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Effect of Motor Learning Theory-Assisted Instruction Versus Traditional Demonstration on Student Learning of Spinal Joint Manipulation

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Abstract

Purpose: A high-velocity low-amplitude thrust joint manipulation (HVLAT) is an intervention used by clinicians to treat spine pain. HVLAT is an entry-level skill included in the curriculum of physical therapist education programs. The objective of this study was to investigate the effects of utilizing a motor learning theory assisted teaching strategy on physical therapy student HVLAT confidence and skill acquisition as compared to a traditional lab.
Method: Thirty physical therapy students were divided into two groups. One group received a traditional lab. The other group received a lab involving sequential partial task practice (SPTP) strategy in which students engaged in partial task practice over several repetitions with different partners. Student confidence and skill acquisition was determined through comparison of pretest and posttest surveys and performance on skills assessments.
Results: The traditional lab and SPTP lab groups demonstrated similar response from pretest to posttest related to their HVLAT confidence. Student grades on their skills assessment measuring skill acquisition showed no significant differences between the lab groups.
Discussion: The findings suggest that the SPTP lab strategy was as effective as a traditional lab structure for developing physical therapy student HVLAT confidence and skill acquisition. The majority of students in both lab groups reached a level of confidence that allowed them to feel comfortable teaching someone else these HVLAT skills. It is up to the instructors involved in delivering HVLAT content in physical therapist education programs to determine what learning activities are best suited to meet their specific objectives.

Keywords: Psychomotor skill acquisition; Student confidence; Thrust manipulation; High-velocity low-amplitude thrust (HVLAT)

1. Introduction

It is estimated that up to 5%–18% of the population seeks medical care annually due to spine pain.[1] Spine pain tends to run a chronic-episodic course, in which people who experience an episode of spine pain will report

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exacerbations or continued pain one year later,[2] and most individuals will not experience complete resolution of their symptoms and disability.[3] This may be a consequence of inappropriate, delayed, or no interventions for patients with spine pain.[4,5] While there are approximately 200 different treatment options available to treat spine pain, (E.g. rest, pharmacological, manual therapy, exercise, surgery), no single treatment is clearly superior.[6,7] Spinal manipulation, which consists of a high-velocity low-amplitude thrust (HVLAT), is an intervention that has a growing body of evidence supporting its use as part of a multimodal treatment plan for the management of neck and low back pain (LBP).[8–20]

The Normative Model for Physical Therapist Education and the Commission on Accreditation in Physical Therapy Education's Evaluative Criteria states that manipulation, which includes HVLATs, is an entry level skill and should be included in physical therapist education programs.[21,22] The American Physical Therapy Association's (APTA) Manipulation Education Manual defines manipulation as 'high velocity, low amplitude therapeutic movements within or at end range of motion'.[23] The American Physical Therapy Association's (APTA) Manipulation Education Manual states that 'instruction should particularly emphasize extremity, thoracic, and lumbo-pelvic techniques'[23,p.13]; however, there are no regulations as to which HVLAT techniques need to be included in physical therapy programs nor how much time should be devoted to teaching HVLAT techniques.

Noteboom et al.[24] surveyed physical therapy programs in the United States and discovered that, out of a total of 147 programs that responded to the survey, 99% of physical therapy programs teach HVLAT techniques and the average time physical therapy programs devote to teaching HVLAT is 50 h. Of these 147 physical therapy programs, 24 programs reported teaching HVLAT in a one to 10-h time frame, 17 programs reported using over 100 h to teach this content, with most programs somewhere between these ranges.[24] Even though time is being devoted to teaching HVLAT in physical therapy programs, up to 50% of physical therapy students do not perform spinal manipulation during professional internships even when it is indicated and appropriate.[25,26] Fifty-five percent of the students said that lack of confidence was a reason for not utilizing HVLATs during professional internships, while 48% said lack of psychomotor skill was a reason for not performing HVLATs.[25] While the beliefs and practices of the student's clinical instructor during the professional internship will affect whether or not students perform HVLATs during professional internships,[25,26] we believe a reason for this reported lack of confidence and psychomotor skill may be ineffective teaching strategies in physical therapy programs. It appears that HVLAT is integrated into the educational curricula of physical therapy programs[24]; therefore, instructors involved with delivering the HVLAT content can now look to refining teaching strategies that enhance confidence, skill acquisition, and learning outcomes.

