EDUCATION
RESEARCH SERVICE

ORIGINAL ARTICLE

Comparison of National Board of Chiropractic Examiners part I examination scores between tutors and tutees at a chiropractic college

Amilliah W. Kenya, MS, DC, John F. Hart, DC, MHSc, and Charles K. Vuyiya, DC

Objective: This study compared National Board of Chiropractic Examiners part I test scores between students who did and did not serve as tutors on the subject matter.
Methods: Students who had a prior grade point average of 3.45 or above on a 4.0 scale just before taking part I of the board exams were eligible to participate. A 2-sample *t*-test was used to ascertain the difference in the mean scores on part I between the tutor group ($n = 28$) and nontutor ($n = 29$) group.
Results: Scores were higher in all subjects for the tutor group compared to the nontutor group and the differences were statistically significant ($p < .01$) with large effect sizes.
Conclusion: The tutors in this study performed better on part I of the board examination compared to nontutors, suggesting that tutoring results in an academic benefit for tutors themselves.

Key Indexing Terms: Education; Chiropractic; Academic Training; Competency Based Education

J Chiropr Educ 2016;30(2):104–107 DOI 10.7899/JCE-15-00013

INTRODUCTION

Students who tutor have the advantage of having frequent reviews of previously learned material, which helps them learn new material in more advanced courses.[1] Many studies have been done to assess the effectiveness of peer tutoring, although we are aware of no such studies in chiropractic. Benefits include improved academic achievement and attitude toward the subject matter and the school in general,[2] and increased retention rates particularly for at-risk students.[3] The focus of these studies has been on students who were tutored (tutees). Most universities and colleges encourage peer tutoring because it is a cost-effective method of providing and evidencing academic support to meet the demands of outside agencies and the needs for individual institutions, common knowledge dictates that tutoring leads to improved retention of knowledge, it reduces failure and drop-out rates among students, and it fosters and enhances relationships among peers leading to higher satisfaction ratings.

Many studies have been done to show the effectiveness of peer tutoring from elementary to higher levels of schooling. Typically these studies have focused on those who are tutored. Bloom,[4] and Roscoe and Chi[5] documented that tutoring is one of the most effective interventions, with tutored students performing 1 to 2 standard deviations above nontutored students. Little focus has been given to the tutors themselves, who not only provide foundational resources but promote educational standards. Roscoe and Chi[5] give the general information believed by many that students sometimes benefit academically from tutoring other students.[6] Thus, a question arises as to whether tutoring in itself may have a benefit for the tutor. Thus, this study compared examination scores from the National Board of Chiropractic Examiners (NBCE) part I between 2 groups: one that tutored and one that did not tutor. The null hypothesis is that there is no difference between groups in NBCE part I scores, while the alternative hypothesis is that there is a difference.

METHODS

Student Research Considerations

The study was approved by the institutional review board at Sherman College of Chiropractic. The chair of the student success department invited all students who were eligible to take part I of NBCE in 2013 to 2014 to voluntarily participate in this study by signing a consent form.

Selection of Students

The cumulative grade point average (GPA) of all the volunteers was obtained from the school registry and

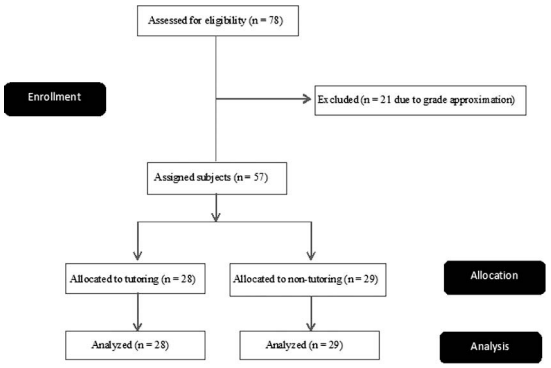

Figure 1 - Participant flow chart for the study.

qualifying participants were determined. The age and sex of qualifying participants also were obtained from the school registry thereafter. The results of part I NBCE were obtained from the school's academic department. Inclusion criteria for students were a chiropractic college GPA at the time just before taking Part 1 of national boards in 2013 to 2014 of greater than 3.45 on a 4-point scale, and attainment of a "B" or better in the subject tutored. Our target was to research students who had an "A" average (3.45 to 4.00) on a 4.00 scale which was a GPA range thought to provide a sufficiently large enough sample size of students with a high GPA.

