ORIGINAL RESEARCH

Megan Ellis, DO; Kaitlyn Finneran, DO; Chunfa Jie, PhD; Drew Lewis, DO, FAAO

Comparing In-person vs. Live-streamed Osteopathic Manual Medicine Lab Instruction

Abstract

Context: Practicing osteopathic manual medicine (OMM) requires medical students to learn a unique psychomotor skill. OMM techniques are taught during hands-on laboratory sessions in osteopathic medical schools across the country. Determining the optimal delivery of OMM training in the first and second years of medical school is instrumental in maximizing student engagement and confidence for future use in practice. In the academic year of 2020-2021, public health guidelines for COVID-19 forced Des Moines University College of Osteopathic Medicine to restructure their OMM laboratory sessions to include in-person and live-stream demonstrations of somatic dysfunction diagnoses and treatments.

Objective(s): To determine if there was a difference in students' perception of the learning experience and exam performance between in-person and live-streamed osteopathic manual medicine (OMM) laboratory instruction.

Methods: An online 8-question survey was sent to 225 first year medical students from Des Moines University at the end of their first year. The survey contained a combination of Likert scale, dichotomous, and open-ended questions. Statistical analysis for the Likert scale questions included paired-t test given the nature of correlated responses by the same cohort of students. A non-parametric permutation test was used to compare Fall 2020 practical exam grades due to the heavy skewness and ties of the exam score distributions. All computations were also made using the statistical computing software R. Free text was qualitatively analyzed for recurrent themes.

Results: The survey response rate was 67.1% with 151 respondents. When students were asked to rate their learning experience (engagement, comfort asking questions, understanding of material, ability to retain and recall lab material) between in-person vs. live-stream delivery of OMM lab material on a 5-point Likert Scale, there was a statistically significant mean difference for all of the responses, indicating a preference for in-person delivery method. Comparisons of the mean practical exam scores revealed no statistically significant differences. When asked to choose between in-person vs. live-stream, 83% of students reported a preference for in-person OMM laboratory demonstrations.

Conclusion: The students' perceptions suggest that in-person delivery of OMM was superior to live-stream instruction based on higher rankings of engagement, comfort in asking questions, understanding material to practice,

Corresponding Author

Drew D. Lewis, DO, FAAO
Des Moines University College of Osteopathic Medicine
3200 Grand Avenue
Des Moines, IA 50312
515-326-0675
drew.d.lewis@dmu.edu

Financial Disclosures

The authors have no financial disclosures relevant to the topic of the submitted manuscript.

Keywords

OMM lab, osteopathic manipulative medicine instruction, OMM exam, osteopathic medical student survey, transactional distance

and recall of material in preparation of practical exams.

Introduction

Throughout their medical education, Doctors of Osteopathy (DO) across the country receive the unique hands-on training of osteopathic manipulative medicine (OMM) first developed by A.T. Still, MD, DO in 1885.[1] While performing OMM, physicians utilize their hands to palpate patients' tissues in order to diagnose and treat somatic dysfunctions that may be contributing to or causing the underlying medical diagnosis.

Learning how to perform OMM, suture lacerations, or establish an airway are just a few of the many psychomotor skills that osteopathic medical students learn during their training. OMM not only requires a foundation of medical and anatomical knowledge, but also the ability to dynamically fine-tune psychomotor skills based on palpatory feedback from the patient's body. As a result, learning OMM techniques is difficult and requires a combination of treatment demonstrations from experts and direct oversight during hands-on practice. Teaching complex psychomotor skills has been well studied. A review article investigating the available evidence for psychomotor skill learning summarized that the ideal approach involves both an observational component and a physical practice component.[2] The observation of a psychomotor skill allows the learner to extract and process information in a way that cannot be done when simultaneously practicing the skill.[2]

Despite the time and effort spent teaching OMM to medical students, a recent study reported over 50% of DO physicians in the United States do not provide osteopathic manipulative treatment (OMT) to their patients.[3] With physicians citing a lack of confidence and proficiency in OMM as key barriers to incorporating OMT into their practice, a closer look should be taken at the delivery method for medical students' hands-on OMM curriculum. The delivery method in which osteopathic medical students are taught the foundational skills of OMM varies by institution.

