

Structured Peer Mentoring Improves Academic Outcomes and Complements Project-Based Learning in an Introductory Research Methods and Statistics Course

Zachary Pilot¹, Malinda Suprise², Cassandra Dinius²,
Alicia Olechowski², and Reza Habib²

¹ Psychology Department, University of Southern Indiana

² Psychology Department, Southern Illinois University Carbondale

The present study explored the benefits of peer mentoring as part of a student-centered approach to the teaching of an undergraduate Research Methods and Statistics (RMS) course in Psychology. In the first semester of the study, one section of the RMS course was taught with the inclusion of a peer mentor intervention in the classroom, while the other section was taught without peer mentors (standard). Curriculum and evaluation were the same in both sections. During the second semester of the study, both sections of the RMS course employed peer mentors in the classroom (peer mentor intervention). Multivariate analysis of covariance (MANCOVA) was conducted to assess the impact of the presence of peer mentors in the classroom on exam performance while controlling for background variables. Results revealed student-performance differences between the RMS sections during the first semester of the study where the sections differed with respect to the presence of peer mentors in the classroom (standard vs. peer mentor intervention sections), but not in the second semester of the study where both sections employed peer mentors. Our findings provide evidence that the presence of peer mentors in RMS classrooms is a practical and cost-effective approach to improving student-learning outcomes.

Keywords: peer mentoring, student-centered, achievement, gatekeeper, social support

Undergraduate Research Methods and Statistics (RMS) is a foundational course in the Psychology major (American Psychological Association, 2013). For many social science students, RMS is their first exposure to understanding the scientific method, research jargon, and statistical analysis. Students often enter this course with trepidation (Connors et al., 1998; Dempster & McCorry, 2009; Freng et al., 2011; Vittengl et al., 2004) fueled by factors including a fear of being underprepared for the material (Hudak & Anderson, 1990), believing that traditional lectures are passive (Gasiewski et al., 2012), and being

anxious about learning statistics (Macher et al., 2012; Onwuegbuzie, 1997). RMS classes often serve as gatekeeper courses for social and behavioral science majors where classroom performance can impact student retention within those majors (Seymour, 2001). Some student-centered approaches such as “flipping” classrooms, using problem-based learning, peer-assisted learning, and peer mentoring have been proposed to combat these challenges (Peterson, 2016; Winquist & Carlson, 2014). Accordingly, we redesigned our RMS course to be student-centered, involving a semester-long research project, and including

This article was published Online First April 12, 2021.
Zachary Pilot  <https://orcid.org/0000-0003-3100-8278>
Malinda Suprise  <https://orcid.org/0000-0002-2213-8479>
Cassandra Dinius  <https://orcid.org/0000-0001-9279-5899>

Correspondence concerning this article should be addressed to Zachary Pilot, Psychology Department, University of Southern Indiana, 8600 University Boulevard, Evansville, IN 47712, United States. Email: zpilot@usi.edu

problem-based learning activities to mitigate student trepidation about RMS courses. This deviation from a purely lecture-based classroom to a student-centered classroom requires more individualized time for each student. Student-centered classrooms necessitate more instructional resources (e.g., graduate teaching assistants [GTAs]) that many institutions (like ours) cannot afford. For these reasons, we were particularly interested in the benefits associated with peer mentoring. If an undergraduate peer mentor program can improve academic achievement in an intimidating gatekeeper course without additional cost, this approach would benefit both the students and the institution. Here, we report the effectiveness of our redesigned approach focusing on the inclusion of our peer mentor program.

When redesigning our RMS course, we adopted teaching elements from student-centered approaches with the goal of creating a learning community that was accessible to all students (e.g., descriptive examples were provided to explain new jargon), resource rich (e.g., all students received access to free, online course companion notes), and supportive through the implementation of a peer mentor program based on a social-support framework (Jacobi, 1991) with the goal of improving academic outcomes (see Crisp et al., 2017 for a review of mentoring frameworks). We tested the effectiveness of this design by comparing an intervention classroom that included a structured peer mentor program to a standard classroom without the presence of peer mentors (Semester 1). The following semester (Semester 2), we implemented the peer-mentoring program in both classrooms. Below, we describe the redesign of the course from a traditional lecture format to a student-centered approach and how the inclusion of a structured peer mentor program may improve academic outcomes.

Course Outline

The redesigned course focused on active and experiential learning, borne from cognitive developmental theory (Piaget, 1964; Popkewitz, 1998; Vygotsky, 1978) and included a semester-long group research project. Throughout this project, students created, conducted, and evaluated their own research. Students completed activities during lecture and applied those concepts to their research projects during laboratory sessions. Integrating lecture activities with the research project

was rooted in both project-based and problem-based learning. Problem-based learning provides complex problems that require group collaboration to arrive at a solution (Cockrell et al., 2000). This approach is associated with better academic outcomes (e.g., increased information retention, examination performance, and knowledge application; Dochy et al., 2003; McParland et al., 2004; Vernon & Blake, 1993), which has been demonstrated in undergraduate statistics courses (Karpiak, 2011). Project-based learning is centered around a long-term project that culminates in realistic products that utilize scaffolding during the learning process, as well as investigation, evaluation, explicit educational goals, and a community of inquiry (see Thomas, 2000 for a review; Hmelo-Silver, 2004). Both approaches have been used in medical and engineering fields, so their application to a social science research methods classroom provides a natural extension of this work.

