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ORIGINAL RESEARCH ARTICLE

Academic performance of physical therapy students participating in a student-led pro bono clinic: a quasi-experimental, cohort study across two orthopedic courses

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Abstract

***Purpose*:** Prior studies have explored the influence of student-run pro bono clinics on attitudes, empathy, and professional development; however, limited research has examined the potential academic impact. The TSU Tiger Rehabilitation Clinic is a student-led clinic offering physical therapy services to underserved populations. The purpose of this study was to investigate whether involvement impacted the performance on written examinations and practical scores of second-year Doctor of Physical Therapy (DPT) students enrolled in two consecutive orthopedic courses.

***Methods*:** A quasi-experimental crossover design was employed to investigate the effect of student-led pro bono clinic participation on the academic performance of second-year DPT students across two consecutive cohorts. Students were randomly assigned to either the experimental group (clinic participation) or the control group (fundraising) during the fall semester and switched roles in the spring. Academic performance was assessed using standardized quizzes, written exams, and practical assessments in Orthopedics I and II. Written evaluations were administered through an electronic management system with NPTE-style questions from a consistent question bank; item reliability was confirmed using platform analytics. Practical exams evaluated both clinical skill performance and theoretical knowledge, with structured remediation and safety protocols in place. A paired sample t-test and MANOVA were performed to analyze differences in academic outcomes between groups.

***Results*:** No statistically significant differences were found between groups on any written or practical assessments. Score differences were minimal, correlations were weak, and effect sizes were consistently small, indicating a minimal to negligible measurable impact on academic outcomes from clinic participation.

***Conclusion*:** Although clinic participation did not significantly impact academic performance, pro bono experiences may promote interpersonal and professional development that is not captured by traditional assessments. Future research should employ mixed-method designs to explore broader educational impacts and long-term outcomes of early clinical exposure.

Keywords: *student-led clinic*; *clinical education*; *experiential learning*; *DPT curriculum*; *physical therapy students*

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A substantial amount of predominantly qualitative research demonstrates the positive effects of pro bono participation for physical therapy students, including improvements in clinical reasoning skills, the development of leadership characteristics, the opportunity to practice communication with patients, applying the psychomotor and clinical skills learned in the classroom, cultivating a sense of professional responsibility and pride, increased empathy and cultural competence, the opportunity to contribute to community health, a better understanding of the healthcare difficulties encountered in underserved communities, learning about the administrative aspects of operating a clinic, and the potential to collaborate with other students and clinical instructors.[1–6] Despite the significant amount of literature assessing the inclusion of pro bono clinics on the attitudes and beliefs

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of physical therapy students, minimal research has evaluated whether participation in student-run clinics influences academic performance on quantitative assessments, such as written examinations or laboratory practicals.

Pro bono translates to 'for the public good' and 'providing professional services at no cost or a reduced cost for individuals with limited means'.[7] Pro bono services have a long history in law and medicine, with free medical clinics becoming widespread in the 1960s and 1970s.[8,9] According to a 2014 study, 75% of medical schools offer pro bono services through student-operated clinics.[10] The provision of pro bono care extends to other disciplines that also believe they have a social responsibility to the public.[11] For example, the American Physical Therapy Association (APTA) Code of Ethics advocates for pro bono services to underserved communities as a form of altruism in its core values.[12] According to the Code of Ethics, 'Physical therapists shall provide pro bono physical therapy services or support organizations that meet the health needs of people who are economically disadvantaged, uninsured, and underinsured'.[13] Providing pro bono services does not necessarily have to begin as a licensed clinician, but is often integrated into entry-level curricula.[14–20] According to a 2018 survey, roughly 42% of all physical therapy programs in the United States provide pro bono services, with the majority being facilitated by students.[21]

There is a gap in physical therapy research between the potential qualitative benefits of early clinical engagement in pro bono clinics and academic performance. This is relevant for multiple reasons, including justifying why objective resources should be allocated to physical therapy programs for pro bono clinics instead of relying on anecdotal evidence. The most substantial evidence for embedding pro bono participation early in a curriculum is from research showing a link with better student performance on the Clinical Performance Instrument (CPI) during the first long-term clinical.[1,4,22] For example, students at the University of Florida who participated in a minimum of two pro bono experiences per semester, had superior CPI scores in the examination, clinical reasoning, professional conduct, and overall clinical competence categories.[22] But again, this study focused on clinical performance and not academic performance so it is difficult to make a cause-and-effect determination. It is also unknown if these pro bono experiences translate to superior performance on the National Physical Therapy Examination (NPTE).

