

A Peer-Assisted Learning Program and its Effect on Student Skill Demonstration

W. David Carr, PhD, ATC*, Jennifer Volberding, PhD, ATC †, Phillip Vardiman, PhD, ATC*

*University of Kansas, Lawrence, KS, †Oklahoma State University, Stillwater, OK

Objective: To explore the effect of an intentional Peer-Assisted Learning (PAL) program on peer-tutors and peer-tutees for performance on specific psychomotor skills.

Design and Setting: Randomized, pretest-posttest experimental design.

Participants: Undergraduate students (N = 69, 42 females and 27 males, all participants were 18 to 22 years old, 19.5 ± 1.2) enrolled in the professional phase of an accredited Athletic Training Education Program.

Measurements: Pretest and posttest performance for the peer-tutors and post-peer interaction for the peer-tutees on identified therapeutic modality and orthopedic assessment psychomotor skill sets. Peer-tutors were randomly assigned to one of four groups; PAL only (PAL), PAL and the focused review session (PAL+), focused review session only (REV), and a control group (CON). Peer-tutees were randomly assigned to interact with the peer-tutors from the PAL and PAL+ or no interaction as a control group. Pretest-posttest percentage correct average changes for the peer tutors were analyzed with an ANOVA.

Results: The pretest-posttest skill scores were found to be significantly different for the peer-tutors ($F_{3,102} = 4.703$; $P = .004$). Post-hoc means comparison revealed significant differences between the peer-tutor groups PAL versus CON, PAL+ versus CON, and REV versus CON. Analysis of the peer-tutee means revealed no significant differences (PAL; $.906 \pm .087$, PAL+; $.918 \pm .077$, and Control; $.881 \pm .061$).

Conclusion: These data suggest that peer interaction can increase student skill performance scores for the peer-tutors. A visual review of the means indicates a trend of increased skill level for the peer-tutees that received peer-tutoring from the PAL+ peer tutors. No significant difference was found with the REV group. It would appear from the peer-tutor perspective that a focused review session has more of an effect on student learning than peer interaction.

Key Words: peer education, peer teaching, athletic training education.

Dr. Carr is currently the Director of the Athletic Training Education Program at the University of Kansas. Please address all correspondence to David Carr, PhD, ATC, University of Kansas, 1301 Sunnyside Ave, Robinson Center Room 161C Lawrence KS, 66045. wdcarr@ku.edu.

Full Citation:

Carr WD, Volberding J, Vardiman, Phillip. A peer-assisted learning program and its effect on student skill demonstration. *Athl Train Educ J*. 2011;6(3):129-135.

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Peer Assisted Learning (PAL) is a process in which students work with one another to augment classroom/laboratory instruction. A simple example would be found when two or more students discuss and practice skills that are being taught in the classroom. This may occur in any setting at any mutually agreeable time. In the context of athletic training, PAL has been defined by Henning *et al*¹ as the process of gaining knowledge, understanding, or skill among students at the same or different skill levels through instruction and/or experience.

PAL has been widely used to augment formal classroom and laboratory instruction within allied health education.¹⁻¹⁶ Cognitive psychology, more specifically sociocultural learning theory, provides a theoretical foundation for the use of PAL. The work of Lev Vygotsky¹⁷ outlined the interaction between the social and individual perspectives in the process of learning as well as the importance of social interactions in cognitive development. The theory indicates the importance of optimal amounts of peer interaction, or scaffolding, for more difficult activities so the student will be challenged and fall within the Zone of Proximal Development (ZPD). The ZPD is where the student receives the optimal amount of support to achieve the desired learning. Vygotsky's concept of scaffolding and ZPD lends credence to the theoretical basis of PAL. To apply this theory, the evaluation or assessment must be provided by a more competent peer. However, within Athletic Training education, it has recently been reported that the level of the student did not affect their ability to accurately assess their peer.¹⁸

Nursing education research has spent considerable effort studying mentoring. Melia¹⁹ highlighted an emphasis in clinical education of getting the work done as opposed to addressing specific clinical learning needs. Mentors can be used to bridge the gap between the work that needs to be done and learning that needs to occur. Additionally, Davidhizar²⁰ argued there can be benefits for the mentors. In a peer-to-peer mentoring study, Yates *et al*²¹ found no significant differences on academic and clinical performance for peer-mentors. However, this project was exploratory and based upon a pilot study with limited subject participation rates and compliance with the prescribed mentoring program. One focus of our project was the benefits to the peer mentor. While much of the research on mentoring of nursing students has addressed the supervisor to student interaction, the nursing concept combined with scaffolding and ZPD can be applied to peer-to-peer interaction.

