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COLUMBUS STATE UNIVERSITY

AN ANALYSIS OF THE IMPACT OF THE CSU PEER LEADER PROGRAM ON STUDENT

PERFORMANCE IN 2014-2015

A THESIS SUBMITTED TO

THE HONORS COLLEGE

IN PARTIAL FULFILLMENT OF THE

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COLLEGE OF LETTERS AND SCIENCES

BY

HARRISON E. SHARITT

COLUMUS, GEORGIA

2016

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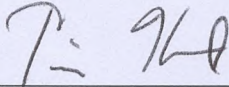
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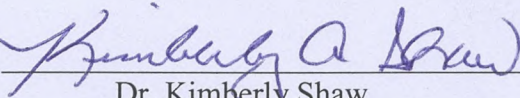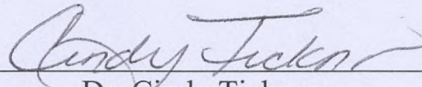
HARRISON E. SHARITT

A Thesis Submitted to the

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In Partial Fulfillment of the Requirements
for Honors in the Degree of

BACHELOR OF SCIENCE
MATHEMATICS
COLLEGE OF LETTERS & SCIENCES

Thesis Advisor _____ Date 4/28/16
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ABSTRACT

In efforts to retain students and increase student performance, Columbus State implemented a Peer Leader program. With access to archival data on the CSU Peer Leader Program, the goal of this project was to determine if the program at CSU had a significant impact on students' course performance. The impact of the program was assessed by performing multiple regression analyses and ANOVA. Preliminary results showed that Columbus State's Peer Leader program had a small, but statistically significant, positive impact on students' final course grades.

ACKNOWLEDGEMENTS

I would like to thank Dr. Howard and Dr. Ticknor for their continued assistance and support throughout this project. Without their guidance, this research would have not been completed.

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Background and Literature Review

For the past two decades, increasing the number of successful students in the STEM fields

has been a pressing issue in the United States. Student success rates in such classes have been

declining. Factors contributing to failure in these classes include "problems with study habits,

time management, and inability to organize and process the information" (Hughes, 2011, p. 144).

Peer supported learning provides a strategy for addressing these areas. Peer supported learning

has taken many forms and some research has been conducted on the outcomes of programs of

this nature. Considering and analyzing this research, Columbus State University built and

implemented the Peer Leader (PL) program. Columbus State's PL program has transformed over

the past five years and shows similarities to national programs such as Supplemental Instruction,

the Learning Assistant Model, and the Peer-Assisted Learning model.

Supplemental Instruction (SI) is one program that has shown promise. The SI program was

formed to "improve the learning of students in historically difficult courses" by "incorporat[ing]

collaborative learning in small, peer-led, group settings in order to integrate instruction in

learning and reasoning skills with course content" (Fayowski, 2008, pp. 843-844). By aiding

students in these challenging courses, the SI program hopes to "reduc[e] the attrition rate within

those courses, and increas[e] graduation rates of all students" (Arendale, 2004, p. 30). Since it

has been in use for over forty years, the SI program has had time to work out its flaws. Now, the

SI program has a sound, well-established structure. Arendale identifies four main roles in the SI

program. First, there is the SI supervisor who is a "trained professional on the SI staff" and is

"responsible for identifying the targeted courses, gaining faculty support, selecting and training

SI leaders, and monitoring and evaluating the program" (Arendale, 2004, p. 30). Second, there is

the faculty member who is the instructor for the SI-assisted course. The third person involved is

the SI leader, chosen by the faculty member. The leaders are "students or learning center staff members who have been deemed course competent, approved by the course instructor, and trained in proactive learning and studying strategies" (Arendale, 2004, p. 30). The leaders have several duties, as they must "attend the course lectures, take notes, read all assigned materials, and conduct three to five out-of-class SI sessions per week" (Arendale, 2004, p. 30). And lastly, the fourth role is that of the student.