At Des Moines University College of Osteopathic Medicine (DMU-COM) medical students traditionally receive in-person laboratory instruction from a physician or pre-doctoral OMM fellow as they demonstrate techniques in a step-by-step fashion. Each class of 220 students is broken up into four laboratory groups of 55 students with 7 faculty, comprised of 4 pre-doctoral OMM fellows and 3 attendings. This allows DMU-COM to meet the 1:8 table-trainer to student ratio recommendation from a 2012 study.[4]

The onset of the COVID-19 pandemic forced many medical institutions to improvise and develop innovative delivery methods for their medical curricula.[5] The OMM department at DMU-COM restructured their OMM laboratory instruction at the start of the academic year of 2020-2021 to adhere to the public health recommendations and room capacity restrictions.[6] The laboratory sessions were divided into two locations: the pre-COVID-19 OMM laboratory classroom with in-person instruction and the Olsen Center–an additional large-capacity room on campus that received a live-stream projection of the instruction taking place in the OMM laboratory classroom. The general outline for teaching the OMM lab at Des Moines University remained the same and included an overview of techniques and indications, demonstration of techniques by faculty, followed by small group practice with oversight from faculty. Although some osteopathic institutions may already use nontraditional methods for teaching OMM skills, there are very few studies investigating the impact of changing the delivery method from traditional in-person demonstration to a method that incorporates technology (live or recorded videos). To our knowledge, there are no studies that have investigated the use of live-stream instruction or compared it to in-person instruction for teaching OMM to medical students.

The purpose of this pilot study was to focus on the observational component of learning OMM and to determine if there were differences in the perceived learning experience and examination performance between in-person vs. live-stream delivery methods. Based on the research encompassing the fundamentals of learning psychomotor skills, it was hypothesized that osteopathic medical students would perceive a difference between in-person vs. live-streamed lab instruction, as evidenced by higher levels of engagement, comfort in asking questions, as well as understanding and retention of the material. It was further hypothesized that there would be a statistically significant difference between mean practical exam grades in Fall 2020 for students who received only in-person instruction compared to students who received only live-streamed instruction.

Methods

This was a descriptive survey study composed of 8 Likert-scale questions, one dichotomous question, and one open-ended question was created using Qualtrics software (version XM, www.qualtrics.com). At the end of the academic year, the survey was sent via email to 225 first-year osteopathic medical students who successfully completed the Osteopathic Manual Medicine Lab I Course at Des Moines University. In the Fall of 2020, students were assigned to either the OMM lab classroom (in-person) or Olsen center (live-stream) and remained there for the entire semester. In the Spring of 2021, students received rotating assignments in both the OMM lab classroom (in-person) and Olsen center (live-stream) to ensure they received a minimum of 3 lab sessions in the OMM lab classroom. No monetary incentive was offered for participation and responses were kept anonymous; no personal identifiers were collected.

The comparisons between the in-person vs. live-stream delivery of OMM lab material on a 5-point Likert Scale were made by paired-t test given the nature of correlated responses by the same cohort of students. The 95% confidence interval for the proportion of the preferred in-person instruction in the OMM lab classroom was computed based on the large sample normal approximation and utilized the statistical computing software R to make computations.

Free-text responses to 1 open-ended question were qualitatively analyzed into major themes. Responses were independently read by 2 researchers. Major themes were identified by individual researchers and then corroborated among the research team. Themes were included if the frequency of occurrence was greater than or equal to 20% of the responses and if the content was related to the delivery method. The themes were identified by keywords or phrases and if the context of the sentence was equally relevant to the question. A single free-text response could contain more than 1 major theme. Student responses were excluded if they did not include comments pertaining to the delivery method of the laboratory material.

Examination scores from OMM practical exams in the Fall of 2020 were collected from the course administrative assistant. The scores were identified using student ID numbers and did not contain any other personal identifiers. The student ID numbers were used to form groups of students who received lab instruction in-person (OMM Laboratory classroom) vs. live-stream (Olsen Center) during the Fall of 2020. The comparisons of mean practical exam scores between the in-person and live-stream delivery methods were made using non-parametric permutation tests due to the heavy skewness and ties of the exam score distributions. These computations were also made using the statistical computing software R.

IRB approval was obtained from the institutional review board at Des Moines University College of Osteopathic Medicine (IRB ID 2021-8) on May 4th, 2021.

Results

Learning Experience

The survey response rate was 67.1%, with 151 of 225 students completing the survey. The students were asked to rate their learning experience between in-person vs. live-stream delivery of OMM lab material on a 5-point Likert Scale.