Physical therapy instructors often strive to maximize effectiveness and efficiency of their instruction by identifying and comparing alternative methods of teaching and learning. Flynn et al.[5] wrote a clinical commentary on teaching the psychomotor skill of HVLAT techniques, which included breaking each HVLAT into two components, the set up and the thrust, but did not investigate the effects of this model on student confidence or skill acquisition. Wise et al.[27] described an innovative model of active learning and investigated the effects of using the strategy on the development of physical therapy student confidence in performing HVLAT. This new teaching strategy, 'Sequential Partial Task Practice (SPTP)', incorporates principles of motor learning in order to improve skill acquisition and retention by facilitating quantity of practice, partial task and complete task practice, random practice, and confidence development.[27] The SPTP teaching strategy was designed to improve upon the common method of teaching HVLAT where a demonstration of the technique by an instructor is followed by a lab where students practice that psychomotor skill.[27]

In a study by Wise et al.,[27] the SPTP teaching strategy was applied to a cohort of 15 physical therapy students in their final semester of entry-level professional education while instructing six specific thoracolumbar-pelvic HVLAT techniques during a single 3-h lab session. These six techniques included: (1) upper- and mid-thoracic traction; (2) thoracic posterior-anterior with rotation (screw); (3) thoracic segmental rotation (pistol); (4) upper thoracic facet-opposition lock; (5) lumbo-sacral regional; and (6) lumbar ligamentous tension locking neutral gapping.[27] Measures were taken to assess the opinions of the students regarding the implementation of the SPTP teaching strategy and its impact on student confidence in their ability to perform HVLAT techniques. They concluded that the SPTP teaching strategy during a HVLAT lab improved student confidence by 20%.[27] They also found that the majority of the physical therapy students reached a level of confidence that allowed them to feel comfortable teaching someone else these techniques and that 88% of the physical therapy students rated

agree or strongly agree to the statement '*I am fully capable and competent in the performance of lumbopelvic thrust mobilization/manipulation on an actual patient*'.[27] Overall, physical therapy students were more confident in their ability to use HVLAT immediately after the SPTP lab session.

The fact that student confidence in performing HVLAT was improved as a result of using the SPTP teaching strategy is a positive outcome, however, there was no attempt to measure improvement in skill acquisition. Additionally, it is unclear whether the SPTP teaching strategy is superior to traditional instructional methods. Therefore, the purpose of this study is to investigate the effects of utilizing the SPTP teaching strategy on physical therapy student HVLAT confidence and skill acquisition as compared to a more traditional teaching strategy.

2. Methods

2.1. Subjects

A convenience sample of a cohort of 30 physical therapy students (n = 6 males; n = 24 females) in their 2nd year of entry-level professional education were included in this study. This was the first time these students were exposed to HVLAT content within this entry-level program. The study was approved by the University Institutional Review Board.

All 30 students participated in an introductory HVLAT lecture and then were divided into two groups. One group received a traditional lab in which an instructor demonstrated a technique followed by student practice, while the second group received a SPTP lab modeled after Wise et al.[27]

2.2. Introduction lecture

All 30 students received a 2.5-h introductory lecture presenting the effectiveness and safety of HVLAT. The goal of this presentation was to prepare students for lab instruction by presenting operational definitions, risks involved with HVLAT, indications and contraindications for HVLAT, clinical prediction rules related to HVLAT, evidence for these techniques, case examples, and student performance expectations.

Immediately after this 2.5-h HVLAT introduction lecture, students were given time at the end of class to complete a voluntary and anonymous pretest survey to evaluate their thoughts on the safety, effectiveness, and their confidence in utilizing HVLAT techniques in the clinic. Students' data was collected using a survey delivered via Qualtrics Software (Qualtric LLC; Seattle, WA). Thirty students were enrolled in this course and 30 students completed this pretest survey.

The quantitative data collected on this pretest survey used a 5-point Likert scale, and was consistent with the survey used in previous research[27] with 1 indicating strongly disagree and 5 indicating strongly agree (Appendix A).

2.3. Skill acquisition lab session

One of the investigators visually appraised the students and placed students in pairs based on gender and anthropometrics. These student pairs of the same gender and similar anthropometrics were then discussed by all investigators, and any disagreements in the pairs were resolved through discussion and consensus. These student pairs were used for the skills assessment in order to create a fair environment for student assessment. For example, it may be more challenging for a small statured student to perform a technique on a larger student, as compared to a student with long limbs performing a technique on a smaller student. The class was randomly assigned into two lab groups consisting of 15 students per lab. In an attempt to make the SPTP and traditional lab groups as similar as possible, they each contained one student from each matched student pair, which ensured each lab session had similar student genders and anthropometrics. This allowed students in each group the ability to practice on similarly sized partners. Each 15-student lab group attended a 2.5-h lab session that was devoted to instructing the students in six HVLAT techniques, which are described elsewhere,[23,28–30] and included: (1) sacroiliac joint (SIJ) regional manipulation (Fig. 1); (2) lumbar rotation manipulation in side lying (Fig. 2); (3) rib manipulation in prone (Fig. 3); (4) thoracic extension manipulation in prone (Fig. 4); (5) thoracic anterior to posterior manipulation in supine, the 'pistol' (Fig. 5); and (6) cervicothoracic (CT) junction lateral break manipulation in prone (Fig. 6). One lab group learned the six HVLAT techniques through a traditional demonstration of each technique by an instructor followed by a lab where students practice the technique on each other (control group, n = 15), while the other lab group learned the six HVLAT techniques using the SPTP teaching strategy (experimental group, n = 15).