Many studies have been done on the outcomes of the SI program, and almost all are positive. The International Center for Supplemental Instruction ran Chi-square analyses and t-tests to determine the "SI significance for improving course grades, decreasing D, F, and W(withdrawal) grades, and improving retention trends" (Fayowski, 2008, p. 847). These analyses had a sample size of nearly 51,000 students, and the results yielded significant differences with 54% of SI participants earning A's and B's in comparison to 43% of non-SI participants. Additionally, the study showed significant decreases in D, F and W grades amongst those students who participated in SI and observed that the SI participants had a significant increase in their GPA's.

Another popular peer supported learning program is the Learning Assistant (LA) model developed by the University of Colorado, Boulder. Beginning in 2003, the LA model was founded to "address[] the national challenges in science education" and was initially only used with physics courses (Otero, 2010, p. 1218). While the LA model does help students in historically difficult courses, it also has other goals. The LA model actively tries to recruit future STEM teachers, "engage science faculty more in the preparation of future teachers and discipline-based research," and "transform science departmental cultures to value research-based teaching as a legitimate activity for professors and students" (Otero, 2010, p. 1218). At

University of Colorado, Boulder, learning assistants are hired by faculty, and each assistant's main objectives are to give students "ample opportunities to work in small groups to articulate, defend, and modify their ideas about a relevant problem" (Otero, 2015, p. 107). Learning assistants will hold small group study sessions as they lead students in solving "challenging conceptual or mathematical problems" (Otero, 2015, p.108). LA sessions can either be held during normal class time, where the class regularly meets, or the sessions can be held outside of normal class times. In addition to leading sessions, learning assistants are required to meet weekly with the course instructor and attend a weekly *Mathematics and Science Education* course. This education course allows learning assistants to "reflect on their teaching practices, evaluate the transformations of courses, share experiences across STEM disciplines, and investigate relevant educational literature" (Otero, 2010, p. 1219).

By putting its main focus on the learning assistants, the LA model at the University of Colorado, Boulder has seen both an increase in interest in STEM teaching and an increase in student success rates in courses where the LA model is used. According to Otero, from 2000 to 2006 an average of six undergraduates per year completed math or science teacher certification. After the LA model was used in the years 2006 to 2013, an average of 12 undergraduate students per year earned a math or science teacher certification. Also, LAs were more likely to graduate within six years compared to their peers, 94.8% to 84.4% (Otero, 2015). Moreover, LAs had, on average, higher GPAs than their peers – 3.52 compared to 3.28 (Otero, 2015). UC Boulder tracked student achievement through Force and Motion Conceptual Evaluations (FMCE) and Brief Electricity and Magnetism Assessments (BEMA). These results show that courses that used the LA model had "greater learning gains for students and…even greater learning gains for students who participated as LAs" (Otero, 2010, p. 1220). From the data from the FMCE and

BEMA, Otero concludes that the LA model "produces students who are better prepared for graduate school and for teaching careers and that the LA experience greatly enhances students' content knowledge" (Otero, 2010, p. 1221).

A third commonly used program is the Peer Assisted Learning (PAL) Model. The PAL model began in 2006 at the University of Minnesota for "students enrolled in historically difficult college courses due to challenging course material" (Arendale, 2014, p. 1). It was based on three other peer learning programs: the SI program, the Emerging Scholars Program, and the Peer-led Team Learning Program. As Arendale describes, the PAL model has a flexible approach, but in general, follows a uniform guideline. The PAL model offers sessions twice a week, led by a PAL facilitator. This facilitator is chosen because he or she has shown competence by earning a high course grade and/or the facilitator has taken the same class with the same instructor. Facilitators are required to "attend at least one lecture a week, take notes, and read all assigned reading" (Arendale, 2014, p. 6). At PAL sessions, facilitators lead discussions and aim for participating students to "discover new learning strategies, connect ideas in the class, review key concepts from lecture and text, and increase their confidence" (Arendale, 2014, p. 7). Arendale emphasizes that the PAL sessions are not perceived as remedial, but as an enrichment opportunity to improve grades.

At the University of Minnesota, research was conducted on the effectiveness of the PAL model. Studying 500 undergraduate students in two different mathematics courses, PAL participants earned, on average, higher final course scores than non-PAL participants. In addition, going to all PAL sessions during the term "corresponded with ten times higher odds of success than attending none of the PAL sessions," where success was defined as earning a C- or higher (Arendale, 2014, p. 8). Another study showed statistical significance at the $p<.05$ level,

where PAL participants were "earning a higher percentage of *A* grades and lower rates of *C,D*, and *F*, and course withdrawal as compared with PAL nonparticipants" (Arendale, 2014, p. 8).