The purpose of this quasi-experimental crossover study was to determine whether participation in a student-led pro bono clinic was associated with improved academic performance on written and practical examinations among second-year DPT students enrolled in two consecutive orthopedic courses. By examining whether participation in these early clinical exposures influences course-based academic performance, this study may provide empirical data to help physical therapy educators, academic administrators, and clinical education professionals inform curriculum development, resource allocation, innovative clinical education models, and strategies for enhancing student engagement.

Methods

This study employed a quasi-experimental crossover design to investigate the impact of participating in a student-led, pro bono physical therapy clinic on the academic performance of second-year Doctor of Physical Therapy (DPT) students. Two consecutive cohorts were used for this study. While the initial group assignment was randomized within each cohort, allocation concealment was not used, and group equivalence at baseline was not stratified or verified, classifying the design as quasi-experimental. The study was approved by the Tennessee State University Institutional Review Board (HS-2023-4949).

A total of 65 students participated in this study over a 2-year period. The first cohort included 31 students, with 16 initially assigned to the experimental group and 15 to the control group. The second cohort, from the following year, included 34 students, with 17 assigned to each of the experimental and control groups.

During the fall semester of an Orthopedics course focusing on the cervical spine, thoracic spine, and upper extremity, each group was assigned using a random number generator. Students in the experimental group participated in five in-clinic experiences over the 15-week semester. They conducted examinations, evaluations, and treatments of musculoskeletal conditions commonly encountered in outpatient settings under the supervision of volunteer clinical instructors who had completed the APTA's Credentialed Clinical Instructor Program Level 1 course.[23]

Students were required to complete a structured clinical education tool designed to support student development and supervision during participation in the Tiger Clinic. The form was an internal document developed by the Clinic Director that was not researched for its validity. The form was divided into two primary sections: one completed by the student therapist before clinical supervision and the other completed by the supervising clinician during or immediately after the clinical session. The first section prompted students to reflect on their patient encounter by documenting key clinical and contextual information. This included the patient's occupation, chief complaint, and the date of symptom onset. Students are also asked to identify the patient's goals, the severity and progression of their condition, and any relevant outcome measures. Subjective data was supplemented by the identification of 'asterisk signs' – functional or movement-specific findings that were reproducible and indicative of the primary complaint. Objective observations focused on posture, biomechanics, mobility, strength, and

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other measurable characteristics. Students also outlined the interventions completed to date, the current home exercise program, and evaluated which aspects of treatment have been effective and which have been ineffective. Additionally, students articulate a progression plan and identify any additional resources, referrals, or areas where they require further guidance.

The clinical mentor used the second section to provide structured feedback to the student. This included rating the student's preparedness, professionalism, patient safety, equipment competency, receptiveness to feedback, and overall clinical performance using a 10-point scale. The form also included space to identify any red flags that the faculty should address, describe the student's strengths during the session, and suggest specific strategies for improvement before the subsequent mentoring encounter. A copy of the TSU Tiger Student Mentoring Form is provided in Fig. 1.

Each clinic session lasted between 4 and 8 hours, and students were allowed to see only one patient per hour to maximize their interactions. Patients with primary neurological diagnoses and those requiring complex care, such as post-operative patients, were outside the scope of the Tiger Clinic and were referred to a local partner. The control group focused on fundraising activities for the Tiger Clinic. After the semester, grades from quizzes, written exams, and practical assessments for both groups were analyzed to identify any differences.