The reliability of PAL has been widely debated in the literature. Multiple studies have reported high reliability when comparing peer assessments to teacher assessments, which are often expressed as a percentage agreement of correlation coefficients.²²⁻²⁴ While these studies have identified high reliability, others have criticized the use of the term reliability when discussing PAL. Topping²⁵ argues that comparing peer to teacher assessment is more a measure of validity than reliability. In other words, comparing an instructor assessment to a peer assessment is like comparing apples to oranges; the perspective and training of the two evaluators is very different. Lower levels of reliability have been reported in the application of PAL to peer

assessment of group projects²⁶ and assessment of oral reports.²⁴

²⁷ One could presume that the lower reported levels of reliability are in part due to the subjective nature of the PAL application. Marty *et al*¹⁸ has reported that peer assessments of psychomotor skills are accurate. While this was based upon a small sample of Athletic Training students, it is an important finding for validating the use of PAL. In an attempt to address the possible low levels of reliability established by recent research,²⁴⁻²⁷ our project added an additional group (PAL+) of peer-tutors that received a focused review session prior to their interaction with the peer-mentee.

Numerous applications of PAL have been outlined by Topping.^{25, 28, 29} These include peer assessment of oral presentation skills, writing ability, group work and projects, and professional skills. The latter category of professional skills is the most applicable to our current research question. PAL has been employed in several allied health fields, such as; nursing,¹⁰⁻¹³ occupational and physical therapy,^{3,7} medicine,^{2,4,5,14-16} and athletic training.^{1,8,9} Within the field of athletic training, most of the work has focused on the prevalence or use of PAL^{1,9} with only one study focused on the effect of PAL upon the students.⁸ Weidner and Popp⁸ utilized a similar methodology of pretest and posttest performance skills but found no significant difference in posttest scores when comparing groups and did not address the impact upon peer-tutor skill performance.

Limited research has been conducted within Athletic Training education to determine the direct effect of PAL on both peer-tutor and peer-tutee skill demonstration.^{1,8} While PAL is widely used in medical education, as previously referenced, very little has been learned on how it will affect the peer-tutor. With a better understanding of the effects of PAL, educators will be better able to employ PAL strategies to augment their current instruction. We hypothesized that the general process of PAL would increase student skill performance and that an additional focused review session (PAL+) would further increase skill performance for both the peer-tutors and peer-tutees. Our research questions were twofold: 1) how does a PAL program impact student skill performance, and 2) does an additional focused review session enhance skill performance?

METHODS

Participants

Participants consisted of undergraduate students aged 19.5 ± 1.2 (N = 69, 42 females and 27 males, 18 to 22 years old). Data collection occurred over four semesters during the 2008-09 and 2009-10 academic years. Data was collected over a two year period to achieve a desirable level of peer-to-peer interactions. Many students progressed from being assigned as a peer-tutee to being assigned as a peer-tutor in subsequent semesters. As a result, there were 84 peer-tutors and 73 peer-tutees. Over the two academic years, we recorded 106 peer-tutor interactions and 104 peer-tutee interactions. The discrepancy in the number of interactions was due to two students removing themselves from the project voluntarily. Participants were drawn from a convenience sample of the students enrolled in the professional phase of an

accredited undergraduate ATEP. All participants had previously utilized an informal peer-review process when completing assigned skills. Participants were randomly assigned to peer-tutor and peer-tutee groups. For our study, we defined *peer-tutors* as upperclassmen that have completed the appropriate course work within the last academic year of a three-year curriculum program. *Peer-tutees* were defined as underclassmen currently enrolled in the appropriate course work. All students who were enrolled in the ATEP were eligible and participated in the project. Peer-tutors were randomly assigned to one of four groups; peer interaction only (PAL), peer interaction and a focused review session (PAL+), a focused review session only (REV), and a control group (CON). The REV and CON groups were instructed to restrict their interaction with fellow students to issues outside of the scope of our project. Peer-tutees were randomly assigned to three groups; work with upper level students from two of the peer-tutor groups (PAL and PAL+) or a peer-tutee control group. An Institutional Review Board approved our study and each participant read and signed an informed consent document.