Mentoring Benefits

Mentoring relationships focus on student growth and development, increase broad forms of support (i.e. career, professional, and emotional), build personal and reciprocal relationships, and transmit relevant information and experience from the more experienced individual to the less experienced individual (Crisp & Cruz, 2009). Mentoring is related to several positive academic outcomes for undergraduate students, including better performance on exams (Chester et al., 2013; Fox et al., 2010; Leidenfrost et al., 2014), increased involvement in one's academic program (Brittian et al., 2009; Gross et al., 2015), and bolstered persistence (Crisp, 2010; Yomtov et al., 2017). By observing a healthy working relationship between instructors and students, undergraduates may perceive fewer barriers to becoming involved within the major and in research labs.

In addition to the psychosocial and academic benefits associated with peer mentor programs, they may be especially effective in undergraduate RMS courses. As described above, many students enter RMS classes with reservations and concerns. Peer mentors provide an easily accessible, less intimidating, relatable resource to struggling students. The current peer mentor program was designed from an outcome-based orientation, using the peer mentors as social and academic support in the socialization of students to the demands of

the Psychology major and career (Weidman, 1989). Peer mentors provided academic support, but the interpersonal relationships facilitated such support, reflecting the social support framework Jacobi (1991) describes. The immediate goal of the peer mentor program was to provide needed support to improve academic outcomes, but the situation of this program in a gatekeeper course with a semester-long research project is critical in facilitating several forms of that support.

Crisp et al. (2017) identifies a conceptual model of undergraduate mentoring that details the critical components of a mentoring program that include the context, student characteristics, forms of support, features of the mentoring relationship, and outcomes. These components interact to create a dynamic environment that supports student success. To better understand the function of peer mentors and how they differ from other forms of support (like GTAs or supplemental instructors), Table 1 shows how peer mentors in this program provide the four forms of support described in Nora and Crisp's (2007) conceptual model. Psychological and emotional support entails a mutual understanding, exercising empathy, providing encouragement, and the development of positive regard. Degree and career support focuses more on developing personal and professional potential, cultivating critical thinking skills, and identifying and making progress toward career goals. Academic subject knowledge is focused on the acquisition and strengthening of the academic skills necessary for

success. The final form of support, role model, is providing a model for the student to learn from the peer mentors' successes and failures, facilitated by disclosure on the part of the peer mentor.

The ultimate goal of the peer mentor program was to improve academic performance. Academic performance is negatively related to anxiety, so alleviating that anxiety using peer mentoring may improve academic outcomes (Seipp, 1991; Sprengel & Job, 2004). In particular, peer mentoring may allow students who require additional scaffolding in problem/project-based learning classrooms to gain explicit feedback and instruction (Kuh et al., 2011).

Summary

Project-based and problem-based learning are identified as effective approaches to teaching classes like RMS by combining profession-specific projects with self-directed learning. However, the literature suggests that challenges associated with RMS classes within the social sciences may make it difficult for *all* students to succeed in a project-based classroom. Students in these classrooms engage with the material by negotiating and practicing efficient self-regulation. Some students, especially first-year students and sophomores, may have difficulty with self-regulation due to individual differences in traits like statistics anxiety, self-confidence, and locus of control (Ertmer et al., 1996; Loyens et al., 2008). These students may struggle in a

Table 1
Examples of the Forms of Support Provided by Peer Mentors

Psychological and emotional support	<ul style="list-style-type: none"> • Students are given time alone in the first lab meeting to openly ask peer mentors questions • Peer mentors are required to speak to their assigned groups of students every class. They build rapport over time by showing interest in their students, asking about assignment progress, and reminding students about upcoming due dates
Degree/career support	<ul style="list-style-type: none"> • Peer mentors relay stories of their own struggles in the course from the previous semester • Required for psychology major, so open conversations about one's future career are promoted by all instructors • Peer mentors share experiences in research labs, courses, working as a peer mentor, tutoring • Peer mentors share opportunities in labs, promote involvement in psychology-related student organizations
Academic subject knowledge support	<ul style="list-style-type: none"> • Assist students with in-class activities and research project management • Provide individual tutoring sessions if requested • Host supplemental instruction sessions throughout the semester
Role model	<ul style="list-style-type: none"> • Peer mentors are psychology majors who were in the same course the previous semester, so they are similar to their students • Peer mentors provide an example of undergraduate collaboration with professors and graduate teaching assistants at every class session • Peer mentors earned an A in the course, so they can model good classroom practice in note taking, professional behavior, and career ambition

self-directed learning classroom without explicit instruction and adequate scaffolding. They may lack the metacognitive understanding necessary to navigate the problem environment without additional guidance (Hmelo-Silver, 2004). Peer-mentoring programs are widely used to ameliorate several of these issues. Therefore, we predicted that the use of peer mentors will complement problem-based and project-based learning, resulting in better academic outcomes compared to a traditional classroom without peer mentors.