When presented with the statement "I felt the lab presentation was engaging and held my attention," the average ranking for in-person vs. live-stream instruction was 4.8 and 3.85 respectfully (Figure 1). The corresponding mean difference was –0.947 (p-value < 0.0001) and indicated a significant preference for in-person instruction.

When presented with the statement "I felt comfortable to ask the OMM faculty/fellows questions about the lab material," the average ranking for in-person vs. live-stream was 4.88 and 4.65 respectively with a corresponding mean difference of –0.2266 (p-value < .0005; Figure 1), indicating a significant preference for in-person instruction.

The third statement presented to the students was "I understood the material presented well enough to practice the techniques;" the corresponding average ranking for in-person vs. live-stream was 4.54 and 4.23 respectively with a mean difference of –0.3046 (p-value < 0.0001; Figure 1) indicating a significant preference for in-person instruction.

The final Likert-scale statement presented was "I was able to retain and recall the lab material when preparing for the practical exam," the average ranking for in-person vs. live-stream was 4.28 and 4.04 respectively with a mean difference of –0.245 (p-value of < 0.0001; Figure 1) indicating a significant preference for in-person instruction.

Figure 1. *Average rankings on 5-point Likert Scale (1 = strongly disagree, 2 = somewhat disagree, 3 = neither agree or disagree, 4= somewhat agree, 5 = strongly agree) in response to four statements for in-person setting (OMM lab classroom) vs. live-stream setting (Olsen Center) (n= 151). All respondents experienced at least 3 or more laboratory sessions in each setting during 2020-2021 academic year. Paired t-test of mean differences between in-person vs. live-stream was performed.*

** = p-value <0.001; ** = p-value <0.0001*

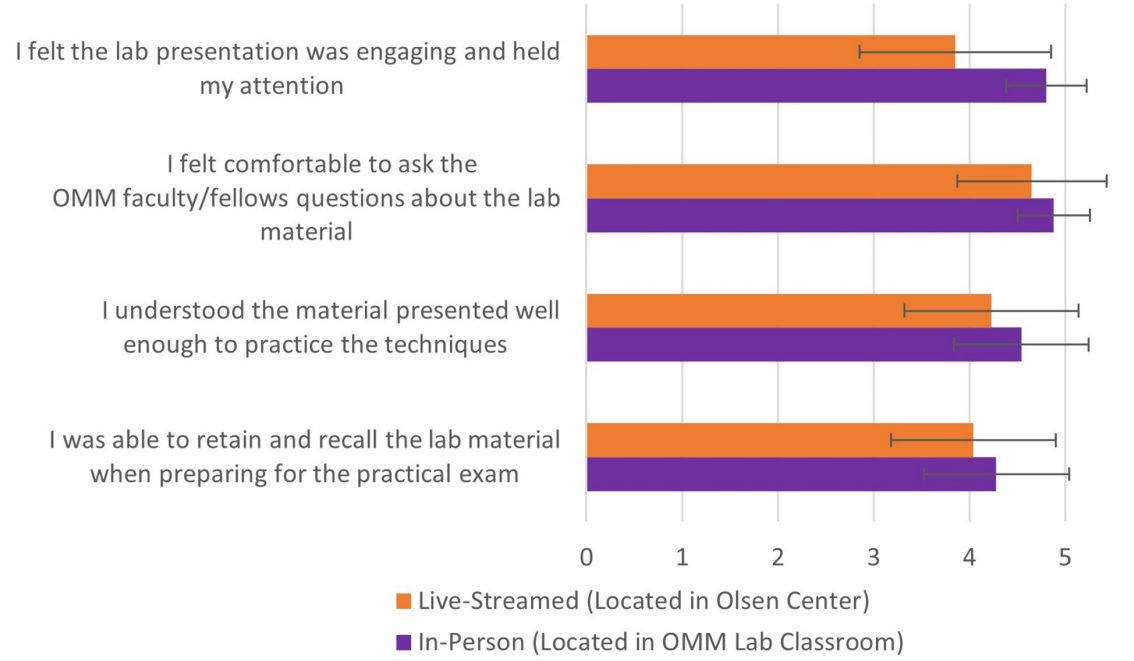

Figure 2. *Students' (n = 147) preference of delivery method when given a choice between in-person demonstration vs. live-stream demonstration. Students were only able to pick one option. 95% confidence interval for in-person demonstration = 76.14-88.48.*