Procedures

A pretest-posttest design was used for the peer-tutor groups. A baseline (pretest) measure of percentage correct was obtained for all peer-tutor groups one week before the planned peer interactions and focused review interventions. Peer-tutors were assessed on a combination of cognitive and psychomotor skills by one of the researchers for the appropriate skill set in a lab setting. Based upon the number of participants within the study in a given semester, each group of peer-tutors was assigned to interact with at least one peer-tutee and no more than two peer-tutees to ensure that each peer-tutor in the PAL and PAL+ group had similar levels of peer interaction. Each peer-tutor and peer-tutee interaction lasted on average 15 to 20 minutes. Students were instructed to take as much time as they needed to fully review a given skill set. The PAL interactions were scheduled independently by the students outside of class and occurred in a variety of settings. These interactions were chosen by the participants for convenience, without any interaction from the investigators. This was allowed as it closely resembles the informal nature of most PAL interactions. Post-test scores, percentage correct, were obtained for the peer-tutors within one week of their assigned group completion. Peer-tutee percentage correct scores for each skill set were collected in the normal course of their class requirements through a formal assessment by the course instructor during a practical examination.

Instrumentation

Skill sets currently utilized from two Athletic Training courses (Therapeutic Modalities, and Orthopedic Evaluation) were used for our study. The skill sets are a collection of psychomotor and cognitive skills associated with a given topic from a given course (i.e.; therapeutic modality application techniques, injury evaluation). Each cognitive and psychomotor skill was assessed on a nominal scale with one point for each correct description or demonstration. Each skill set was reviewed independently for content validity by three athletic training faculty members with more than 20 years of combined classroom and clinical teaching experience. Input from the faculty members was used to make

adjustments to the instruments. Each instrument was tested for reliability by the three faculty members simultaneously observing a student complete the skills on a test subject. Percentage agreement was calculated amongst the three observers and the highest rated instruments were utilized from each course. Illustration 1 is an example of the format of each skill set. Five skill sets were reviewed and tested from Therapeutic Modalities with the Electrical Stimulation to Elicit Muscle Contraction skill set rating the highest (91% agreement). Six skill sets were reviewed and tested from Orthopedic Evaluation with the Thoracic Abdominal and the Ankle and Lower Leg Injury Evaluation skill sets rating the highest (92% agreement). Table 1 illustrates the skill sets utilized along with the percentage agreement scores. A minimum threshold score of 80% agreement was established to determine inclusion in the study. Two therapeutic modality skill sets were used along with four Orthopedic Evaluation skill sets. This arrangement allowed for the greatest number of students to be eligible and for two skill sets from each course; Therapeutic Modalities and Upper Extremity Orthopedic Evaluation in the fall and Lower Extremity Orthopedic Evaluation in the spring.

Review Session

A single focused-review session was developed and administered to the appropriate peer-tutor groups (PAL+ and REV) following their pretest assessment. Handouts were developed for each skill set to illustrate the information and reviewed with each of the students in the appropriate peer-tutor groups. Each skill set instrument was reviewed with the peer-tutors by the instructor of the corresponding course. Each session lasted 10-15 minutes and occurred the same week that the same skill set was being taught to the peer-tutees. The review sessions were taught during a class meeting with the peer-tutors in attendance. On a few occasions, when a peer-tutor was not in attendance, a meeting was scheduled with one of the researchers to complete the review session. The REV and CON peer-tutors were dismissed from class during the review session. Peer interactions occurred within one week of the review session. All skills were demonstrated by the instructor then discussed and practiced by the peer-tutors. Peer-tutees received instruction on the appropriate skill sets during their normal course work before working with the assigned peer-tutors.

Table 1. Skill Sets Utilized and Corresponding Percentage Agreement Scores

Content Area Skill Set	Percentage Agreement
Therapeutic Modalities	
Electrical Stimulation to Elicit Muscle Contraction	.92
Electrical Stimulation for Pain Control	.88
Orthopedic Evaluation	
Ankle and Lower Leg Evaluation	.92
Foot and Toes Evaluation	.89
Elbow Evaluation	.91
Thoracic Abdominal Evaluation	.92

THORACIC AND ABDOMINAL SKILL SET

HISTORY - Ask two questions for each of the following areas. (1pt each)

M - Mechanism ☐

A - Acute or Chronic ☐

P-Pain ☐

P - Previous injury ☐

S - Sounds ☐

S - Other Signs & Symptoms ☐

INSPECTION / OBSERVATION (1pt each)