Methods

Participants

In Semester 1, 108 students at a public university in the midwestern United States enrolled in two sections of the RMS course offered by the Psychology Department: 60 students in the standard (Classroom A—tenured faculty lecturer) section and 48 students in the intervention (Classroom B—doctoral graduate student lecturer) section. In Semester 2, both classrooms adopted the intervention approach and participants consisted of 101 students with 42 in Classroom A and 59 in Classroom B. Instructors and GTAs remained together (i.e., the same instructor with the same GTA) across both semesters to control for lecturer/GTA individual differences. Equal numbers

of peer mentors were included in each intervention classroom across semesters (i.e., three peer mentors per lecturer). Demographic information for students included in the analyses are shown in Table 2. Students self-selected into the different sections of the four-credit RMS course. There was no indication of the difference in classroom format at the time of registration.

To fit the inclusion criteria of the study, students needed to complete two pretest instruments as well as four tests used to evaluate student knowledge of course content prior to and throughout the semester. During Semester 1, 12 students were excluded for failure to complete the pretest instruments (i.e., 5 from Classroom A and 7 from Classroom B) while 6 students were excluded for failure to complete one or more tests (i.e., 5 from Classroom A and 1 from Classroom B). The same parameters were used for Semester 2, with 16 students excluded for failure to complete the pretests (i.e., 11 from Classroom A and 5 from Classroom B) and 5 students excluded for failure to complete one or more tests (i.e., 2 from Classroom A and 3 from Classroom B).

Peer Mentor Intervention

The primary difference between classroom A and classroom B in Semester 1 was the presence of peer mentors. In the structured peer-mentoring program, peer mentors were selected from

Table 2

Enrollment and Demographic Information for Semester 1 and Semester 2 by Section Pairs for Students Included in Analyses

Semester Lecturer	Semester 1		Semester 2	
	A	B	A	B
Instruction format	Standard	Intervention	Intervention	Intervention
Enrollment (% female)	50 (76.0%)	40 (72.5%)	29 (69.0%)	51 (82.4%)
Asian	2.0%	2.5%	3.5%	5.9%
African American	14.0%	32.5%	24.1%	27.5%
Ethnicity	10.0%	5.0%	3.5%	9.8%
Hispanic/Latino				
White	42.0%	47.5%	58.6%	47.1%
Other	32.0%	12.5%	10.3%	9.8%
First generation	54.0%	52.5%	34.5%	52.9%
Class (mean credit hours)				
Freshmen	0.0% (0.0)	2.5% (21.0)	3.5% (13.0)	7.8% (14.8)
Sophomore	42.0% (36.0)	32.5% (37.6)	37.9% (40.2)	35.3% (41.4)
Junior	30.0% (68.4)	42.5% (68.7)	48.3% (73.0)	43.1% (72.2)
Senior ^a	28.0% (126.0)	22.5% (117.8)	10.3% (98.7)	13.7% (93.3)
Psychology major	60.0%	62.5%	65.5%	47.1%

^aIncludes seniors who have been awarded a previous degree.

undergraduate students who earned a letter grade of “A” in the course during the prior semester, demonstrated effective use of necessary skills (e.g., communication, organization, empathy, and mastery of content), and expressed an interest in the program. All peer mentors were enrolled in a three-credit independent study course. Because of the limitations to independent study credits in the degree program, students were only able to serve as a peer mentor for one semester. They were required to attend all lecture and laboratory meetings, meet weekly with the GTAs, offer individual tutoring sessions where appropriate, create practice problems, and host weekly supplemental instruction sessions (attendance was between 5 and 15 students). GTAs in all sections attended all lectures, taught laboratory sections, held office hours, and hosted the supplemental instruction sessions that directly preceded tests (attendance was between 35 and 50 students). Prior to the first class, a peer mentor training meeting was held to discuss responsibilities inside and outside the classroom. At weekly 1-hr meetings, run by the GTAs, peer mentors would discuss the previous week, receive feedback on in-class activities, prepare for the following week, and ask any questions about course material prior to class. Peer mentors also provided valuable, real-time feedback about student comprehension and any need for extra support. Peer mentors met individually with the GTAs to prepare to host the supplemental instruction meetings. As part of their professional development, peer mentors were evaluated by the GTAs every time they hosted a supplemental instruction session, were required to form goals, evaluate progress on those goals, reflect on their experience, and were consistently given teaching advice during meetings. In the classroom, each peer mentor supervised several groups of three to five randomly assigned students who they monitored and assisted during in-class activities. Peer mentors were instructed to directly communicate with their assigned students every class session.

Classroom Parameters

Both classes were taught concurrently, with Classroom A on a Monday, Wednesday, Friday schedule and Classroom B on a Tuesday, Thursday schedule. Both lecturers were male (one tenured faculty and one doctoral graduate student) and both GTAs were female (both master’s

level graduate students). The lecturers and GTAs met weekly to ensure consistency between classes. All lecture slides, assignments, homework, in-class activities, and exams were identical. All students had the same amount of time to complete these assessments. Classroom exercises included activities such as conducting observational research on campus, identifying research designs, solving statistical problems, and designing elements of the research project.

Assessment of Academic Performance

Academic outcomes were assessed by performance on multiple-choice tests throughout the semester. Given the group project components of this course and the significant contribution they make to the final course grade, exam scores were the most relevant and clear measure of individual academic achievement available. The organization of course and test content was minimally altered between semesters (see Table 3). All students had 50 min to complete each of three multiple-choice tests and 2 hr to complete the cumulative multiple-choice final exam. Two pretests (Course Pretest and Math Concepts Pretest)¹ were administered on the first day of class to assess previous knowledge.