Other peer learning programs have shown similar results, such as Tenney and Houck's research on peer-supported learning in introductory biology and chemistry courses at the University of Portland. The PL program at the University of Portland took on a variant form of the national Peer-Led Team Learning model. Portland's program establishes study groups with a target peer-to-student ratio of 1:8. They hold weekly two-hour workshops, where the workshops are based on the lectures given by the professor. Peer leaders try to maintain the same group of students in each workshop, in attempts that the students will form a cohesive, team unit. The PL program was implemented at the University of Portland in a number of ways. Students in the chemistry course were required to attend the workshops, in contrast to biology students who were given the option to attend their workshops. The results for both courses were positive. For the chemistry courses, "there was a significant increase in the percentage of students earning A's and B's compared to similar classes in the past without workshop chemistry" (Tenney and Houck, p. 14). There were similar results for the biology courses, which showed positive correlation between participation in the workshops to final grades in the course.

In response to low student success rates in her class, Dr. Kathleen Hughes, a Biology professor at Columbus State University, applied for and received a faculty mini-grant through the University System of Georgia's STEM Initiative. With this grant, Dr. Hughes developed a peer-leader program for the Human Anatomy and Physiology course. The initial success of the program motivated the development of a unified PL Program at CSU within the STEM fields. The goal of the program is to increase student learning, student success rates, and retention of students within STEM fields. Peer leaders are chosen from the undergraduate students who have demonstrated

success in the specific subject area. Peer Leaders attend class meetings, participate in PL training, hold organized learning sessions, and meet regularly with their course instructors to plan sessions and maintain consistency.

The PL program at Columbus State has been implemented for nearly five years. Columbus State is primarily an undergraduate, four-year institution. In a CSU Facts and Figures report from 2015 conducted by the Columbus State Office of Institutional Research and Effectiveness, it was found that 53% of the student population identified as Caucasian compared to 47% Non-Caucasian ("Enrollment by ethnic origin," 2015). The same study reports that Columbus State's student population was 59.7% female and 40.3% male ("Enrollment by gender," 2015). In 2013, Dr. Kimberly Shaw, Dr. Cindy Ticknor, and Dr. Timothy Howard conducted an initial assessment of the impact of the program (Shaw, 2013). They identify five questions for investigation; the progress of the first three are discussed in their paper, and leaving the remaining questions to be addressed in future work. In efforts to answer these remaining questions, this study uses 2014-2015 archival data to investigate the impact PL sessions had on students' course performance. The findings from the analyses of this data will be compared to the results reported by Fayowski, Tenney, and Houck.

Methodology

For the 2014-2015 academic year, peer-leaders at Columbus State recorded attendance at study sessions. To analyze this data, it first had to be cleaned – organized and standardized in a way that allowed for proper analysis. In addition, the data was coded to insure participant confidentiality and additional considerations required excluding a few particular cases.

Cleaning and Coding the Data

Several steps were taken during these processes. The first step in cleaning was to count how many sessions each student attended, using records developed and maintained by the peer leaders. However, since some peer leaders just passed around a sign-in sheet at the study sessions, names of the attendees were sometimes illegible. Later, when the peer leaders entered their attendance records into Excel spreadsheets, the illegibility often lead to misspellings. These misspellings were corrected by going through each attendance record and comparing the names to official class rosters. Names in the attendance records that were misspelled by a few letters were changed to the name indicated in the official class roster. After the names were corrected, all attendance records were inserted into one Excel spreadsheet, which was categorized by course number, professor, peer leader, names of students who attended peer-learning sessions, and number of peer-learning sessions attended by each student.

At this point, Dr. Tim Howard created another data, containing official class rosters, categorized by course number, professor, student identification number, and student name. Once both of these data sets were complete, the sets were merged together and into one master Excel spreadsheet, being able to identify students who did not attend any sessions.