☐ Kyphosis

☐ Scoliosis

☐ Breathing pattern

☐ Posture

☐ Gait

☐ Guarding pattern

☐ Skin color

☐ Hematuria

Signs of Shock

☐ Rapid weak pulse

☐ Decreased blood pressure

☐ Pale bluish skin

☐ Rapid shallow breathing

☐ Nausea and/or vomiting

☐ Excessive thirst

☐ Restless and irritable

☐ Drowsiness or Loss of Consciousness (LOC)

PALPATION (1pt each)

Bony-

☐ Sternum

☐ Costal cartilage

☐ Ribs

Soft tissue-

Quadrants – student makes reference to structures

☐ **ULQ** - ☐ Stomach, ☐ Spleen, ☐ L Kidney

☐ **URQ** - ☐ Liver, ☐ Pancreas, ☐ Gall Bladder, ☐ R Kidney

☐ **LRQ** - ☐ Appendix, ☐ Bladder, ☐ Colon

☐ **LLQ** - ☐ Colon, ☐ Bladder

FUNCTIONAL TESTS (3pts each)

☐ Measures heart rate, notes normal resting range

☐ Measures respiratory rate, notes normal resting range

☐ Measures blood pressure, notes normal resting ranges for systolic and diastolic

☐ Heart sounds (demonstrates)

☐ Lung sounds (demonstrates)

☐ Bowel sounds (demonstrates)

SPECIAL TESTS

	<u>demonstrated</u>	<u>test for</u>	<u>positive sign</u>
Lateral Rib Compression test	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Anterior/Posterior Rib Compression test	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Inspiration/Expiration tests	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Valsalva Maneuver	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

NEUROLOGICAL (2pts each)

Indicates sites of referred pain for following structures:

☐ Heart – chest, left shoulder and left arm

☐ Spleen – left shoulder (Kehr's sign)

☐ Appendix – LRQ (McBurney's Point)

☐ Bladder – bilateral inner thighs

☐ Kidneys – mid-back of appropriate side

Analysis

Data was collected by the corresponding course instructors and entered in SPSS 17 (SPSS Inc., Chicago, IL) for analysis. Pretest-posttest percentage correct average changes for the peer tutors were analyzed with an ANOVA to determine statistical significance. Post-hoc contrast analysis was used to determine which group comparisons were significant. Peer-tutee post-interaction percentage correct scores were analyzed with an ANOVA to determine statistical significance ($P \leq .05$).

RESULTS

Instrument Survey Results

Table 2 presents the pretest-posttest score change means and standard deviations for the peer-tutor groups which were found to be statistically significant ($F_{3,102} = 4.703$; $P = .004$). The PAL+ group displayed the largest pretest-posttest score changes ($M = .161$, $SD = .119$) while the CON group had the smallest increase ($M = .041$, $SD .121$). Table 3 presents the post-hoc contrast analysis for the peer-tutor group comparisons. Three contrasts were statistically significant (PAL versus CON; $P = .003$, PAL+ versus CON; $P = .001$, and REV versus CON; $P = .001$). Table 4 presents the percentage correct mean and standard deviations used for the peer-tutee groups ANOVA analysis which revealed no statistical significance ($F_{1,85} = 1.419$; $P = .147$).

Table 2. Pretest-Posttest Score Changes for Peer-Tutor Group Interactions

Group	N	Mean	SD
PAL	29	0.149	0.109
PAL+	30	0.161	0.119
REV	30	0.159	0.121
CON	17	0.041	0.121

Abbreviations: SD, Standard Deviation; PAL, Peer assisted learning only; PAL+, Peer assisted learning and Focused review; REV, Focused review only; CON, Control.