Tutors and nontutors took the same administration of NBCE. They also were encouraged to attend internal faculty board reviews, though attendance was not tracked. A total of 78 students enrolled in the doctor of chiropractic degree program were recruited for the study. Half of the students were tutors ($n = 39$, "tutor" group) and the other half were not ($n = 39$, "nontutor" group). All students who met the requirements were offered the opportunity to become tutors and those who accepted the offer were trained and assigned tutees.

Tutoring Process

Tutors were trained in the basics of tutoring, including the need to prepare what to tutor and to be well versed with the content; virtues to uphold as a tutor, including dependability, integrity, empathy, and a caring attitude; effective communication of content during tutoring; equipping the learner by pointing them to resources, engaging them, covering a wide base as opposed to focusing on passing an exam; and handling difficult situations.

Tutoring was integrated gradually allowing those in their second quarter of study to tutor first quarter students. Tutors were encouraged to maintain and move with their tutees through subsequent quarters. This was done strategically to ensure that tutoring was done in all basic sciences that constitute the 6 sections tested under part I of NBCE. As tutors started to tutor fourth quarter subjects, they were assigned a second tutee from the first quarter. This was to ensure mastery of content taught in their first year of chiropractic school on which they would be heavily tested on part I of NBCE. Tutors who were considered masters at their work (e.g., experienced, competent) were assigned to tutor groups of 5 to 10 students in selected basic science subjects. Tutors' work was monitored, evaluated, and discussed on a weekly basis. Tutees' performance was monitored and discussed every week with the chair of the student success department, including a review of tutoring logs and discussion of the tutoring process and tutee progress.

Tutors were directed to reliable resource materials (selected by the student success department chair, in collaboration with instructors who taught in the subject matter) to make their tutoring effective. Upon obtaining national board scores, the results of the tutors versus nontutors were compared in all the 6 subjects tested under Part 1 on NBCE, as follows: General anatomy, Chemistry, Microbiology, Spinal anatomy, Pathology, and Physiology.

Analysis

Analysis consisted of comparing GPA, age, and NBCE scores between the tutor and nontutor groups. Normal probability plots indicated satisfactory normality of the data for each NBCE subject by group (tutor versus nontutor) in the final analysis. Thus, the 2 sample t-test was considered appropriate since there were only 2 groups being compared (tutor versus nontutor) for the 6 aforementioned NBCE subjects. Effect size, using a pooled standard deviation also was included, calculated in Excel 2010 (Microsoft Corp., Redmond, WA). Two-tailed p values less than or equal to the conventional α level of 0.05 were considered statistically significant. For readers who subscribe to the Bonferroni-adjusted α approach, the adjusted α would be 0.0083 (0.05/6 NBCE subjects). A subgroup analysis was performed by sex in tutor versus nontutor groups for GPA to assess the possible effect of sex on GPA. Analysis was performed in Stata 12.1 (StataCorp, College Station, TX).

RESULTS

Initial analysis indicated that the tutor group's GPA was higher (3.77) than that of the nontutor group (3.60), and this difference was statistically significant ($p < .0001$; effect size [ES] 1.2), even though the mean GPA for both groups was >3.45. Thus, to render the 2 groups more similar GPA-wise at baseline, certain students were removed from the analysis. This removal process began with the highest GPA in the tutor group, then the lowest GPA (though >3.45) from the nontutor group, and so on until the p value for GPA was >0.05. This resulted in 11 students being removed from the tutor group and 10 being removed from the nontutor group, where p was no longer statistically significant ($p = .075$ for GPA with an effect size 0.49). This left 28 students in the tutor group and 29 in the nontutor group, representing the core study group for this report (Fig. 1). The closer approximation of GPA between groups helped to allow a greater similarity between groups in an effort to isolate the variable of interest (tutoring versus no tutoring). The removal of 1 GPA at-a-time from each group, while checking for a

Table 1 - Characteristics by Group

Group	*n*	Female	Male	Mean Age (SD)	Median Age
Tutor	28	13	15	28.8 (6.2)	26.5
Nontutor	29	13	16	29.2 (5.4)	28.0

SD, standard deviation.

statistically significant difference between groups for GPA allowed for the maximum sample size in each group.