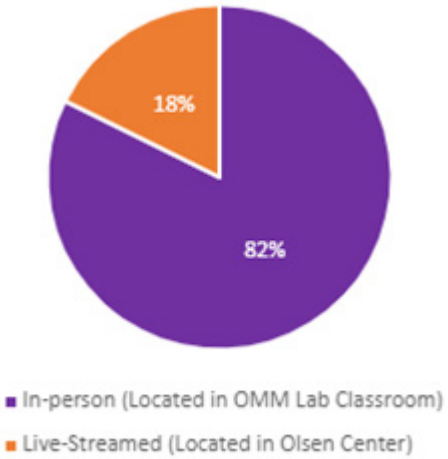

Table 1. *Analysis of free-text responses from students who preferred the in-person demonstration setting (n= 70). One free-text response could contain more than one theme.*

Major themes	Frequency (%)
Ability to ask questions	17 (24.29)
Improved engagement	31 (44.29)
Better visual representation	42 (60.0)

Table 2. *Analysis of free-text responses from students who preferred the live-stream demonstration setting (n= 15). One free-text response could contain more than one theme.*

Major themes	Frequency (%)
Camera angles	3 (20.0)
Low-pressure environment	5 (33.33)

Table 3. *Mean practical exam scores from the Fall of 2020, in-person vs. live-stream. Each exam was worth 40 points total.*

Comparison of mean scores between students who were assigned to in-person vs. live-stream settings revealed no statistically significant difference.

Fall 2020 Practical Exam	In-Person (n= 64)	Live-stream (n=161)
Practical Exam 1 Mean Score	37.38	37.35
Practical Exam 2 Mean score	37.35	37.59

Preference of Delivery Method

When the students were asked "when attending OMM laboratory sessions, which delivery method did you prefer for your learning experience?" they had to choose between in-person (located in OMM lab classroom) and live-streamed (located in Olsen center).

Students were also presented with a clarifying sentence: "Please disregard differences in the OMM tables and focus on delivery of material." The majority of students reported a preference for in-person demonstration (82.30% with 95% CI 76.14-88.48) (Figure 2).

A follow-up open-ended question was presented to the students as "Please provide an explanation for your preference." A total of 40 free-text responses did not meet the inclusion criteria to focus on the delivery of material and were excluded from the analysis. For the respondents who preferred in-person instruction, the following 3 major themes were found: ability to ask primary instructor questions (24.29%), more engagement (44.29%), and better visualization (60.0%) (Table 1). For the respondents who preferred live-stream instruction (17.70%) the following 2 major themes were found: camera angles/better visualization (20.0%) and low-pressure learning environment (33.33%) (Table 2).

Examination Performance

Out of 40 possible points, the mean practical exam scores from the Fall of 2020 were calculated for practical exam 1 and practical exam 2 (Table 3). Practical exam 1 had a mean score of 37.38 for students who received in-person instruction and a score of 37.35 for students who received live-stream instruction. The mean practical exam 2 score was 37.35 for students who received in-person instruction and 37.59 for students who received live-stream instruction. Comparisons of the mean practical exam scores revealed no statistically significant differences.

Discussion

Learning Experience

In this pilot study, the learning experience of DMU-COM students during their OMM lab instruction was broadly characterized by the students' self-reported levels of engagement, ability to ask questions, understanding of material, and ability to retain/recall information.

Student engagement has become a significant focal point for academic institutions to measure success and quality of education, and it has been repeatedly shown to positively correlate with academic achievements, persistence, and satisfaction.[7] The definition of engagement can take many forms and depths of meaning. The Glossary of Education Reform defines engagement as "the degree of attention, curiosity, interest, optimism, and passion that students show when they are learning or being taught, which extends to the level of motivation they have to learn and progress in their education."[8] The term "engagement" can also be broken down into three categories: cognitive engagement (thoughtfulness or willingness to exert effort necessary for comprehension), behavioral engagement (willingness to get involved with academic or extracurricular activities), and emotional/affective engagement (positive and negative reactions to teachers, students, and academic material).[9,10] Although engagement was not defined in this survey study and left to the respondents' interpretation, the aforementioned framework helps elucidate the different factors that may influence a student's level of engagement. With this study's primary focus pertaining to the experience of students during OMM lab instruction, cognitive and affective engagement are the main categories of interest.