This process was repeated during a second Orthopedics course the following spring semester, which concentrated on the lumbar spine, sacroiliac joint, pelvis, and lower

Tiger Community Rehab Clinic
Student Mentoring Form

(To be completed by the student prior to clinical supervision)

Date _____ Patient's Name _____ Patient's Age _____

Patient's Occupation _____ Chief Complaint _____ Date of Onset _____

Patient's Goal(s) _____

Patient Status (Last visit or Intake Form)

Condition Severity/Pain Level: _____

Condition Progression: _____

Condition Stage/Stability: _____

Current Outcome Measure/Score/Date: _____

Subjective Status:

Current Asterisk Signs (something you can reproduce/retest that reflects the 1° complaint. It can be functional or movement specific)**:**

Objective Status: (Posture/Biomechanics, Mobility, Stability/Strength, Swelling/Effusion, etc.)

What interventions have been performed to date?

What is the current home program?

What has been successful? (Describe why you think this patient has progressed or not.)

What is your progression plan?

What additional resources/referrals/consultations do you need for this patient?

What do you feel you need guidance/assistance with?

Student Therapist's Name: _____ **Date of Exam:** _____

Fig. 1. Tiger Community Rehab Clinic Student Mentoring Form.

extremity. In this second course, the experimental and control groups switched roles: the experimental group from the fall Orthopedics course became the control group. In contrast, the control group from the fall semester participated in the Tiger Clinic during the spring course. This procedure was repeated the following year with a new cohort of second-year students. The course structure remained consistent with that of the previous year, utilizing the same format for lab practicals and the same question bank for written assessments to enhance the study's internal validity.

All quizzes and exams included multiple-choice and true-false questions. Quizzes had 25 questions, midterm exams consisted of 50 questions, and final exams included 75 questions. The content of the written assessments aligned with the Patient Management Model, a framework that guides the components of a patient's plan of care.[24] Questions covered topics ranging from examination, evaluation, diagnosis, prognosis, intervention, and outcomes.

All written assessments were completed electronically through eLearn, a common educational platform, and questions for each assessment across all cohorts were taken from the same question bank. Both instructors completed an item-writing course through the APTA on creating National Physical Therapy Exam-style questions. The reliability of all questions was assessed using eLearn's internal analytics and performance tracking tools, which provided data such as the percentage of students who answered correctly, standard deviations indicating score variation, discrimination indexes measuring how well an item distinguished between high and low performers, and the point biserial correlation coefficient, which is similar to the discrimination index and relates individuals' scores to whether they answered a question correctly.

The practical examination emphasized mastery in both hands-on performance and theoretical understanding, offered structured remediation opportunities, and prioritized safety throughout the assessment process. Students were randomly assigned three clinical skills to perform and were expected to respond to any follow-up questions from the instructor. Each skill was evaluated for both performance and knowledge components, with ratings of 'Excellent', 'Good', or 'Poor'. The Performance section assessed the student's ability to demonstrate a clinical skill or procedure physically, including correct technique, safety, efficiency, body mechanics, and adherence to clinical protocols. At the same time, an evaluator observed the student in real-time. The knowledge section focused on the student's theoretical understanding and reasoning related to the assigned skill, involving oral answers to questions about indications, contraindications, anatomy, rationale, and clinical decision-making.

Students had to achieve at least a 'Good' or 'Excellent' rating on both components for each of the three skills to pass. If a student failed a single skill, they attempted a randomly assigned fourth skill, which resulted in a lower score if successful. Failing the fourth skill resulted in a failing grade, and students were required to retake the practical. Students who failed the initial practical but passed a retake received a minimal passing score. Failure of the retake resulted in a course failure. Any unsafe activity or inability to follow safety protocols resulted in an automatic failure and a requirement to retake the course.

The data analysis was conducted using SPSS version 30.[25] A paired sample t-test was initially employed to evaluate differences in performance between the control group, which did not participate in the Tiger Clinic rehabilitation rotation, and the experimental group, which did, across the various assessments.[26] The analysis incorporated three quizzes, a midterm exam, a final exam, a midterm practical exam, and a final practical exam.