Results

To be included in the analyses for any semester, students needed to have a complete set of data across the following measures: Test 1, Test 2, Test 3, Final Exam, Course Pretest, and Math Concepts Pretest.

Semester 1

In Semester 1, 50 of 60 students (83.3%) in Classroom A (i.e., standard classroom) and 40 of 48 students (83.3%) in Classroom B (i.e., peer mentor intervention classroom) met the criteria for inclusion and were included in the analysis (for student demographic information see Table 1).

¹ The Course Pretest consisted of 32 multiple-choice questions pulled from subsequent tests so we could measure prior RMS knowledge. The Math Concepts Pretest consisted of 17 free response questions. The questions tested foundational math concepts like negative numbers, inequalities, proportions, order of operations, etc.

Table 3
Test Content

Test	Semester 1	Semester 2
Test 1	Types of psychological research Naturalistic versus laboratory settings Behavioral recordings, neuroscience, self-reports and questionnaires Experimental design Controls and confounds	Types of psychological research Naturalistic versus laboratory settings Behavioral recordings, neuroscience, self-reports and questionnaires Experimental design Controls and confounds
Test 2	Scales of measurement Reliability/validity Central tendency Frequency distributions Variance and standard deviation Selecting research participants Probability and nonprobability samples	Scales of measurement Central tendency Frequency Distributions Variance and Standard Deviation Correlation Z scores Probability
Test 3	Correlation Z scores Probability Hypothesis testing Sampling distributions Independent/paired samples <i>t</i> test	Hypothesis testing Sampling distributions Independent/paired samples <i>t</i> test Reliability/validity Selecting research participants Probability and nonprobability samples
Final Exam	Analysis of variance Research ethics All previous content	Analysis of variance Research ethics All previous content

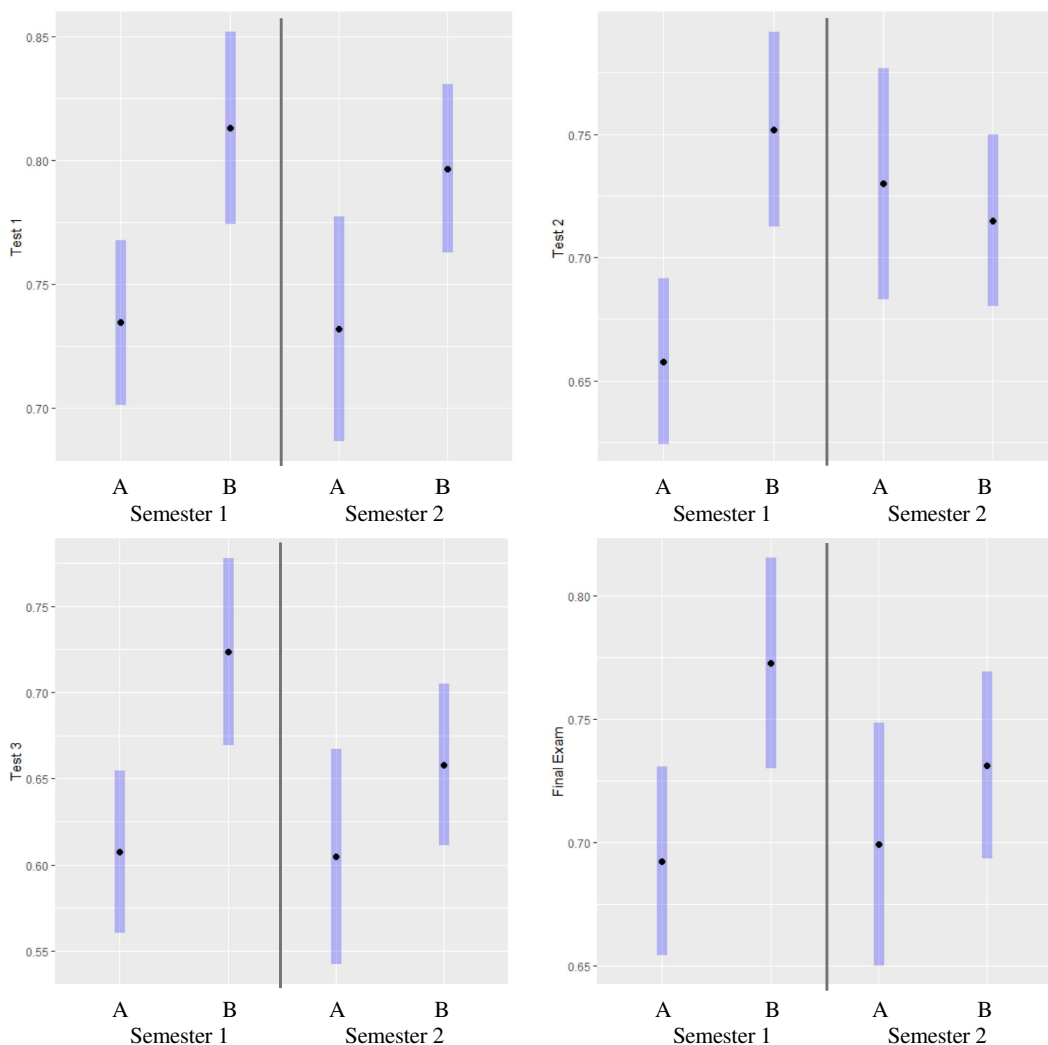
To test for differences in student-performance based on Classroom (i.e., A vs. B) during Semester 1, multivariate analysis of covariance (MANCOVA) was used with the Math Concepts Pretest and the Course Pretests as covariates to control for potential confounds and Evaluations (i.e., Test 1, Test 2, Test 3, and the Final Exam) as dependent variables. The only effect to reach significance was the main effect of Classroom, $F(1, 86) = 12.78, p < .001; \eta_p^2 = 0.129$. These results suggested that peer mentoring may have influenced student performance outcomes.