Based on the comparison of the Likert-scale responses for in-person vs. live-stream demonstrations, the students reported statistically significantly higher rankings for the in-person demonstration setting when responding to statements about engagement, comfort in asking questions, understanding of material, and ability to recall information (Figure 1). Several factors may explain the respondents' higher rankings of engagement for the in-person demonstration compared to the live-stream demonstration setting. A review article that analyzed the impact of COVID-19 on virtual learning explained that an in-person event allows the students to have an "emotional buy-in" that is difficult to attain with recorded/virtual event.[11] The in-person setting may allow students to more easily develop an emotional connection with the instructor leading the OMM lab, and this could have led to the perception of being more affectively engaged. "Transactional distance" is a term used when considering the impact of learning in-person vs. virtual/online, and it refers to the social, psychological, and emotional distance created by virtual/online learning.[12] Moore suggests the transactional distance can be overcome by improving dialogue and interaction between instructor and student and by improving the structure of a course.[12] The DMU-COM OMM students who were assigned to the

live-stream demonstration setting did not have the ability to interact with the instructor leading the lab. Thus, it is reasonable to assume that teaching OMM via live-stream projection created a higher transactional distance between the student and instructor and may explain the lower levels of engagement when compared to in-person demonstrations. Furthermore, a well-established 5-step teaching method for psychomotor skill learning was developed by George and Doto, and "affective factors" are cited as some of the main barriers to learning.[13] Affective barriers include but are not limited to distraction, lack of belief in the value of the skill, sense of skill irrelevancy, or performance anxiety.[13] Since psychological and emotional factors contribute to transactional distance, the reported lower levels of engagement for live-stream instruction may be a result of students experiencing more affective barriers with the live-stream instruction.

In addition to the reported higher levels of engagement for the in-person demonstration setting, the students perceived significantly higher level of understanding, comfort in asking questions, and ability to retain/recall information. Active engagement has been defined as "the product of motivation and active learning."[14] Experts agree that teaching adult learners requires an active learning environment that creates dialogue and enables students to ask questions, grasp a deeper understanding of the material and its importance, and recall information after the learning event.[15] Furthermore, several reviews on student engagement have concluded that students who are more engaged are more likely to learn at deeper levels and achieve academic competency.[7,15] Thus, it is not surprising that the respondents in this study also reported significantly higher rankings of understanding, comfort in asking questions, and ability to retain/recall material for the in-person demonstration setting (Figure 1).

When asked to choose between the two settings, the clear majority of respondents preferred the in-person demonstration method (Figure 2) and wrote free text responses that cited higher levels of engagement, ability to ask questions, and better visualization as the most common reasons (Table 1). A potential confounding factor that needs to be considered in this study is the difference in classroom environment between the in-person (OMM laboratory classroom) and live-stream (Olsen Center) settings. These factors may include size of the classroom, presence or absence of windows, quality of acoustics, etc. Although the survey questions asked the respondents to focus on the observational experience when learning from the instructor demonstrating OMM techniques, it is possible that the differences of each classroom environment influenced their perceptions.

The theme of "better visualization" was defined as any responses that pertained to improved visibility of demonstrations. Three different camera angles were used for the live-stream projection in an attempt to bridge any visual gaps; however, the live-stream projection forced students to learn complex motor skills from a 2D screen and may have lessened the students' ability to comprehend the treatment techniques. In medical courses of anatomy, value is placed on in-person cadaveric dissections and 3-dimensional plastinated models as students are able to easily make connections of how structures are organized within the human body being able to view the structures firsthand—ultimately helping to solidify information received through textbooks and lectures.[16,17] Similarly, when medical students are observing OMM demonstrations, it could be presumed that the in-person setting provides a superior visual learning experience and allows them to make more connections and better understand the movements in space and time.

Another successful strategy to teaching psychomotor skills is giving students some degree of control in their learning.[2,15,18] Free text analysis from students who preferred the in-person demonstrations revealed 24.29% of responses commented on the improved ability to ask questions and interact with the instructors (Table 1). In the in-person setting, students were able to stop the instructor who was demonstrating techniques to ask questions in real-time, whereas the students watching a live-stream projection did not have the option to stop the demonstration or interact with instructor. Based on literature review, a lack of control in their learning may have led to lower rankings of engagement and understanding for the live-stream delivery method. Adding control to a student's learning experience has advantageous effects on information processing and motivation.[18] A study from 2005 sought to investigate the impact of self-control on observational learning using instructional videos.[2] Participants with no prior experience to shooting a basketball were randomly assigned to two groups: the self-control group or the "yoked" group. The self-control group was able to watch the instructional videos whenever they wanted and however many times they wanted. The "yoked" group had a predetermined schedule for watching the instructional video. At 1 week, the retention scores in

