes to learn about a topic in anatomy, how would you spend this time?

If you are given 50 minutes to learn about any topic other than anatomy, how would you spend this time?

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