Semester 2

In Semester 2, both sections received the peer mentor classroom intervention. This was done to help determine whether the better academic outcomes observed in Semester 1 were due to the peer mentor intervention or differences due to the lecturer/GTA pair. For this semester, 29 of the 42 students (69.0%) in Classroom A and 51 of 59 students (86.4%) in Classroom B met criteria for inclusion in the analysis. A MANCOVA with the Math Concepts Pretest and the Course Pretest as covariates and Evaluations as the dependent variables revealed a significant two-way interaction of Classroom x Evaluation,

$F(3, 228) = 2.90, p < .05; \eta_p^2 = 0.120$. The finding of the two-way interaction between Classroom and Evaluation in Semester 2 reflects a diminishing difference in student performance over the course of the semester between the two classrooms, with the largest difference observed on Test 1, and those differences decreasing on Test 2, Test 3, and the Final Exam (see Figure 1).

When considering the results of Semester 1 in comparison to Semester 2, the main effect of classroom that was present in Semester 1 (standard classroom vs. peer mentor classroom) was not observed, unsurprisingly, in Semester 2 (where peer mentors were present in both classrooms). This was the main hypothesis of interest in the present study: that the presence of peer mentors would benefit student performance. Although the sample size was constrained by the number of students that enrolled in each section during Semester 1, a post hoc power analysis with the observed effect size indicated that the study had sufficient power ($1 - \beta > 0.99$) to detect the effect of the peer mentors on test performance. Alternatively, there was an absence of a two-way interaction in Semester 1 that was present in Semester 2. The absence of this interaction in Semester 1 indicates that the difference in test performance between

Figure 1*Estimated Marginal Mean Values and Confidence Intervals of Grades by Semester and Class*

Note. Semester 1 A is the standard classroom, and the remaining classrooms used the peer mentor intervention. Panel A: Test 1, Panel B: Test 2, Panel C: Test 3, Panel D: Final Exam. See the online article for the color version of this figure.

the two classrooms was maintained throughout that semester, which was not the case for Semester 2 (where the differences between student performance diminished over the semester).

Discussion

Over the course of two semesters, we measured the academic outcomes of undergraduate psychology students to better understand the

effectiveness of a structured peer mentor program in a RMS course. The findings from this study are in line with the hypothesis that motivated us to implement such a program: Students in the classroom with peer mentors had improved academic outcomes relative to their counterparts in the classroom without peer mentors. Although direct comparisons could not be made across semesters due to small changes in the sequencing of course content from one semester to the next, there were

consistent and marked differences between test scores when mentors were absent from the classroom. The lack of substantial differences between test scores when mentors were assisting in both classrooms provides support for our conclusion that offering peer mentoring to students in RMS courses improves learning outcomes.

Notably, differences in test performance between Lecturer A and B remained consistent throughout Semester 1 but decreased through Semester 2. One possible reason why performance decreased, instead of being equivalent throughout, is experience with the mentoring program. Lecturer B and his GTA had prior experience implementing the peer mentor program, but Lecturer A and his GTA did not. Lecturer B and his GTA had several semesters of experience using the program prior to Semester 1 in the current study, but Semester 2 was the first time Lecturer A and his GTA utilized this peer-mentoring program. Test 1 was taken at the end of week three of the semester, so prior experience is especially valuable in such a short window when building rapport and managing the peer mentors.

Our findings coincide with previous literature regarding the impact of peer mentoring on student performance. Participation in mentoring programs designed for first-year students in accounting (Fox et al., 2010) and psychology (Chester et al., 2013; Leidenfrost et al., 2014) improved final course grades. Our mentoring program demonstrated similar results in test performance on the skills necessary to conduct and evaluate research within the social sciences, just as the research above has done with introductory-level courses. These results suggest that tailoring mentoring programs to specific issues within gatekeeper courses, beyond simply survey courses, has a positive impact on student performance and thus may help in retaining those students within the major (Seymour, 2001). Our peer mentor classroom intervention could serve as a cost-effective way to improve academic outcomes and prepare students for the rigors of advanced/graduate study at minimal cost.

Why peer mentor programs are effective is much more difficult to answer. Our RMS course utilized both problem-based and project-based learning approaches. These techniques allow students to use self-directed learning, requiring them to actively navigate real-world applications of classroom concepts (Loyens et al., 2008). Scaffolding can mitigate some of the challenges that

students face with self-directed learning by increasing access to support, allowing students to have successive positive interactions with the material, and building metacognitive skills (Iiskala et al., 2011; Molenaar et al., 2012). Support from peer mentors may serve as this scaffolding for student development in multiple domains, helping them successfully navigate a course and resulting in improved academic performance, reflecting a social support model (Chi et al., 2001). This effect can explain differential performance in classrooms that rely on self-directed learning (Azevedo & Cromley, 2004; Azevedo & Hadwin, 2005; Greene & Land, 2000; Hannafin et al., 1997), which may have driven the performance differences between our classrooms. Although the current study proposes a peer mentoring model and demonstrates its effectiveness, the future research must delve into the potential mechanisms that drive the effectiveness of such interventions.