Adding Predictor Variables and Excluding Cases

Student identification and predictor variables were merged into the data set. These variables were student name, student identification number, ACT/SAT scores, high school GPA, Columbus State GPA, gender, age, and ethnicity. To protect student privacy, the professor overseeing the project, Dr. Howard, collected these variables and inserted them into the previous

two files. Dr. Howard created a coded database that replaced each student name and ID number with a unique code. This coding system prevented the researcher from knowing specific students' personal or academic information. Lastly, the end of course scores were added to the merged data set by Dr. Howard.

Because standardized test scores are known to be significant predictors of students' academic performance in college, a concordance table was used to convert ACT scores to approximate SAT scores (Dorans, 1999). This substitution was necessary in order to include as many subjects as possible, since many students only took one of the standardized tests. For instance, if a regression analysis was performed with SAT scores as an independent variable, 688 of the 1892 cases would be omitted since 688 students did not take the SAT. It should be noted that the College Education Board warns that the SAT and ACT have, "different content," and therefore, "should not be viewed as interchangeable measures of the same combination of skills and abilities" (Dorans, 1999, p. 9). However, in a study done by the Educational Testing Service, where the sample size was 103,525 students, a correlation of 0.89 was found between the ACT and SAT math scores. With such a high correlation, these concordance tables are widely accepted and used.

By using the concordance procedure, all students who had either an SAT math score or an ACT math score could be included in the analysis. However, some cases were omitted due to lack of other information. Fifty-five students from the Preparatory Algebra courses were omitted since end of course scores were not available. The final data set consists of 1856 student cases from 62 classes of eleven different courses, which were Principles of Chemistry 1, Principles of Chemistry 2, Principles of Biology, Introductory Physics 1, Physical Geology, Natural Disasters, Developmental Math 1, Developmental Math 2, Preparatory Algebra, College Algebra, and

Introduction to Mathematical Modeling. These courses were taught by thirteen unique professors, supported by fifteen different peer leaders. Of the 1856 students, 57.33% were female, 38.2% were male, and 4.47% did not identify as either male or female. Additionally, ethnicity percentages of the 1856 student cases were calculated. It was found that the sample of students were 45.2% White, 37.6% Black or African American, 6.1% Hispanic or Latino, 2.6% two or more races, 2.3% Asian, 1.3% international student, 0.3% American Indian or Alaska Native, and 0.1% Native Hawaiian or Pacific Islander. 4.5% of students did not identify with any ethnic group.

Data Analysis

Two multiple regression analyses were performed to see if the PL program at Columbus State significantly affected 2014-2015 student performance. In addition, a stepwise regression was used in order to include only statistically significant predictor variables. A linear regression analysis depicts the relationship between an independent and dependent variable and estimates how much that independent variable affects the dependent variable. For a multiple regression model, a similar process was conducted, except with two or more independent variables. Running the analyses for this data, a linear regression equation was produced, which was used to model the relationship between session attendance and student performance. When determining whether a predictor variable contributes significantly to the outcome, the p-values for each independent variable are analyzed and the R^2 values observed. For this analysis, a 95% confidence interval was used, meaning that any independent variables with p-values less than 0.05 will be a statistically significant predictor of the dependent variable. It was hypothesized that the PL program at Columbus State had a significant effect on student performance. If this

were the case, the multiple regression analyses should yield small p-values (<0.05) and low variability of the residual values around the regression line, and henceforth, a large R^2 value.

In addition to the regression analyses, a one-way ANOVA was implemented. An ANOVA, or analysis of variance, is a test that compares means between groups and determines if there are any significant differences. To use an ANOVA, data must meet three assumptions: samples must be independent of each other, the samples represent a normal distribution, and variance of the data is relatively the same. These three assumptions were checked and confirmed before the analyses were conducted. The first ANOVA compared variation between number of peer sessions attended and students' institutional grade point average. Number of peer sessions attended was grouped in a tiered fashion, where students who attended zero sessions were coded as 0, students who attended one to four sessions were coded as 1, students who attended five to nine sessions were coded as 2, and students with ten or more sessions attended were coded as 3. For this test, a p-value higher than 0.05 would provide evidence that there is no significant difference between grade point averages of students who attend a different number of sessions. The second ANOVA compared the variation between number of peer sessions attended and students' course scores. In this case, a low p-value is sought, providing evidence of a significant difference among course scores and number of peer sessions attended. In conjunction with the second ANOVA, Tukey's Range Test was performed to see which groups, if any, were statistically significantly different from each other, by comparing two groups at a time. Tukey's Range Test was chosen over other post HOC tests because it allows for the analysis of groups that are unequal in size.