Quizzes, written exams, and practical assessments were selected as outcome measures to provide objective, course-based indicators of student learning. This combination of assessments supports clinically based learning by evaluating both the knowledge and skills students apply in patient care. Specifically, the content of the written quizzes and exams was clearly aligned with the Patient Management Model, covering the entire spectrum from patient examination and evaluation through diagnosis, prognosis, intervention, and outcomes.[24] This approach tests students on the comprehensive clinical reasoning and decision-making processes essential to physical therapy practice. Additionally, the laboratory practical exams evaluated hands-on clinical skills and applied decision-making, requiring students to demonstrate examination and treatment techniques and explain their clinical reasoning in real time. By using these standard academic measures, the study captured multiple learning domains – cognitive knowledge through written tests and psychomotor skills through practical exams – increasing the likelihood that any academic impact of pro bono clinic participation would be reflected in areas most relevant to professional clinical performance.

A more detailed analysis was conducted using a multivariate analysis of variance (MANOVA). The purpose of the MANOVA was to examine whether there were statistically significant multivariate differences in academic performance between the experimental and control groups across the dependent variables. Wilks' Lambda was used to determine whether there were overall differences between groups across the dependent variables. It specified whether group differences did not describe the amount of the total variance in the dependent variables.[27]

Results

For each assessment type, the average score difference between students in the non-clinical and clinical groups was minimal. All the confidence intervals included zero, indicating that none of the differences were statistically

significant. For example, on Quiz 1, the control group's average score was approximately 93.16 (standard deviation [SD] = 8.47), while the experimental group's score was 92.73 (SD = 8.50), and the 95% CI for the difference ranged from negative to positive values, including zero. Similar small differences and wide intervals were observed for all quizzes, exams, and practicals, indicating a high overlap in performance between the two groups. The mean differences (control minus experimental) and their 95% confidence intervals for each assessment, combining data from both groups, are shown in Table 1.

Paired sample correlations demonstrated weak relationships between control and experimental group scores. For instance, Quiz 1 showed a moderate positive correlation ($r = 0.448$, $P < 0.001$), but most other assessments, such as Quiz 2 ($r = 0.050$, $P = 0.661$) and the Final Practical ($r = -0.119$, $P = 0.351$), did not reveal significant correlations. This suggests that performance in one condition did not consistently relate to performance in the other.

The paired samples t-tests further indicated no statistically significant differences between the groups. The 95% confidence intervals often included zero, reinforcing the lack of meaningful differences. The *P*-values by assessment are presented in Table 2.

The number of student scores included in each assessment varied slightly due to differences in cohort sizes and student participation. In the first cohort, there were 31 students, while the second cohort had 34 students. Because one cohort had an odd number of students, the experimental (clinic) and control (non-clinic) groups were not equal in size (e.g. one group had 16 students, while the other had 15). Every student in both cohorts was required to complete all assessments according to the course requirements, ensuring that no missing data had to be omitted from the analysis. However, variations in numbers across assessments could limit the statistical power for those specific assessments.

Effect sizes, calculated using Cohen's d and Hedges' correction, were statistically insignificant across assessments. For instance, Cohen's d for Quiz 1 was 0.052, indicating a trivial effect. Similar small values were observed for other evaluations, suggesting that any observed differences were not practically significant. The effect sizes by assessment are presented in Table 3.

Assumption testing was performed for all assessments in every semester. The Shapiro–Wilk tests indicated that the normality assumption held for all variables (all $P > 0.05$), and Levene tests verified equal variances across groups for each assessment (all $P > 0.05$). These results justify the use of parametric comparison methods

Comparing the combined analysis with individual semester analyses revealed consistent patterns of minimal impact from the experimental intervention. The combined data provided a broad overview but potentially masked semester-specific variations. Despite these variations, the mean scores, correlations, and t-test results remained stable across semesters, indicating that the experimental condition did not meaningfully enhance or detract from academic performance.

For the MANOVA, six dependent variables were identified, consisting of Quiz 1, Quiz 2, Quiz 3, the Practical Exam, the Midterm Exam, and the Final Exam. The group assignment for each experimental and control group served as the independent variable. The MANOVA results did not find a statistically significant difference between the experimental and control groups across the combined dependent variables. Wilks' Lambda assessed whether there were overall differences between groups on a combination of dependent variables.[26] Wilks' Lambda was 0.966, indicating that