One of the strengths of the current study is that it was conducted with real psychology undergraduate students in a real classroom. Our most important research question was whether the implementation of this program was feasible without additional funding at a midsize university and whether it actually helped students. We conducted this study in a naturalistic classroom context to provide maximum ecological validity because educators, like us, are hungry to improve outcomes critical to the success of their students. This choice, however, comes with several consequences. It is possible that the addition of tutoring and review sessions and not the presence of peer mentors in the classroom was the cause of change. The current design does not allow us to parse these two factors apart, but this is an obvious avenue for the future research. Many universities offer tutoring or supplemental instruction free of charge to students, as was the case here. Peer mentoring is meaningfully different from supplemental instruction and drop-in tutoring, see Crisp et al. (2017) for a review, and future research should consider these differences when choosing appropriate measurements and applications. In addition, supplemental instruction and drop-in tutoring requires that students have the time to take advantage of these resources, but often our students are at work, caring for a family member, or commuting. Kim et al. (2019) suggests that participation in lecture sessions mediates the relationship between attendance and

academic achievement. Future research looking to draw distinctions between forms of support and academic achievement might use a GTA to measure attendance and participation in lecture, lab, and other instructional methods in classrooms with peer mentors, without peer mentors, and a course with only supplemental instruction.

Our study was conducted at a single university on a limited number of students which restricts the generalizability of the results. Similarly, although the demographics showed that the two classrooms were essentially equivalent in performance and students were not aware of their classroom condition (i.e., the option to have peer mentors) prior to registering, self-selection bias into a Monday, Wednesday, Friday versus a Tuesday, Thursday classroom, and the lack of restriction on the semester the course was taken may have introduced bias into the results. Despite the limitations of naturalistic classroom research our main point remains: The peer mentor intervention we used produced improved academic outcomes in a course that often determines whether students can graduate as psychology majors.

Implications and Future Directions

This course redesign does not require expensive equipment, convoluted technology, or large grants. It can be implemented at any university, even those low in departmental resources or serving an underprepared student body. Students who are successful in gatekeeper courses are expected to be successful in the major (Seymour & Hewitt, 1997). At our university, students are required to earn a “C” in RMS to progress within the major. Prior to our redesign, 65% of students who received a “D” left the Psychology major versus 36% of those who received a “C.” As many of our students are first generation or come from historically underrepresented groups, retaking courses or delaying graduation can result in substantial financial consequences. It may be that these students benefit most from programs like ours (Collier & Morgan, 2008). Although we would have liked to explore this avenue within our study, our sample size did not permit us the ability to run analyses for demographic information without risking a biased outcome. Future researchers with larger class sizes should consider exploring the impacts of peer-mentoring interventions on

students who are first generation or part of an underrepresented group because an inclusive approach to learning benefits all students. Even slight improvements in the lowest performing students could shift D grades to C grades in this gatekeeper course and allow more students to continue in the major.

A peer mentor program also benefits the highest performing students, allowing us to identify outstanding students early in their college career and provide them with opportunities for both academic and personal growth (Amaral & Vala, 2009). Students who served as mentors practiced teaching, shouldered increased responsibility, and forged valuable relationships with the faculty and department. These benefits can improve engagement within the major, increase participation in research labs, and prepare students for the rigors of graduate study.

In summary, RMS is a foundational course for undergraduate psychology students. Students vary in preparedness for the science and math-based content of the course and report having anxiety about statistics courses. Performance in gatekeeper courses is critical to student success and retention in the major. As such, our structured peer mentor program provides a classroom community of support for students who need it and valuable professional experience for the high-performing students who serve as mentors. Students in the classrooms that incorporated a structured peer mentor program performed better than their counterparts in the standard classroom setting. The metacognitive skills and relationships formed in this course could benefit students in the future RMS classes and throughout the major. The implementation of a structured peer mentor program in a RMS curriculum is feasible for most institutions and may provide a cost-effective way to support students in the months and years ahead.

References

- Amaral, K. E., & Vala, M. (2009). What teaching teaches: Mentoring and the performance gains of mentors. *Journal of Chemical Education*, 86(5), 630–633.
- American Psychological Association. (2013). *APA guidelines for the undergraduate psychology major: Version 2.0*. <http://www.apa.org/ed/precollege/undergrad/index.aspx>
- Azevedo, R., & Cromley, J. G. (2004). Does training on self-regulated learning facilitate students'