DISCUSSION

Table 3. Post-Hoc Contrast Analysis for Peer-Tutor Group Interactions

Group Comparison	Significance
PAL versus PAL+	0.677
PAL versus REV	0.727
PAL versus CON	0.003
PAL+versus REV	0.947
PAL+ versus CON	0.001
REV versus CON	0.001

Study acronyms are explained in the footnote to Table 2

Effect of PAL on Peer-Tutors

Our results suggest that PAL has a significant positive effect on

Table 4. Post-Peer Interaction Percentage Correct for Peer-Tutee Group Interactions

Group	N	Mean	SD
PAL	43	0.906	0.087
PAL+	44	0.918	0.076
CON	17	0.881	0.061

Study acronyms are explained in the footnote to Table 2

skill performance for the peer-tutors. Peer-tutors in the three experimental groups (PAL, PAL+, and REV) had significant increases in pretest-posttest scores. While this may be due to a test-retest learning curve, it is likely due to the review of prior course work and refreshing their memory. We have not been able to find any studies that objectively measure the skill performance of the peer-tutors pre and post PAL. Numerous studies have measured the perceptions of PAL from the perspective of the peer-tutor.^{1,8,10,30-33} The general consensus is that PAL is helpful for both the peer-tutor and peer-tutee,^{1,8,31-33} that PAL reduces anxiety commonly associated with practicing skills with a supervisor/preceptor,^{1,8,10,33} and that PAL improves the understanding of the material for both the peer-tutor and peer-tutee.^{8,30-33} Results of our study indicate that the peer-tutor focused review session only (REV) group scored higher than the peer interaction only (PAL) group but they were not statistically significant. This matches the hypothesis that the review session would be a greater contributor to increased skill performance than peer interaction alone. This finding is consistent with the findings of Yates and colleagues²¹ where no statistically significant results were found that would indicate peer-mentors' skills and abilities improved following a PAL program. However, Yates et al²¹ did report that peer-tutors indicated through focus group interviews that the PAL program had been a benefit to their practice.

Effect of PAL on Peer-Tutees

Results suggest that PAL may have a positive effect by increasing peer-tutee skill performance and select skill sets; however, we did not find statistically significant differences among the peer-tutee groups. A visual analysis does indicate a trend toward increased performance in the peer-tutees assigned to the PAL and PAL+ peer-tutor groups. Vygotsky's¹⁷ concept of scaffolding and ZPD would indicate that the feedback provided by the peer-tutors was effective, but not significant, in improving performance of the peer-tutees. These findings are consistent with Weidner and Popp⁸ who found that peer-tutee scores significantly improved following an intentional PAL program in an athletic training education program. The Weidner study was unique in that it compared peer-led review (PAL) to instructor-led review and found no significant differences between the two review groups. Our findings are also consistent with numerous other studies^{5,10,34,35} that found increases in peer-tutee scores following tutorial and review sessions with peer-tutors in a variety of education programs.

LIMITATIONS AND SUGGESTIONS FOR FURTHER RESEARCH

The nature of a test-retest methodology allows for improvement upon the second testing. While this is an expressed limitation, we found it to be the best method for assessing the peer-tutors

initial level of knowledge and skill. Future projects could utilize alternative methodology when looking at the effect of PAL upon the peer-tutors. Future research should examine the methods of training for the peer-tutors. A general review session may not have as much impact as a focused simulated patient review upon both the peer-tutor and subsequent peer-tutee. The skill sets used in our study were limited to two broad content areas that do not encompass the entirety of Athletic Training education content. While this is a limitation of the applicability of the procedures, we believe that the findings can be generalized to any content area, but further research is warranted. Our study was limited to one institution with a sample of convenience. A larger sample size with a multi-institution study would strengthen the conclusions of the study. Further study would be warranted to determine if gender and cultural variables have an impact upon a PAL program.

CONCLUSIONS

Our study provides evidence to support the use of an intentional PAL program for the beneficial effects upon the peer-tutors. The results indicate that our PAL program may increase peer-tutor performance as seen with post-hoc comparisons for the PAL, PAL+ and REV groups versus the CON group. Further research could explore the use of alternative dependent variable measures. Furthermore our results indicate that a PAL program may increase peer-tutee performance on certain skill sets as seen with the reported average for the PAL+ group. Future research focusing on a variety of skill sets from across the curriculum may yield interesting results. PAL has been shown to increase student confidence, reduce anxiety, and, therefore, should be incorporated into ATEPs. Much of the available research has focused on the perceptions of participants in a PAL program. We feel that it has been clearly shown in numerous academic fields that PAL has positive perceptions amongst the participants. It is time for researchers to shift their focus onto how to structure and organize PAL programs to maximize the learning for both the peer-tutors and peer-tutees. ATEPs should practice with PAL to determine what works best for their students and institution. Focused review sessions can be developed from existing course materials, the peer assignments can occur by design or happen naturally based upon the scenario, and outcome measures can be easily identified and captured to help determine what is working and what needs to be refined.

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