The instructor that provided the lab instruction had more than 12 years of experience and is residency trained in orthopedic manual physical therapy. Two full-time clinicians, who were experienced in manual therapy and routinely use these HVLAT techniques in clinical

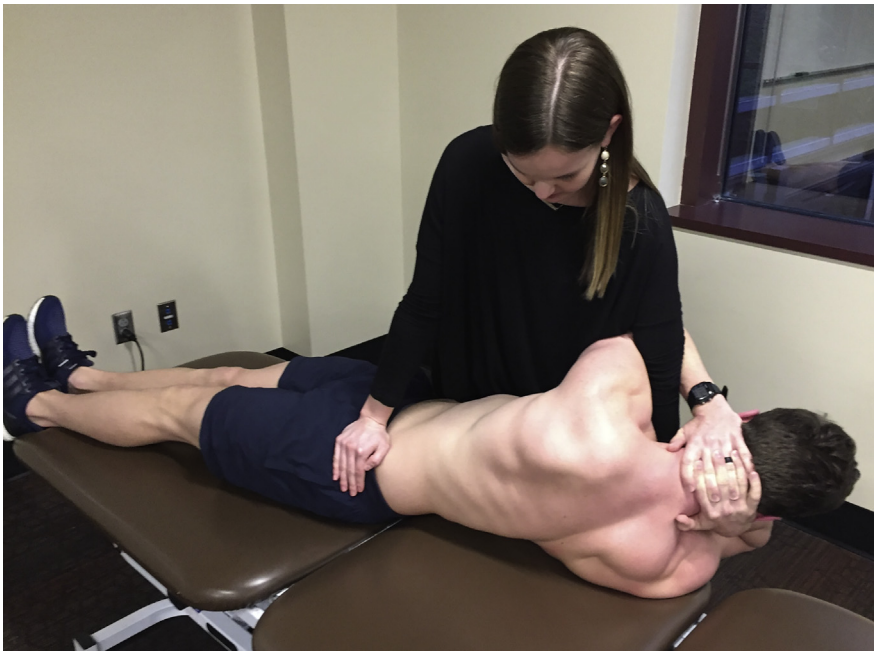

Fig. 1. Sacroiliac joint (SIJ) regional manipulation.

practice, functioned as lab assistants. These three lab instructors were involved in both labs and provided students with feedback throughout each lab session.

2.3.1. Description of the traditional lab (control group)

The traditional lab was executed very similar to many of the labs within our physical therapist education program. The instructor demonstrated each technique in real time on a student, then demonstrated the technique again on another student while narrating each step. This was followed by students practicing the technique on classmates. Student were encouraged to switch partners frequently while practicing the technique. This sequence was repeated for each of the six HVLAT techniques.

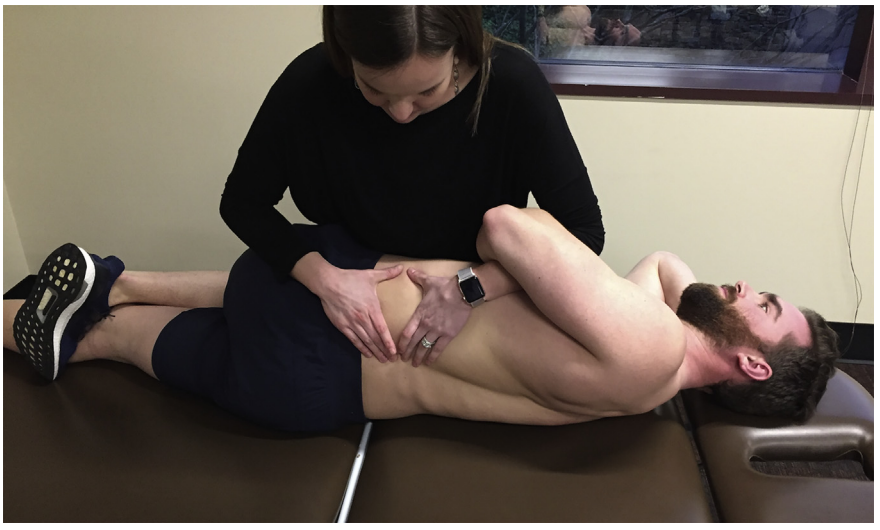

Fig. 2. Lumbar rotation manipulation in side lying.