Table 1. Control versus experimental group mean scores

Assessment	Control mean	Experimental mean	Mean difference	Confidence interval (95%)
Quiz 1	93.16	92.73	0.43	[–2.19, 3.27]
Quiz 2	88.51	88.05	0.46	[–1.43, 4.03]
Quiz 3	82.89	84.42	–1.53	[–6.11, 1.87]
Midterm Exam	85.82	85.74	0.08	[–1.75, 2.50]
Midterm Practical	95.49	95.50	–0.01	[–2.01, 1.27]
Final Exam	84.80	85.28	–0.48	[–3.52, 1.76]
Final Practical	95.00	94.83	0.17	[–1.41, 1.87]

Table 2. *P*-values for clinical and non-clinical groups

Assessment	*t*	Df	*P*
Quiz 1	–0.25	128	0.80
Quiz 2	–1.24	128	0.22
Quiz 3	–0.41	128	0.68
Midterm Exam	–0.10	128	0.92
Midterm Practical	0.55	128	0.58
Final Exam	–0.79	128	0.43
Final Practical	2.21	128	0.03

Table 3. Assessment by effect size

Assessment	Cohen's d	Hedges' g
Quiz 1	–0.04	–0.04
Quiz 2	–0.22	–0.22
Quiz 3	–0.07	–0.07
Midterm Exam	–0.02	–0.02
Midterm Practical	0.10	0.10
Final Exam	–0.14	–0.14
Final Practical	0.39	0.39

Table 4. MANOVA test results

Test	Value	*F*	*P*
Wilks' Lambda	0.966	0.701	0.651

group assignment did not result in a meaningful variance in academic outcomes for any assessment. The *P*-value was 0.651, indicating there was no probability of rejecting the null hypothesis because there were no group differences. The MANOVA results are presented in Table 4.

These results were consistent with the earlier paired-sample t-test analyses for individual semesters. In summary, the study found no significant differences in performance between the control and experimental groups. The consistently small mean differences, weak correlations, and non-significance illustrate the fact that participation in the Tiger Clinic had little to no impact on the participants' academic outcomes. The observed differences are likely due to random variation rather than the experimental condition.

A post hoc power analysis was performed for each between-group comparison using observed means, standard deviations, and sample sizes from each assessment. The estimated effect sizes (Cohen's d) were small (range, 0.01–0.3), and the statistical power to detect effects at the $\alpha = 0.05$ level was low (often below 0.2). Larger sample sizes would be needed to identify small to moderate between-group differences reliably.

Discussion

These findings suggest that participation in a brief, student-led clinic rotation was not associated with short-term improvements in academic performance on course-based assessments. Despite the hypothesis that hands-on clinical experience would enhance the understanding and application of course content, the data showed insignificant differences in scores between groups across multiple semesters. The slight deviations in quiz, exam, and practical scores between the experimental and control groups may indicate that both groups had similar levels of academic preparedness by the program's second year, which is why the additional time in the Tiger Clinic did not make a significant difference.

The first year of an entry-level curriculum focuses on fundamental content like anatomy, biomechanics, neuroscience, and physiology. This may have reduced the potential for this limited clinical exposure to alter academic performance. This aligns with previous research, which demonstrates the fact that clinical reasoning and psychomotor skills may not necessarily correlate with short-term academic performance.[2,28] Another possible factor was the timing and organization of the clinical experiences. Both groups participated in the control and experimental conditions over a period of two semesters. The crossover design may have reduced the collective effect of pro bono service on learning outcomes, as students alternated between the clinical setting and the traditional classroom environment.

Students had minimal time in the clinic, with an average exposure of once per week for 5 weeks, and each session lasted 4 h. This may not have allowed for sufficient time for significant changes to develop. Clinical skills take longer to cultivate and refine, so these brief experiences cannot significantly impact performance on typical assessments, such as multiple-choice exams. Novices understandably require time to practice, self-reflect, and refine their skills before making reasonable improvements. This is why clinical rotations are usually at least 7–8 weeks long, with students spending between 22 and 36 weeks total before graduation.[29] Research demonstrates that students perform better on the skill development portions of the CPI when rotations are at least 8 weeks long.[30] This is due to the prolonged and deliberate practice students get while receiving structured critique. Students were unlikely to receive sufficient practice to refine their psychomotor skills in the limited number of sessions allotted through the Tiger Clinic.