- learning with hypermedia? *Journal of Educational Psychology*, 96(3), 523–535. <https://doi.org/10.1037/0022-0663.96.3.523>
- Azevedo, R., & Hadwin, A. F. (2005). Scaffolding self-regulated learning and metacognition: Implications for the design of computer-based scaffolds. *Instructional Science*, 33(5), 367–379. <https://doi.org/10.1007/s11251-005-1272-9>
- Brittian, A. S., Sy, S. R., & Stokes, J. E. (2009). Mentoring: Implications for African American college students. *The Western Journal of Black Studies*, 33(2), 87–97.
- Chester, A., Burton, L. J., Xenos, S., & Elgar, K. (2013). Peer mentoring: Supporting successful transition for first year undergraduate psychology students. *Australian Journal of Psychology*, 65(1), 30–37. <https://doi.org/10.1111/ajpy.12006>
- Chi, M. T., Siler, S. A., Jeong, H., Yamauchi, T., & Hausmann, R. G. (2001). Learning from human tutoring. *Cognitive Science*, 25(4), 471–533. https://doi.org/10.1207/s15516709cog2504_1
- Cockrell, K. S., Caplow, J. A. H., & Donaldson, J. F. (2000). A context for learning: Collaborative groups in the problem-based learning environment. *The Review of Higher Education*, 23(3), 347–363.
- Collier, P. J., & Morgan, D. L. (2008). “Is that paper really due today?”: Differences in first-generation and traditional college students’ understandings of faculty expectations. *Higher Education*, 55(4), 425–446.
- Connors, F. A., McCown, S. M., & Roskos-Ewoldsen, B. (1998). Unique challenges in teaching undergraduates statistics. *Teaching of Psychology*, 25(1), 40–42. https://doi.org/10.1207/s15328023top2501_12
- Crisp, G. (2010). The impact of mentoring on the success of community college students. *The Review of Higher Education*, 34(1), 39–60. <https://doi.org/10.1353/rhe.2010.0003>
- Crisp, G., Baker, V. L., Griffin, K. A., Lunsford, L. G., & Pifer, M. J. (2017). Mentoring undergraduate students. *ASHE Higher Education Report*, 43(1), 7–103.
- Crisp, G., & Cruz, I. (2009). Mentoring college students: A critical review of the literature between 1990 and 2007. *Research in Higher Education*, 50(6), 525–545. <https://doi.org/10.1007/s11162-009-9130-2>
- Dempster, M., & McCorry, N. K. (2009). The role of previous experience and attitudes toward statistics in statistics assessment outcomes among undergraduate psychology students. *Journal of Statistics Education : An International Journal on the Teaching and Learning of Statistics*, 17(2). Advance online publication. <https://doi.org/10.1080/10691898.2009.11889515>
- Dochy, F., Segers, M., Van den Bossche, P., & Gijbels, D. (2003). Effects of problem-based learning: A meta-analysis. *Learning and Instruction*, 13(5), 533–568. [https://doi.org/10.1016/S0959-4752\(02\)00025-7](https://doi.org/10.1016/S0959-4752(02)00025-7)
- Ertmer, P. A., Newby, T. J., & MacDougall, M. (1996). Students’ responses and approaches to case-based instruction: The role of reflective self-regulation. *American Educational Research Journal*, 33(3), 719–752. <https://doi.org/10.3102/00028312033003719>
- Fox, A., Stevenson, L., Connelly, P., Duff, A., & Dunlop, A. (2010). Peer-mentoring undergraduate accounting students: The influence on approaches to learning and academic performance. *Active Learning in Higher Education*, 11(2), 145–156. <https://doi.org/10.1177/1469787410365650>
- Freng, S., Webber, D., Blatter, J., Wing, A., & Scott, W. D. (2011). The role of statistics and research methods in the academic success of psychology majors: Do performance and enrollment timing matter? *Teaching of Psychology*, 38(2), 83–88. <https://doi.org/10.1177/0098628311401591>
- Gasiewski, J., Eagan, M., Garcia, G., Hurtado, S., & Chang, M. (2012). From gatekeeping to engagement: A multicontextual, mixed method study of student academic engagement in introductory stem courses. *Research in Higher Education*, 53(2), 229–261. <https://doi.org/10.1007/s11162-011-9247-y>
- Greene, B. A., & Land, S. M. (2000). A qualitative analysis of scaffolding use in a resource-based learning environment involving the world wide web. *Journal of Educational Computing Research*, 23(2), 151–179. <https://doi.org/10.2190/1GUB-8UE9-NW80-CQAD>
- Gross, D., Iverson, E., Willett, G., & Manduca, C. (2015). Research and teaching: Broadening access to science with support for the whole student in a residential liberal arts college environment. *Journal of College Science Teaching*, 44(4), 99–107.
- Hannafin, M., Hill, J., & Land, S. M. (1997). Student-centered learning and interactive multimedia: Status, issues, and implication. *Contemporary Education*, 68(2), 94–99.
- Hmelo-Silver, C. E. (2004). Problem-based learning: What and how do students learn? *Educational Psychology Review*, 16(3), 235–266. <https://doi.org/10.1023/B:EDPR.0000034022.16470.f3>
- Hudak, M. A., & Anderson, D. E. (1990). Formal operations and learning style predict success in statistics and computer science courses. *Teaching of Psychology*, 17(4), 231–234. https://doi.org/10.1207/s15328023top1704_4
- Iiskala, T., Vauras, M., Lehtinen, E., & Salonen, P. (2011). Socially shared metacognition within primary school pupil dyads’ collaborative processes. *Learning and Instruction*, 21(3), 379–393. <https://doi.org/10.1016/j.learninstruc.2010.05.002>
- Jacobi, M. (1991). Mentoring and undergraduate academic success: A literature review. *Review of educational research*, 61(4), 505–532.