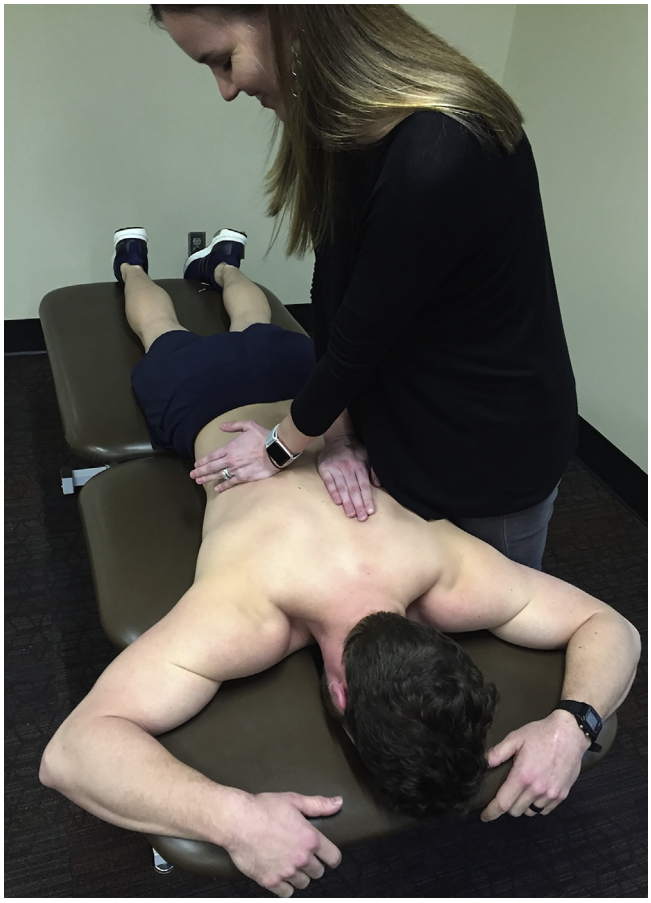

Fig. 3. Rib manipulation in prone.

2.3.2. Description of the sequential partial task practice lab (experimental group)

The lab session utilizing the SPTP teaching strategy consisted of the instructor demonstrating each technique as a complete task in real-time using a student volunteer, and then dividing the technique into three individual partial tasks consisting of: (1) patient set-up; (2) clinician hand placement; and (3) force application. The instructor performed each partial task as each student simultaneously performed the same task on his or her partner. The student then rotated immediately to the next adjacent partner on the plinth and performed the same partial task again. This process was repeated until 3–5 repetitions of the same task were consecutively performed on 3–5 different partners. After each student completed the patient set-up, hand placement, and force application partial tasks, the instructor and students simultaneously performed the complete technique in real-time. The students then rotated on to the next partner until 3–5 repetitions of the complete technique were consecutively performed on 3–5 different partners. Partners then switched roles and the process was repeated, allowing each student an opportunity to perform the technique on many classmates and have many classmates perform the technique on them. This sequence was repeated for each of the six HVLAT techniques.

A 2.5-h lab was allocated to both the control (i.e., traditional lab) and the experimental (i.e., SPTP lab) groups with about 25 min being devoted to each of the six techniques in each lab. Immediately following each HVLAT lab session, students were asked to complete a voluntary and anonymous posttest survey, using Qualtrics Software. This posttest survey included the same seven items from the pretest survey, with the addition of a free response section (Appendix B).

2.4. Spinal manipulation skill acquisition assessment

During the next available class session, four days after the lab sessions, all 30 students were assessed on their ability to perform two HVLAT techniques. Two of the investigators, who were not involved in the lecture or lab

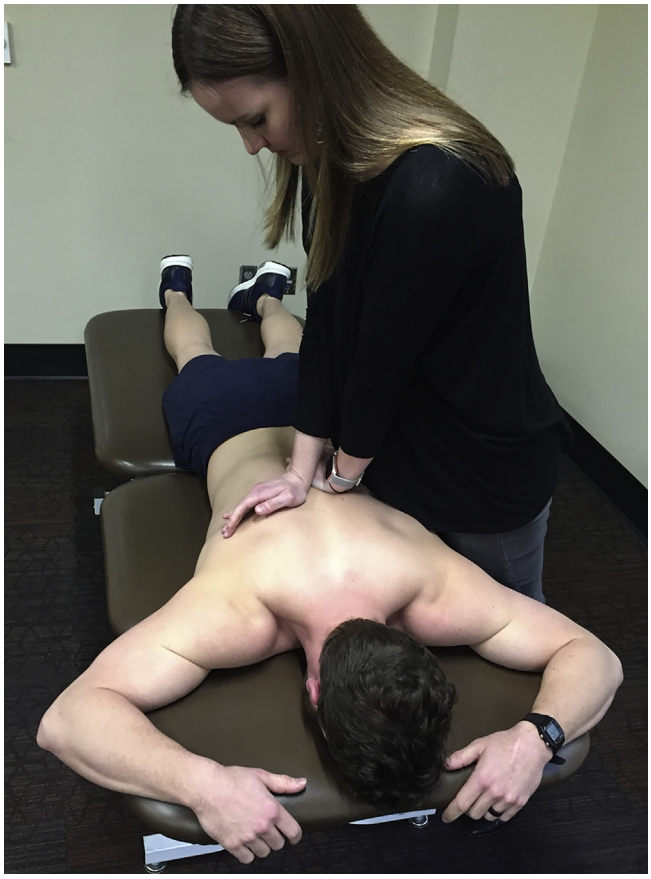

Fig. 4. Thoracic extension manipulation in prone.