Group characteristics are provided in Table 1 and group academic scores are provided in Table 2. The mean age in each group was not statistically different (Table 1), nor was the GPA. GPA was essentially the same for each sex within groups ($p = .86$ in the tutor group and $p = .33$ in the nontutor group). Thus, the 2 groups were considered similar at baseline.

All part I NBCE scores were higher in the tutor group compared to the nontutor group, and the differences were statistically significant, even with Bonferroni adjustments, with very large effect sizes (Table 2).

DISCUSSION

This study revealed higher part I NBCE scores for students who tutored other students in NBCE subject matter. The findings of the study may have implications for those wishing to prepare further for NBCE testing by using tutoring as an option. As evidenced in our earlier research,[7] students who attained and maintained a high GPA performed better on NBCE. The current study investigated differences in part I NBCE scores among students with similar GPA but different experiences in tutoring other students in topics pertinent to part I NBCE. Peer tutoring requires a purposeful program of specific learning objectives, activities, and assessments for developing student's mastery of concepts and skills.[8] This study suggested that peer tutoring results in an academic benefit for the tutors.

There are several limitations to this study. The use of convenience sampling (no randomization) limits the generalizability of the findings. Also, board review history was not tracked for each student. Thus, if more students in the tutor group took board reviews compared to the nontutor group, then this could explain why they outperformed the nontutor group. Another possibility is that tutors may have been more likely to attend the board reviews versus their counterparts, perhaps due to their having greater internal drive to succeed. This could have influenced their resulting NBCE scores. Future study should track this information. It also is possible that the reason for the higher scores in the tutor group may have little to do with tutoring but pertain more to noncognitive skills, such as overall life affluence and access to resources. Also, the initial sample revealed a statistically significant difference of GPA between groups. It was thought initially that the criteria of GPA > 3.45 would result in a homogenous pool of GPAs between groups. However, upon closer baseline analysis, such was not the case, as substantiated by the statistically significant difference in GPAs between the groups. We could have included only 1 GPA (e.g., 3.50) but would have lost much statistical power due to very small sample sizes in each group. Thus, our method of removing one extreme GPA at-a-time was thought to guarantee the largest sample size possible while better approximating between-group GPA. Not to have better approximated the GPA between the 2 groups would have resulted in a greater difference of GPA between the groups, and, therefore, a greater likelihood that the higher GPA group's reason for doing better on NBCE was their higher GPA. Future study should have a more narrow range for GPA inclusion criteria.

A potential confounder in the present study is that those who are attracted to becoming tutors may have more developed executive function skills helping them to better organize their study habits, which, in turn, could result in higher NBCE scores. Future study should include this and other potential confounders, such as environment influences on behaviors that contribute to student learning, performance, contentment, and success.[9] Moreover, students' perception of their current learning environment is a strong predictor of their learning outcomes.[10] As Rahman and Mokhtar[11] noted while researching with engineering students, we too observed that the learning community had direct relationship to acquisition of generic skills and knowledge.

CONCLUSION

The tutors in this study as a group performed better on NBCE Part 1 subjects compared to the nontutor group.