Forecasting potential obstacles, an issue may arise. This concern is selection bias. Students were not required to attend PL sessions, which raises doubt that the students going to the

sessions composed a random sample. Students may have attended the sessions because they were struggling academically and wanted to improve their grades. On the other hand, students with A's or B's may have attended sessions in hopes of maintaining good grades. The latter scenario poses a problem as it would be difficult to track the improvement of a student who is already receiving high grades. Thus, this factor needed to be properly addressed in the analysis by consideration of standardized test scores and grade point averages.

<div align="center">Results</div>

With the finalized merged data set, multiple regression analyses, ANOVA, and Tukey's Range Test were performed. Additionally, the percentage of students who received A's and B's was calculated. When performing the regression analyses, institutional GPA and standardized test scores were controlled, as those two factors are considered predictors of end of course score. Additionally, 148 course scores that were less than 50 were excluded because some professors did not indicate which students dropped a course; typically students drop courses will have compiled these lower grades. Excluding these cases, the sample size for the regression analysis was 1409.

Results from the first regression analysis, with students who attended zero peer sessions included, can be viewed in Table 1. The first column, B, represents the coefficients for the regression equation. For every unit increase in CSU GPA, an increase of 9.609 in a students' final course score can be expected. Similarly, for every unit increase in Standardized Test Scores, it is expected a students' final course score will increase by 0.017 points. Lastly, for every unit increase in sessions attended, it can be predicted that a students' final course score will increase by 0.126 points on a 100-point scale. The second column contains the standard errors for the coefficients. The smaller the standard errors, the more accurate the prediction. The

third column, β, contains the standardized coefficients. These would be the coefficients of the independent variables if they were tested on the same scale. By "standardizing," it can easily be seen which independent variables had the largest effects.

Table 1

Multiple Regression Analysis with All Peer Sessions Included

	B	SE	β	Sig.
(Constant)	42.264	1.487		.000
CSU GPA	9.609	.373	.577	.000
Standardized Test Scores	.017	.003	.122	.000
Sessions	.126	.049	.053	.0111
R Squared	.411			
Adjusted R Squared	.41			

It can be seen in the last column, "Sig.", that "sessions" has a p-value of 0.011 (p < 0.05), meaning the number of peer sessions attended is a significant predictor of the course score. As expected, CSU GPA and Standardized Course Scores are statistically significant predictors as well. And, it is important to note that since this was a stepwise regression analysis, the predictor variables gender, age, and ethnicity were excluded since they were not statistically significant predictors of a student's final course score. Lastly, with an R-Squared value of .411, we estimate that 41.1% of the variance in the dependent variable (course score) can be explained by the independent variables, which are CSUGPA, standardized test scores, and number of sessions attended.

The second regression analysis, which only includes students who attended at least one peer session, can be seen in Table 2. Since this analysis only considers those students who attended peer sessions, this regression is slightly stronger than the previous. For every unit increase in CSU GPA, an increase of 10.063 points in students' final course score is expected. For every unit increase in Standardized Test Score, an increase of 0.013 points in student's final course score is expected. And, for every unit increase in number of sessions attended, it can be predicted the final course score will increase by 0.164 points. The variable "sessions" has a p-value of 0.005, which is less than 0.05, meaning it is a significant predictor of the course score. Like the previous regression analysis, both CSU GPA and Standardized Test Scores remain strong predictors of course score. This regression's R-Squared is a little higher, its value being 0.429.

Table 2

Multiple Regression Analysis with only Students Who Attended Peer Sessions

	B	SE	β	Sig.
(Constant)	42.575	2.589		.000
CSU GPA	10.063	.638	.598	.000
Standardized Test Scores	.013	.006	.086	.022
Sessions	.164	.058	.1	.005
R Squared	.429			
Adjusted R Squared	.426			

The third test applied was the One-way ANOVA comparing sessions attended and CSU GPA. Because there were about thirty-five unique numbers of sessions attended, number of

sessions attended was grouped in a tiered fashion for this ANOVA. For those who attended zero

sessions, sessions were coded as 0. For students who attended one to four sessions, it was coded

as 1. For those who attended five to nine, 2, and those who attended ten or more sessions was

coded as 3. This ANOVA output can be viewed in Table 3.