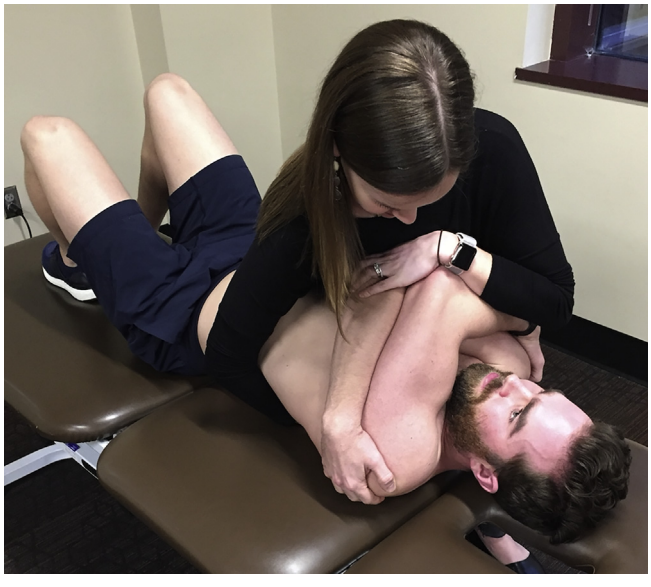

Fig. 5. Thoracic anterior to posterior manipulation in supine, the ‘pistol’.

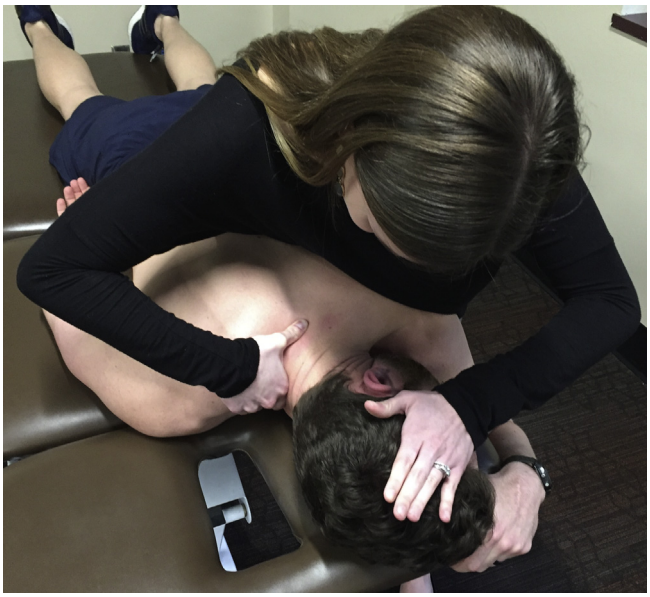

Fig. 6. Cervicothoracic (CT) junction lateral break manipulation in prone.

sessions and who were blinded to the student group assignment, graded the students' performance during the skills assessment. The instructor and lab assistants that delivered the lecture/lab instruction did not participate in student assessments.

The initial development of the grading rubric was based on the investigators' review of published work.[23,31,32] The investigators then consulted other faculty, both internal and external to their institution, in order to refine the rubric and improve its face validity (Appendix C).

To ensure standardized assessment, the graders reviewed the rubric and participated in a training session with the principal investigator, which included a review of the rubric scoring and demonstration of the techniques. Two investigators independently graded the students on each technique performed, and their scores were averaged for a final score used for data analysis.

The skills assessment involved paired students of the same gender and similar anthropometrics. Each student pair consisted of a student from the SPTP group and a student from the traditional lab group. The pair of students entered the assessment room and the first student was informed which two techniques to perform on his/her partner. After the first student performed these two techniques on the partner, the second

Table 1
Pretest and posttest survey results.