the self-control group clearly outperformed the "yoked" group. Similarly, the University of North Texas Health Science Center Texas College of Osteopathic Medicine (UNTHSC-TCOM) investigated replacing in-person OMM demonstrations with instructional videos.[19] The study design allowed students to watch the instructional videos at their own pace during OMM lab, practice the techniques, and receive feedback from table trainers. The students reported an overall positive experience with self-paced instructional videos, 2/3 of the students indicated the videos were superior to in-person demonstration.[19] These studies suggest that using technology does not have to be a barrier for student engagement and highlight the need for further research on innovative teaching methods for OMM at osteopathic medical institutions.

Examination Performance

Similar to other clinical skills, students' competency and ability to perform OMM techniques are tested in an examination setting known as a practical.[19,20] Assessing learners' procedural skills typically involves a checklist style examination or a global rating scale.[21] Global rating scales are often based on a tool known as "objective structural assessment of technical skills" (OSATS) and utilized by surgical subspecialties to evaluate the technical skills of residents.[21] For osteopathic institutions like DMU-COM, utilizing a checklist-style of examination in conjunction with a grading rubric helps promote standardization of examiners and determine if students are performing the OMM technique with the appropriate setup and subsequent steps.

While the main purpose of this research was to determine if there was a perceived difference in the learning experience of students receiving in-person vs. live stream OMM demonstrations, a second component was investigating for an impact on practical examination performance. It had been further hypothesized that students who received in-person OMM lab demonstrations would have higher practical exam scores compared to students who received live-stream demonstrations. However, this study does not support this hypothesis and revealed the Fall of 2020 exam scores for practicals 1 and 2 had no statistically significant mean differences when comparing the delivery methods (Table 1). The UNTHSC-TCOM study revealed similar results,[19] noting no significant improvement between examination scores for students who were taught with an in-person instructor compared to students who received self-paced OMT instructional videos and an active learning session during their laboratory sessions.[19] These studies refute an objective difference in testing outcomes yet support a subjective learning experience preference for in-person OMM lab instruction.

If students obtain similar objective practical exam scores regardless of the OMM delivery method, further investigation should seek to determine whether or not practical exams are assessing students' OMM competence and self-efficacy. At DMU-COM, the practical examinations may not be a sensitive enough assessment tool to determine if one learning experience is superior for students learning OMM, as seen by the high mean practical examination scores in both settings (Table 1). Additionally, there may be supplemental learning experiences and activities taking place outside of the labs. Students practicing with classmates or partaking in extracurricular OMM activities may have allowed them to close any potential gaps in their self-efficacy, resulting in no statistical difference. Despite the use of OMM practical examinations, as well as the Comprehensive Osteopathic Medical Licensing Examination-USA Level 2-Performance Evaluation (COMLEX Level 2-PE) to provide objective measures for students' OMM competence, it has been noted that no evidence exists to relate competence in OMM to the rate of OMM use in future practice.[22]

At DMU-COM, the OMM curricular delivery encompasses a lecture presentation, lab demonstrations with printed handouts, and access to recorded lectures and labs. However, the traditional delivery method of OMM demonstrations followed by student practice has been shown to result in lower self-efficacy and fewer students mastering a technique compared to curriculum that integrates video recordings, self-paced studying, print materials, and individualized expert feedback.[20] This may help to explain why studies have found students' attitudes toward OMM change during their clinical and residency training years—feeling less confident later in practice to continue utilizing OMM.[3,20,23]

The ultimate goal of teaching OMM at osteopathic medical schools is to give students the knowledge and confidence needed to apply OMM to patient care. Yet, the majority of osteopathic graduates cite "lack of confidence"as one of the main barriers to implementing OMM into their practice.[3] Several studies have found a positive correlation between student engagement and self-efficacy—both of which have been shown to impact the competency of students.[24,25] In a survey of over

3,000 students, both affective and cognitive engagement mediated the effects of self-efficacy on academic growth and achievement outcomes.[24] Researchers have shown a reciprocal effect among engagement, self-efficacy, and academic success.[25] Students often have their interest in OMM piqued during their first or second year of osteopathic medical training[26] and may be more likely to integrate OMM into their practice. By extension, one can assume that more students' interest could be captured early on with quality OMM instruction that keeps students engaged, creates an active learning environment, and allows students to receive direct feedback from experts. Thus, further investigation about the impact of OMM teaching methods on the engagement and self-efficacy of osteopathic medical students may help address the continued decline in OMM utilization.