Table 2 - Academic Scores by Group, Reported as Mean (Standard Deviation)

Group	*n*	GPA	GEA	SPA	PHY	CHE	PAT	MIC
Tutor	28	3.70 (0.03)	610.6 (9.0)	629.8 (8.0)	617.0 (8.1)	617.1 (10.4)	627.8 (9.1)	651.1 (9.8)
Nontutor	29	3.64 (0.02)	528.9 (11.2)	559.0 (11.2)	550.4 (10.1)	567.7 (10.0)	557.9 (8.4)	582.8 (9.8)
Difference		−0.06	−81.7	−70.8	−66.6	−49.5	−69.9	−68.4
DF		48.7	52.8	50.2	52.9	54.8	54.5	55.0
t Statistic		1.81	5.68	5.13	5.12	3.43	5.62	4.93
P value		0.0755	<0.0001	<0.0001	<0.0001	0.0012	<0.0001	<0.0001
Effect size		0.49	8.0	7.3	7.3	4.8	8.0	7.0

Difference was calculated as nontutor minus tutor. GEA, general anatomy; SPA, spinal anatomy; PHY, physiology; CHE, chemistry; PAT, pathology; MIC, microbiology.

This suggests that tutoring results in an academic benefit for tutors themselves, though other factors not included in the study also may contribute to these findings. Further research that includes other potential confounding variables is a reasonable next step.

FUNDING AND CONFLICTS OF INTEREST

This work was funded internally. The authors have no conflicts of interest to declare relevant to this work.

About the Authors

Amilliah Kenya is an associate professor in the clinical sciences department at Sherman College of Chiropractic (PO Box 1452, Spartanburg, SC, 29304; akenya@sherman.edu). John Hart is assistant director of research at Sherman College of Chiropractic (PO Box 1452, Spartanburg, SC, 29304; jhart@sherman.edu). Charles Vuyiya is an assistant professor in the clinical sciences department at Sherman College of Chiropractic (PO Box 1452, Spartanburg, SC, 29304; vkenya@sherman.edu). Address correspondence to Amilliah Kenya, PO Box 1452, Spartanburg, SC, 29304; akenya@sherman.edu. This article was received June 17, 2015, revised September 10, 2015 and October 26, 2015, and accepted November 8, 2015.

Author Contributions

Concept development: AK. Design: AK, CV. Supervision: AK. Data collection/processing: AL, CV. Analysis/interpretation: JH. Literature search: AK. Writing: AK, JH. Critical review: AK, JH, CV.

REFERENCES

1. National Education Association. Research spotlight on peer tutoring. 2012. Available from: http://www.nea.org/tools/35542.htm. Accessed March 11, 2015.
2. Cascio C. What are some advantages & disadvantages of peer tutoring? Hearst Newspaper. Undated. Available from: http://education.seattlepi.com/advantages-disadvantages-peer-tutoring-3515.html. Accessed March 11, 2015.
3. Gaustad J. Tutoring for at-risk students. OSSC Bulletin 1992; 36 (3). Available from: http://eric.ed.gov/?id=ED353642. Accessed on March 11, 2015.
4. Bloom BS. The 2 Sigma problem: the search for methods of group instruction as effective as one-to-one tutoring. *Educ Res*. 1984;13(6):4–14.
5. Roscoe RD, Chi MH. Understanding tutor learning: knowledge-building and knowledge-telling in peer tutors' explanations and questions. *Rev Educ Res*. 2007;77:534–574.
6. Roscoe RD, Chi MT. Tutor learning: the role of explaining and responding to questions. *Instr Sci*. 2008; 26(4):321–350.
7. Kenya AM, Kenya HM, Hart J. Correlation between academic performance and NBCE part I scores at a chiropractic college. *J Chiropr Educ*. 2013;27(1):27–32.
8. Gordon EE. 5 Ways to improve tutoring programs. *Phi Delta Kappan*. 2008;90(6):440–445.
9. Palmgren PJ, Chandratilake M, Nilsson GH, and Laksov KB. Is there a chilly climate? An educational environmental mixed method study in a chiropractic training institution. *J Chiropr Educ*. 2013;27(1):11–20.
10. Lizzio A, Wilson K, Simons R. University students' perceptions of the learning environment and academic outcomes: implications for theory and practice. *Stud High Educ*. 2002;27(1):27–52.
11. Rahman S, Mokhtar SB. Structural relationship of learning environment, learning approaches, and generic skills among engineering students. *Asian Soc Sci*. 2012;8(13):280–290.