Statement	Lab	Pre-test Mean Response	Post-test Mean Response	Friedman test
Spinal thrust manipulation is safe.	Traditional	4.47	4.53	0.53
	SPTP	4.6	4.67	0.56
Spinal thrust manipulation is effective.	Traditional	4.4	4.67	0.16
	SPTP	4.33	4.47	0.32
Spinal thrust manipulation should be routinely considered in the PT care of individuals with spine pain.	Traditional	4.33	4.47	0.41
	SPTP	4.33	4.53	0.32
Spinal thrust manipulation should be taught to PTs during their entry-level education.	Traditional	4.53	4.80	0.10
	SPTP	4.67	4.73	0.56
I am fully capable and competent in performing spinal thrust manipulation on an actual patient.	Traditional	2.73	3.60	0.02[a]
	SPTP	2.87	3.80	0.03[a]
I am able to confidently teach spinal thrust manipulation to a colleague.	Traditional	2.53	3.47	0.03[a]
	SPTP	2.33	3.67	0.0002[a]
I will use spinal thrust manipulation techniques with my patients.	Traditional	4.40	4.40	1
	SPTP	3.87	4.33	0.16

Note: SPTP = sequential partial task practice.
[a] Indicates significant difference from pretest to posttest ($p < 0.05$).

student was told two different techniques to perform on the first student. The same four techniques were performed by each pair of students, alternating techniques between control and experimental groups. For example, the lumbar rotation manipulation in side lying and the CT junction manipulation were performed by the student in the SPTP group and the SIJ regional manipulation and the 'pistol' manipulation was performed by the student in the traditional lab group. These techniques were switched for the next pair of students being assessed, where the student in the SPTP group performed the SIJ regional manipulation and the 'pistol' manipulation, while the student in the traditional lab group performed the lumbar rotation manipulation in side lying and the CT junction manipulation. These four techniques were selected for the skills assessment due to their clinical utility and evidence supporting their use.[33–35]

2.5. Data analysis

The Likert scale scores were summarized with descriptive statistics. A Shapiro–Wilk test was conducted to determine if the data had a normal distribution. For data not normally distributed, a Kruskal–Wallis test was utilized to determine differences between groups (experimental vs. control) and a Friedman ANOVA test to determine pre to post differences within groups. For data that is normally distributed, pre to post changes were compared with a paired sample t-test and group differences with independent sample t-test (alpha = 0.05).

3. Results

Fifteen students attended the traditional lab (control group) and 15 students attended the SPTP lab (experimental group), and all students completed the pre- and post-survey (Table 1). The Shapiro–Wilk test for normality indicated that data from the survey were not normally distributed and nonparametric statistics were indicated. The scores on the skills assessment were normally distributed and therefore parametric statistics were utilized.

3.1. Survey results on student confidence

There were no differences between groups for any item on the survey either before or after the lab sessions ($p > 0.05$). The surveys were also analyzed to determine if there were any changes from pre to post on all 7 items of the survey. Both groups demonstrated a similar response. For the question 'I am fully capable and competent in performing spinal thrust manipulation on an actual patient,' there was a significant difference pre to post for the traditional lab (pre = 2.73 ± SD, post = 3.6 ± SD, $p = 0.02$) and SPTP lab (pre = 2.87 ± SD, post = 3.8 ± SD, $p = 0.03$). There was also a significant difference in the question 'I am able to teach spinal thrust manipulation to a colleague' for the traditional lab (pre = 2.53 ± SD, post = 3.47 ± SD, $p = 0.03$) and SPTP lab (pre = 2.33 ± SD, post = 3.67 ± SD, $p = 0.0002$).

The qualitative data collected in the posttest survey free response questions was analyzed for general themes. Overall, there was one general theme reported from the 15 students in the experimental group (SPTP lab session) related to what they liked the most about the SPTP lab. Students from the SPTP lab commented positively on the constant switching between partners and breaking each technique down into steps. For example, one student commented 'I liked the constant switching between patients in order to get practice on different genders and body types along with getting a lot of practice.' Another student said, 'I really enjoyed that we did patient set up first, then PT set up, then thrust. This gave us time to process the skill step by step.' Finally, one student stated, 'I enjoyed the constant partner changing, we rarely change partners in class and it felt good being able to try these techniques on different people.'

Table 2
Skill acquisition score and cavitation data.

Technique	Mean score for technique performance		Cavitation achieved on 1st or 2nd attempt	
	Traditional	SPTP	Traditional[a]	SPTP[b]
Lumbar Rotation	12.14	12.19	43%	63%
CT Junction	13.71	13.63	100%	100%
SIJ Regional	12.44	12.7	63%	71%
Thoracic Pistol	12.94	12.3	63%	57%

Note: Scores are out of 21 possible points. Abbreviations: SIJ = sacroiliac joint, CT = cervicothoracic.
[a] Students achieving cavitation: 1st attempt (n = 17); 2nd attempt (n = 3); Unable (n = 10).
[b] Students achieving cavitation: 1st attempt (n = 18); 2nd attempt (n = 4); Unable (n = 8).