Limitations

While the purpose of this pilot study was to investigate for differences in perceived learning experience when observing OMM through 2 different delivery methods, the differences in classroom environments may have confounded the students' perceptions. Additionally, the results of this study found no difference in examination performance between the 2 delivery methods (in-person vs. live-stream), but it is important to highlight that all students had access to detailed lab handouts and video recordings identical to the live-streamed demonstration. These lab video recordings were available for review at any time for students who were absent or wanted a reference while studying. It is unknown to what degree having this resource outside of the OMM lab sessions may have influenced their practical exam scores. In fact, a 2005 study at Ohio University College of Osteopathic Medicine showed osteopathic medical students had higher levels of confidence in performing OMM techniques after having utilized handouts and videotaped demonstrations for practical exam preparation.[20]

Ultimately, relying on self-reporting has several limitations and may not accurately reflect the students' perceptions. Despite utilizing the term engagement in the survey questions, it was not defined for students and left up to individual interpretation. Future research on engagement should utilize standardized questionnaires to measure cognitive, affective, and behavioral engagement with OMM.

Future Research

We hope that this study can serve as a foundation for further research into pedagogical techniques for OMM. The results of this pilot study revealed significant differences in student perceptions of learning quality between in-person vs. live-stream demonstration of OMM. Thus, osteopathic institutions may consider the potential need for maintaining some amount of in-person demonstration time when teaching OMM techniques. Despite the results of this study supporting students' preference for in-person instruction, osteopathic institutions may still decide to deliver their OMM lab demonstrations through recordings or streamed videos based on available resources, class sizes, or faculty available for supervision. In this case, institutions should investigate the impact of implementing non-traditional teaching methods on the learning experience and engagement of osteopathic medical students. Future studies could also investigate the impact of other factors that may impact learning OMM such as class size, classroom set-up, or table-trainer to student ratios.

Conclusion

As medical education continues to adapt to the advances in technology and learning formats shift to virtual learning activities, our study suggests that in-person OMM lab demonstrations led to an improved learning experience compared to live-stream demonstrations. This was broadly characterized by the students' self-reported levels of engagement, comfort in asking questions, understanding of material, and ability to retain/recall information. Our study also suggests objective practical exam scores are not impacted by in-person or live-stream OMM lab demonstrations. The continued expansion of college of osteopathic medicine campuses, learning styles of current and future medical students, and technological advances are all forces that will likely increase the utilization of non-in-person OMM lab instruction. Many practicing doctors of osteopathic medicine do not currently utilize OMM in practice. Determining the optimal delivery of OMM training in the first and second years of medical school is instrumental in maximizing student engagement and confidence for future use in practice.