- Karpiak, C. P. (2011). Assessment of problem-based learning in the undergraduate statistics course. *Teaching of Psychology, 38*(4), 251–254. <https://doi.org/10.1177/0098628311421322>
- Kim, A. S., Shakory, S., Azad, A., Popovic, C., & Park, L. (2019). Understanding the impact of attendance and participation on academic achievement. *Scholarship of Teaching and Learning in Psychology*. Advance online publication. <https://doi.org/10.1037/stl0000151>
- Kuh, G. D., Kinzie, J., Schuh, J. H., & Whitt, E. J. (2011). Fostering student success in hard times. *Change, 43*(4), 13–19. <https://doi.org/10.1080/00091383.2011.585311>
- Leidenfrost, B., Strassnig, B., Schutz, M., Carbon, C., & Schabmann, A. (2014). The impact of peer mentoring on mentee academic performance: Is any mentoring style better than no mentoring at all? *International Journal on Teaching and Learning in Higher Education, 26*(1), 102–111.
- Loyens, S. M., Magda, J., & Rikers, R. M. (2008). Self-directed learning in problem-based learning and its relationships with self-regulated learning. *Educational Psychology Review, 20*, 411–427. <https://doi.org/10.1007/s10648-008-9082-7>
- Macher, D., Paechter, M., Papousek, I., & Ruggeri, K. (2012). Statistics anxiety, trait anxiety, learning behavior, and academic performance. *European Journal of Psychology of Education, 27*(4), 483–498. <https://doi.org/10.1007/s10212-011-0090-5>
- McParland, M., Noble, L. M., & Livingston, G. (2004). The effectiveness of problem-based learning compared to traditional teaching in undergraduate psychiatry. *Medical Education, 38*(8), 859–867. <https://doi.org/10.1111/j.1365-2929.2004.01818.x>
- Molenaar, I., Roda, C., van Bostel, C., & Slegers, P. (2012). Dynamic scaffolding of socially regulated learning in a computer-based learning environment. *Computers & Education, 59*(2), 515–523. <https://doi.org/10.1016/j.compedu.2011.12.006>
- Nora, A., & Crisp, G. (2007). Mentoring students: Conceptualizing and validating the multi-dimensions of a support system. *Journal of College Student Retention: Research, Theory & Practice, 9*(3), 337–356.
- Onwuegbuzie, A. J. (1997). Writing a research proposal: The role of library anxiety, statistics anxiety, and composition anxiety. *Library & Information Science Research, 19*(1), 5–33. [https://doi.org/10.1016/S0740-8188\(97\)90003-7](https://doi.org/10.1016/S0740-8188(97)90003-7)
- Peterson, D. J. (2016). The flipped classroom improves student achievement and course satisfaction in a statistics course: A quasi-experimental study. *Teaching of Psychology, 43*(1), 10–15. <https://doi.org/10.1177/0098628315620063>
- Piaget, J. (1964). Cognitive development in children: Piaget development and learning. *Journal of Research in Science Teaching, 2*(3), 176–186.
- Popkewitz, T. S. (1998). Dewey, Vygotsky, and the social administration of the individual: Constructivist pedagogy as systems of ideas in historical spaces. *American Educational Research Journal, 35*(4), 535–570.
- Seipp, B. (1991). Anxiety and academic performance: A meta-analysis of findings. *Anxiety Research, 4*(1), 27–41. <https://doi.org/10.1080/08917779108248762>
- Seymour, E. (2001). Tracking the processes of change in US undergraduate education in science, mathematics, engineering, and technology. *Science Education, 86*(1), 79–105. <https://doi.org/10.1002/sce.1044>
- Seymour, E., & Hewitt, N. M. (1997). *Talking about leaving: Why undergraduates leave the sciences*. Westview Press.
- Sprengel, A. D., & Job, L. (2004). Reducing student anxiety by using clinical peer mentoring with beginning nursing students. *Nurse Educator, 29*(6), 246–250. <https://doi.org/10.1097/00006223-200411000-00010>
- Thomas, J. W. (2000). *A review of research on project-based learning*. Autodesk Foundation.
- Vernon, D. T., & Blake, R. L. (1993). Does problem-based learning work? A meta-analysis of evaluative research. *Academic Medicine, 68*(7), 550–563. <https://doi.org/10.1097/00001888-199307000-00015>
- Vittengl, J. R., Bosley, C. Y., Brescia, S. A., Eckardt, E. A., Neidig, J. M., Shelver, K. S., & Sapanoff, L. A. (2004). Why are some undergraduates more (and others less) interested in psychological research? *Teaching of Psychology, 31*(2), 91–97. https://doi.org/10.1207/s15328023top3102_3
- Vygotsky, L. (1978). Interaction between learning and development. *Readings on the Development of Children, 23*(3), 34–41.
- Weidman, J. (1989). Undergraduate socialization: A conceptual approach. *Higher education: Handbook of theory and research, 5*(2), 289–322.
- Winqvist, J. R., & Carlson, K. A. (2014). Flipped statistics class results: Better performance than lecture over one year later. *Journal of Statistics Education: An International Journal on the Teaching and Learning of Statistics, 22*(3), 1–10. <https://doi.org/10.1080/10691898.2014.11889717>
- Yomtov, D., Plunkett, S. W., Efrat, R., & Marin, A. G. (2017). Can peer mentors improve first-year experiences of university students? *Journal of College Student Retention: Research, Theory and Practice, 19*(1), 25–44. <https://doi.org/10.1177/1521025115611398>

Received June 10, 2020

Revision received January 11, 2021

Accepted January 20, 2021 ■