3.2. Psychomotor skill acquisition results

To compare the effectiveness of a traditional lab structure to a SPTP lab structure on skill acquisition, each student performed two HVLAT techniques creating 60 technique grades for statistical analysis (30 for the traditional lab, 30 for the SPTP lab). Independent sample t-tests were performed on each technique to determine if between group differences were significant. No significant differences were noted (lumbar rotation $p = 0.97$, CT junction $p = 0.90$, SIJ regional $p = 0.77$, pistol $p = 0.50$).

One of the defining features of a HVLAT is a cavitation[36,37]; therefore, the number of attempts to achieve a cavitation was tracked. A cavitation was said to have occurred if it was heard or felt by the student or their 'patient' (Table 2).

4. Discussion

The purpose of this study was to compare the SPTP teaching strategy to a more traditional teaching strategy and the effect on physical therapy student HVLAT confidence and skill acquisition. Both the traditional lab and the SPTP lab groups showed significant improvement in their confidence in performing HVLAT, however there was no significant difference between lab groups. There was also no difference between the traditional and the SPTP strategies on student performance of these HVLAT techniques as assessed by two blinded investigators or the percentage of students that achieved a cavitation during these HVLAT techniques. It appears that both traditional and SPTP teaching strategies improve student confidence and skill acquisition related to performing HVLAT techniques.

The two survey items that students rated the lowest on both pretest and posttest surveys were, 'I am fully capable and competent in performing spinal thrust manipulation on an actual patient' and 'I am able to teach spinal thrust manipulation to a colleague.' In this study, 73% of students in the traditional lab and 93% of students in the SPTP lab stated they strongly disagree, disagree, or neutral for the pretest survey question 'I am fully capable and competent in performing spinal thrust manipulation on an actual patient.' Wise et al. had 100% of their students score strongly disagree, disagree, or neutral to this same question.[27] After the lab sessions, only 40% in the traditional lab and 33% in the SPTP lab submitted these responses on the posttest survey in this current study. These findings suggest that the majority of students reached a level of confidence that allowed them to feel comfortable teaching someone else these techniques, which is similar to the 35% of students submitting these responses in the study by Wise et al.[27] In this study, 83% of students strongly disagreed, disagreed, or were neutral on the pretest for 'I am fully capable and competent in performing spinal thrust manipulation on an actual patient'. The fact that some students felt competent prior to formal training in this entry-level physical therapy program may be due to some students having prior experience with HVLATs, such as working as a physical therapy technician or during prior professional internships.

One of the objectives of this study was to examine the effect of the SPTP lab structure on student confidence. Twenty-seven percent of students in the traditional lab and 7% of students in the SPTP lab stated they agree or strongly agree with 'I am fully capable and competent in performing spinal thrust manipulation on an actual patient' on the pretest. This improved to 60% of students in the traditional lab and 67% of students in the SPTP lab who indicated these responses at the end of the lab sessions. Wise et al. had 18% of students agree or strongly agree with 'I am fully capable and competent in performing spinal thrust manipulation on an actual patient' prior to the SPTP lab session and 88% of students indicating these responses after the lab. Overall, the findings of this study suggest that students became more confident in their ability to use HVLAT techniques after a lab session, regardless of which teaching strategy was utilized.

Although a cavitation is a defining feature of a HVLAT,[36,37] there is research suggesting that the cavitation following a HVLAT is not related to clinical outcomes.[38,39] Nonetheless, clinicians[36] and researchers[9,11,40] tend to repeat the HVLAT technique if they do not hear a cavitation on their first attempt. In this study, 67% of students achieved a cavitation with the SIJ regional manipulation on either their first or second attempts, which is greater than the 53.8% reported by Grindstaff et al.[40] using a similar technique. It is challenging to compare these numbers as the 'patients' in our study were pain free college aged students and the patients receiving the SIJ regional manipulation in the research by Grindstaff et al.[40] were experiencing musculoskeletal dysfunction. One hundred percent of the students in this study achieved a cavitation on either their first or second attempt with the CT junction HVLAT technique, while Dunning et al.[30] describe a 100% cavitation rate on their first attempt.

Studies have shown low rates of utilization of HVLAT techniques from students during professional internships[25,26] and from licensed physical therapists.[5] Improved HVLAT teaching methods during entry level education may improve skill acquisition and confidence development, leading to students utilizing these

techniques during professional internship and future clinical practice. Routine practice of a skill has been shown to improve skill retention,[41] and practicing HVLAT techniques during professional internships will provide an opportunity for practice in an environment with supervision. Our findings suggest that both the traditional lab and SPTP lab are able to increase student confidence with similar degrees of skill acquisition.

For entry-level physical therapist education programs that designate limited curriculum hour towards teaching HVLAT, it is important to create learning activities that foster skill acquisition, skill retention, and confidence. If there is limited time devoted to HVLAT curricular content, instructors must include learning activities that are effective and efficient. It appears that both traditional labs and SPTP labs have similar effect on improvements in student confidence and skill acquisition; therefore, it is up the instructors involved in delivering this content to determine what learning activities are best suited to meet their objectives.