References

1. Seffinger DM. *Foundations of Osteopathic Medicine: Philosophy, Science, Clinical Applications, and Research*. 4th ed. Lippincott Williams and Wilkins; 2018:2-17.
2. Wulf G, Shea C, Lewthwaite R. Motor skills learning and performance: a review of influential factors. *Med Educ*. 2010; 44: 75-84. doi.org/10.1111/j.1365-2923.2009.03421.x
3. Healy CJ, Brockway MD, Wilde BB. Osteopathic manipulative treatment (OMT) use among osteopathic physicians in the United States. *J Am Osteopath Assoc*. 2021;121(1):57-61. doi.org/10.1515/jom-2020-0013
4. Snider KT, Seffinger MA, Ferrill HP, Gish EE. Trainer-to-student ratios for teaching psychomotor skills in health care fields, as applied to osteopathic manipulative medicine [published correction appears in *J Am Osteopath Assoc*. 2012 Jun;112(6):385]. *J Am Osteopath Assoc*. 2012;112(4):182-187. www.degruyter.com/document/doi/10.7556/jaoa.2012.112.4.182/
5. Wilcha R-J. Effectiveness of virtual medical teaching during the COVID-19 crisis: Systematic Review. *JMIR Med Educ*. 2020; 6(2). doi.org/10.2196%2F20963
6. Considerations for Institutions of Higher Education. Center for Disease Control and Prevention. Updated November 4, 2021. Accessed November 29, 2021. web.archive.org/web/20211129120307/www.cdc.gov/coronavirus/2019-ncov/community/colleges-universities/considerations.html
7. Trowler, Vicki. Student engagement literature review. *The Higher Educ Acad*. 2010; 11(1): 1-15. www.heacademy.ac.uk/system/files/studentengagementliteraturereview_1.pdf
8. Glossary of Education Reform. 2016. Student Engagement. In Great School Partnership. edglossary.org/student-engagement/
9. Fredricks JA, Blumenfeld PC, Paris AH. School engagement: Potential of the concept, state of the evidence. *Rev Educ Res*. 2004;74(1):59-109. www.jstor.org/stable/3516061
10. Groccia JE, Buskist W. What is student engagement?. *Teaching and Learning*. 2018;2018(154):11-20. doi.org/10.1002/tl.20287
11. Bradbury NA. Attention span during lectures: 8 seconds, 10 minutes, or more?. *Am Physiol Soc*. 2016;40:509-513. doi.org/10.1152/advan.00109.2016
12. Moore MG. Theory of transactional distance. In: D. Keegan, ed. Theoretical principles of distance education. Routledge;1997:22-38.
13. George JH, Doto FX. A simple five-step method for teaching clinical skills. *Fam Med*. 2001;33(8):577-578. fammedarchives.blob.core.windows.net/imagesandpdfs/pdfs/FamilyMedicineVol33Issue8George577.pdf
14. Barkley EF. Student Engagement Techniques: A Handbook for College Faculty. 2nd ed. John Wiley & Sons, Incorporated; 2020.
15. McDonough, D. Providing deep learning through active engagement of adult learners in blended courses. *J Learning in Higher Educ*. 2014;10(1): 9-16. files.eric.ed.gov/fulltext/EJ1143328.pdf
16. Fruhstorfer BH, Palmer J, Brydges S, Abrahams PH. The use of plastinated prosections for teaching anatomy—the view of medical students on the value of this learning resources. *Clin Ana.* 2011;24:246-252. doi.org/10.1002/ca.21107
17. Aziz MA, McKenzie JC, Wilson JS, et al. The human cadaver in the age of biomedical informatics. *Anat Rec.* 2002;269(1):20-32. doi.org/10.1002/ar.10046
18. Wulf G, Raupach M, Pfeiffer F. Self-controlled observational practice enhances learning. *Res Q Exerc Sport*. 2005;76(1):107-111. doi.org/10.1080/02701367.2005.10599266
19. Seals R, Gustowski SM, Kominski C, Li F. Does replacing live demonstration with instruction videos improve student satisfaction and osteopathic manipulative treatment examination performance?. *J Am Osteopath Assoc*. 2016;116(11):726-734. doi.org/10.7556/jaoa.2016.143
20. Mann DD, Eland DC. Self-efficacy in mastery learning to apply a therapeutic psychomotor skill. *Percept Mot Skills*. 2005;100:77-84. doi.org/10.2466/pms.100.1.77-84
21. Urbina J, Monks SM. StatPearls: Validating assessment tools in simulation. [Updated 2021 Jul 26]. In: StatPearls [Internet]. StatPearls Publishing; 2022 Jan-. www.ncbi.nlm.nih.gov/books/NBK560531/. Accessed December 10, 2021.
22. Shapiro LN, Defoe D, Jung MK, Li TS, Yao SC. Effects of clinical exposure to osteopathic manipulative medicone on confidence levels of medical students. *J Osteopath Med*. 2017;117(8):e1-e5. doi.org/10.7556/jaoa.2017.105
23. Johnson SM, Kurtz ME. Diminshed use of osteopathic manipulative treatment and its impact on the uniqueness of the osteopathic profession. *Acad Med*. 2001;76(8):821-828. doi.org/10.1097/00001888-200108000-00016
24. Chong WH, Liem GAD, Huan VS, Kit PL, Ang RP. Student perceptions of self-efficacy and teacher support for learning in fostering youth competencies: roles of affective and cognitive engagement. *J Adolesc*. 2018;68(C):1-11. doi.org/10.1016/j.adolescence.2018.07.002
25. Schunk DH, MullenCA. Self-efficacy as an engaged learner. Christenson SL, Reschly AL, Wylie C, eds. In: Handbook of research on student engagement. 1st ed. Springer; 2012:219-235.
26. Draper BB, Johnson JC, Fossum C, Chamberlain NR. Osteopathic medical students' beliefs about osteopathic manipulative treatment at 4 colleges of osteopathic medicine. *J Osteopath Med*. 2011;111(11):615-630. pubmed.ncbi.nlm.nih.gov/22104514/