Another factor to consider is how well the assessments used to evaluate academic performance translate to the knowledge and skills learned during the time spent in the Tiger Clinic. Interpersonal skills, such as communication, collaboration, and compassion, may have improved due to clinical exposure; however, this improvement may not be reflected in performance on traditional assessments, like written examinations, which are generally not designed to evaluate these traits.[2,16] This finding is consistent with previous studies that emphasize the importance of prolonged clinic contact over time in influencing academic performance.[31] The outcomes attained with pro bono clinical experiences largely target the affective domain of learning, which includes empathy, attitudes, values, and empathy, and professional development. Gains in this capacity are important for physical therapy students, as they influence their ability to provide patient-centered care, show cultural competence, and make ethical decisions. While typical cognitive assessments might overlook these aspects, the affective domain has an essential role in clinical practice.[32]

Other noteworthy findings included the fact that neither the paired t-tests nor MANOVA demonstrated a statistically significant difference, and the effect sizes were consistently minor across all assessments. This suggests that any differences between the groups were likely due to random variation rather than the clinical intervention. The small sample sizes for particular evaluations, especially the practical exams, could have limited the statistical power to identify subtle effects. Studies with larger sample sizes or more robust designs, such as longitudinal studies, may provide a more explicit understanding of the potential academic benefits of students participating in pro bono activities.

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Limitations

Several limitations should be considered when interpreting the findings of this study. First, the duration and frequency of participation in the Tiger Clinic were limited. Students typically engaged in the clinic once a week for 5 weeks each semester, which may not have provided sufficient clinical exposure to measurably influence their academic performance. Clinical competencies, particularly those related to psychomotor and interpersonal skills, typically require prolonged and consistent practice to develop and may not be adequately assessed through brief exposure.

Second, the study used a crossover design where students alternated between control and experimental conditions over two semesters. Although this method helped balance the overall learning experience, it may have weakened any cumulative effects of sustained pro bono participation. Neither group received continuous clinical exposure, which may have limited the ability to observe more significant academic differences. Third, the assessments used to evaluate academic performance, primarily written and practical exams, may not fully capture the range of skills and knowledge gained through clinical participation. Improvements in communication, empathy, and professional behavior, which are often emphasized in clinical settings, are usually not reflected in traditional academic metrics. Thus, the impact of clinic participation on these areas may be overlooked.

Fourth, while the data indicated minimal semester-specific deviations, the impact of external variables such as instructional changes, stress levels, and limited patient availability during specific terms cannot be entirely dismissed. These factors might have influenced student performance in ways unrelated to their clinical involvement. Finally, the relatively small sample size and limited statistical power, especially for certain subgroup analyses (e.g. practical exams), may have hindered the detection of subtle effects.

Implications for future research

Although the results did not reveal a significant difference in academic performance between student groups, they underscore the importance of examining the other components of learning that pro bono work may impact. This opens up exciting possibilities for future research. Mixed-method designs that incorporate both qualitative and quantitative data can assess the relationship between early clinical experiences, professional development, cultural competence, communication skills, and academic performance. Additionally, future studies could appraise the long-term influence of sustained clinical participation on academic performance, especially as students transition into their final and clinical rotations. Due to the minimal effect observed in this study, a reassessment of how pro bono service is integrated into the curriculum may be warranted. This would require thoroughly stressing the alignment between these patient exposures and course learning objectives. Other suggestions include examining the effect of different types and lengths of clinical experiences.

Conclusion

While involvement in the Tiger Clinic did not significantly change academic performance, its broader worth should not be disregarded. Although participation in the Tiger Clinic was not associated with significant improvements in assessments, the potential value of such experiences in shaping professional development warrants further study using broader evaluation metrics. The interpretation of these results should be tempered by the study's limitations, including modest sample sizes, short clinical exposure, and reliance on traditional assessments that may not fully capture the impact of experiential learning. The results of this study highlight the need for further evaluation of the effect of pro bono involvement on performance on written examinations and lab practicals within physical therapy education.

Conflict of interest and funding

The authors have no conflicts of interest to report. No funding was received for this project.

Ethics statement

The Institutional Review Board of Tennessee State University approved this project. Project # HS-2023-4949.

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