4.1. Limitations

The convenience sample of one cohort of doctor of physical therapy students had a limited the number of students, decreasing our ability to determine differences between groups. This study applied the SPTP teaching strategy specifically to a lab focused on teaching six HVLAT techniques; thus, we cannot be certain that these results would be replicated in labs teaching other psychomotor skills. The investigators reviewed the literature and consulted numerous faculty, both internal and external of their institution, when creating the rubric for scoring student performance of these HVLAT techniques; however, the reliability, validity, and sensitivity of this rubric has not been comprehensively studied. The relationship between teaching strategies, student performance, and clinical outcomes was not investigated, and it cannot be assumed that students who demonstrate the best HVLAT performance during school will have better clinical outcomes. The impact of teaching methods on the utilization of HVLAT techniques during internships and clinical practice was not tested and should be considered in future studies.

4.2. Conclusion

This study attempted to highlight a teaching strategy to improve student confidence and skill acquisition. The SPTP teaching strategy was as effective as a traditional lab structure for physical therapy student HVLAT skill acquisition, confidence in using HVLAT techniques, and confidence in teaching others HVLAT techniques.

It is essential that students have the opportunity to practice their clinical decision making and psychomotor skills related to HVLAT interventions in the clinic. Confidence and psychomotor skill are two factors that, when improved, may foster more opportunities for practice during professional internships and clinical practice.

Disclosure

Ethical approval

Ethical approval has been granted from the Samford University Institutional.

Review Board for research involving human subjects (1 August 2018, EXMT-HP-18-SUM-3)

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Appendix A.

Pretest Student Survey

1) Spinal thrust manipulation is safe.
   Strong Disagree/Disagree/Neutral/Agree/Strongly Agree
2) Spinal thrust manipulation is effective.
   Strongly Disagree/Disagree/Neutral/Agree/Strongly Agree
3) Spinal thrust manipulation should be routinely considered in the PT care of individuals with spine pain.
   Strongly Disagree/Disagree/Neutral/Agree/Strongly Agree
4) Spinal thrust manipulation should be taught to PT's during their entry-level education.
   Strongly Disagree/Disagree/Neutral/Agree/Strongly Agree

5) I am full capable and competent in performing spinal thrust manipulation on an actual patient.
   Strongly Disagree/Disagree/Neutral/Agree/Strongly Agree
6) I am able to confidently teach spinal thrust manipulation to a colleague.
   Strongly Disagree/Disagree/Neutral/Agree/Strongly Agree
7) I will use spinal thrust manipulation techniques with my patients.
   Strongly Disagree/Disagree/Neutral/Agree/Strongly Agree

Appendix B.

Posttest Student Survey

The posttest survey used the same seven items as the pretest, with the addition of the free response questions below.

For students receiving the SPTP teaching strategy:

1) In the context of other methods used to teach hands-on skills throughout the curriculum, *what did you like the MOST* about the manner in which these techniques were taught?
2) In the context of other methods used to teach hands-on skills throughout the curriculum, *what did you like the LEAST* about the manner in which these techniques were taught?
3) After this lab, how confident do you feel in your ability to use these techniques with patients?

For students receiving the traditional demonstration by an instructor followed by a lab:

1) After this lab, how confident do you feel in your ability to use these techniques with patients?

Appendix C.

Skills Assessment Grading Rubric

Skill_____

	3	2	1	0
Exposure of Area	Ideal and seamless exposure of the area to be treated	Appropriate exposure of the area to be treated	Incomplete exposure of the area to be treated, but does not prevent desired effect	No exposure of the area to be treated
Patient Positioning	Ideal and seamless	Accurate	Mostly accurate, but does not prevent desired effect	Inaccurate
PT Position	Ideal and seamless body mechanics	Proper body mechanics	Mostly accurate body mechanics, but does not prevent desired effect	Improper body mechanics
PT Position	Ideal and seamless hand placement	Proper hand placement	Mostly accurate hand placement, but does not prevent desired effect	Improper hand placement
Direction of Force Application	Ideal and seamless direction of force application	Proper direction of force application	Partially correct direction of force application, but does not prevent desired effect	Improper direction of force application
Force Intensity	Ideal and seamless force intensity	Appropriate force intensity	Acceptable force; does not prevent desired effect	Improper force intensity
Speed	Ideal and seamless speed	Appropriate speed	Acceptable speed; does not prevent desired effect	Improper speed

Cavitation (circle one): 1st attempt 2nd attempt Unable to Cavitate.
3 = Seasoned clinician, automatic and seamless, no hesitation.
2 = Entry level graduate, accurate and correct, has to think through the steps, little to no hesitation.
1 = Student, mostly accurate, thinking through steps slows execution, obvious hesitation, self-correction.
0 = Performs technique in a way that prevents the desired effect

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