Table 3

One-Way Analysis of Variance of Peer Sessions Attended by CSUGPA

Source	*df*	*SS*	*MS*	*F*	*p*
Between Groups	3	1.249	.416	.572	.634
Within Groups	1688	1229.645	.728		
Total	1691	1230.894			

Reviewing Table 3, we recognize that there is a large p-value of 0.634. This means there is not a

statistically significant difference between groups as established by One-Way ANOVA

(F(3,1688)=0.572, p=0.634). With this result, we can conclude that a student's GPA does not

predict how many peer sessions he or she will attend.

The fourth test implemented was a One-Way ANOVA comparing number of peer

sessions attended to course score. This ANOVA can be viewed in Table 4. The number of peer

sessions attended was grouped in the same tiered fashion as the previous ANOVA test. Table 4

indicates a small p-value of 0.011. Thus, there must be at least one significant difference among

the number of peer sessions attended.

Table 4

One-Way Analysis of Variance of Peer Sessions Attended by Course Score

Source	df	SS	MS	F	p
Between Groups	3	1507.997	502.666	3.730	.011
Within Groups	1657	223283.545	134.752		
Total	1660	224791.543			

Looking at the Tukey Range Test in Table 5, it can be identified which groups are significantly different from each other. Table 5 only includes one comparison, zero sessions attended compared to the other three groups. This comparison was displayed because it was the only one that produced a significant figure. When comparing students who attended zero sessions to students who attended ten or more sessions, there is a significant difference in course score, since there is a p-value of 0.012 ($p < 0.05$).

Table 5

Tukey's Range Test Comparing Course Score to Number of Peer Sessions Attended

(I) Sessions Grouped	(J) Sessions Grouped	Mean Difference	Standard Error	p
0	1	-.462	.745	.926
	2	-1.871	1.121	.341
	3	-3.117	1.017	.012

Lastly, in attempts to compare these results to those of the SI program, the percentage of students who received A's and B's was calculated. Recalling the results from the SI program, Fayowski reported that 54% of students who were SI participants received a final course score of an A or B. Only 43% of non-SI participants earned an A or B. These results compare similarly to

that of the PL program at Columbus State, where 48.45% of PL participants earned an A or B and 43.29% of non-PL participants received an A or B.

Conclusion

From the multiple regression analyses and the ANOVA tests, it can be seen that the PL program had a significant, though small, positive impact on students' final course scores. Both regression analyses reported that "sessions" had p-values of less than 0.05, indicating that influence of the number of peer sessions attended on final course score was statistically significant. A student can reasonably expect, by attending one peer learning session, his or her grade will increase by 0.126 points on a 100-point scale. Additionally, the second ANOVA test showed that there was a statistically significant difference between the mean course scores of students who attended no sessions compared to students who attended ten or more sessions. All these results reflect the research conducted by Fayowski and Tenney and Houck - that some form of extra instruction, led by other college students, positively impact students' grades.

Future Work

These results show a small influence by the Peer Leader program at Columbus State University. It should be noted that a few aspects of the program and the analysis could have adversely affected the results. First, a few professors offered extra credit to students who attended peer-led sessions. By attending peer-led sessions, a student's grade would automatically get a boost. Secondly, there were no formal guidelines the peer leader had to follow when leading the peer sessions. Some professors gave peer-leaders class notes or study tips while other professors gave peer-leaders little to no guidance. Future analyses might need to take these two factors into consideration. One should investigate the exact number of professors offering extra credit and explore the different ways in which peer leaders were structuring their sessions.

Lastly, after the analysis was complete, the researcher was informed that the institutional grade point averages used in the analysis corresponded to student GPA at the time of data collection, rather than at the time the student began the applicable course. This makes the institutional GPA a confounding variable since the grade earned in a course would directly affect the CSU GPA. In a future study, student's GPA prior to the course would need to be used or other predictor variables would need to be used in its place.

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