Impact of Supplemental Instruction Frequency and Format on Exam Performance in Anatomy and Physiology

Blase Rokusek, BS[1,2], Emilee Moore, BS[2], Christopher Waples, PhD[2], and Janet Steele, PhD[1]
Departments of [1]Biology and [2]Psychology, University of Nebraska at Kearney, Kearney, NE, USA
Corresponding author: steelej@unk.edu

Abstract

Supplemental instruction (SI) has been shown to be effective in increasing student success in a wide variety of disciplines. Our study investigated the impact of the number of SI sessions attended on student success on exams and the effectiveness of remote SI compared to face-to-face (FTF) SI. Data were gathered for nearly 1,200 students enrolled in the first semester of a sophomore-level anatomy and physiology course at the University of Nebraska at Kearney (UNK). The number of SI sessions each student attended, if any, prior to each exam was compared to exam performance. Results for 2013 – 2017 demonstrated that attending even one SI session had a positive impact on exam performance, and an increase in exam performance was seen with additional SI attendance up to three sessions prior to each exam. We took advantage of the remote SI offered in the Fall of 2020, due to COVID-19, to investigate a potential effect of delivery format on SI effectiveness. There was no difference in exam performance for students attending SI FTF (2019) compared to students attending remote SI (2020), while attending SI in either format was associated with better exam scores. Our study is unique in examining the effectiveness of SI attendance at the level of individual exam performance and adds to the body of evidence that SI, whether FTF or remote, is effective in improving student success. https://doi.org/10.21692/haps.2022.013

Key words: anatomy & physiology, supplemental instruction, student success, online learning, exam outcomes

Introduction

Supplement instruction (SI), developed at the University of Missouri-Kansas City in 1973, is a peer-led collaborative learning support program built around course content. The program is designed as a proactive approach to historically difficult courses (International Center for Supplemental Instruction 2021). SI sessions are led by trained students who have previously taken the course. Because SI leaders have already demonstrated superior academic achievement in the course and attend lectures with the students currently enrolled, they are able to clarify lecture material and draw upon their previous experience in the course. SI leaders receive training and are supervised throughout the semester. They are trained in administering participative activities, questioning techniques, and quiz development that promote group work and peer learning while reducing test anxiety (Fayowski and MacMillan 2008). Strategies utilized in SI sessions are intended to be transferable to other courses and are beyond normal study skills (International Center for Supplemental Instruction 2021).

SI has been shown to be effective in a wide range of disciplines spanning undergraduate, graduate, and professional education (Dawson et al. 2014). For example, Fayowski and MacMillan (2008) found SI to increase the odds of success by 2.7 times for students in a first-year calculus course. Regular attendance at SI sessions during the first semester of an engineering program increased the chances of graduating by 20-35% (Malm et al. 2018).

For students enrolled in an introductory biology course, SI not only increased the percentage of students earning a grade of C- or higher from 73% to 85%, but the proportion of students who participated in SI and ultimately graduated was 67% compared to a graduation rate of only 59% for those students who did not participate in SI (Rath et al. 2007). In addition, Ning and Downing (2010) observed that SI had a significant impact on the academic achievement of first-year business students.

The impact of SI on underrepresented student groups is noteworthy. Bowman et al. (2021) analyzed results from 21 different courses across two semesters and noted that the strongest relationship between SI attendance, grade performance, and retention was for underrepresented student groups and for students who attended at least five SI sessions. Rath et al. (2007) observed that SI participation associated with an introductory biology course increased not only the percentage of students from underrepresented groups earning a grade of C- or higher from 51% to 76% but also the percentage of those students ultimately graduating from 50% to 73%. Bowman et al. (2017) and Malm et al. (2018) did not observe any gender-related differences in the effectiveness of SI, but Peterfreund et al. (2007) noted that the effect of SI was greater for males even though more females participated.

The COVID-19 pandemic forced colleges and universities to shift quickly to remote delivery of instruction. Faculty often

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had to devise creative solutions for courses that had never before been offered remotely (Baldock et al. 2021; Coker 2020; Forster et al. 2020; Heiss and Oxley 2021; Van Heuvelen et al. 2020). Other student support services, including advising and tutoring, also had to move to remote delivery (Bouchey et al. 2021; Johns and Mills 2020). Online peer tutoring has been shown to be effective (Evans and Moore 2012; Gehret et al. 2017; Hrastinski et al. 2019). Hizer et al. (2017) examined the effectiveness of online SI delivery in four biology courses (Introduction to Molecular and Cellular Biology, Introduction to Experimental Design and Statistics, Molecular and Cellular Biology, and Genetics) and found that both online and face-to-face (FTF) students who participated in SI had higher course grades than those who did not attend SI at all. Meanwhile, Price et al. (2007) found online tutoring to be less effective than in-person tutoring, considering course grades, exam scores, and a questionnaire designed to determine tutor effectiveness. As such, it appears that online tutoring and SI can be effective; yet the previous research is somewhat conflicted.

Communication is an important aspect of proper SI implementation, and break-downs in communication between the parties involved, including students, SI leaders, course instructors, and SI coordinators, have been identified as potential impediments to successful SI implementation (Adebola 2020). Thus, online implementation of SI poses challenges to maintaining these lines of communication. In a post-COVID-19 world, where the use of online delivery formats in education has become commonplace, examination of the effectiveness of online SI is very relevant, and one concern of the present study.

Our project had four primary goals. We wanted to determine if: 1) students who attended SI sessions prior to an exam would score higher on that exam than those students who had not attended SI sessions, and 2) increasing the number of sessions attended was associated with additive increases in exam performance. We hypothesized that students who attended SI would have higher average exam scores (Hypothesis 1). Further, we hypothesized that the more sessions students attended prior to exams, the better they would do on the exams (Hypothesis 2). We also wanted to determine if: 3) attendance at SI sessions was associated with higher exam scores compared to non-attendance (whether FTF or remote), and 4) SI was more effective when conducted FTF than when conducted in online. We hypothesized again that those students who attended SI would score better on exams (Hypothesis 3). We also hypothesized that SI would be more effective FTF than online, with the FTF SI attendees scoring better than the students who attended SI online (Hypothesis 4).

Methods

SI was coordinated by the University of Nebraska at Kearney (UNK) Learning Commons—the tutoring center at our university—and was modelled after the SI that was first described and implemented at the University of Missouri-Kansas City (Martin and Arendale 1992). SI leaders were undergraduate students who had previously excelled in the course, were recommended by the course instructor, and were trained by the SI coordinator at the UNK Learning Commons. The SI leaders attended lectures, took notes, and planned and prepared activities for weekly SI sessions. These activities included games, topic discussions, and other collaborative activities, such as having the students in attendance role-play as instructors by taking turns re-teaching each other recent lecture material. Additionally, SI leaders met regularly with the course instructor and with the SI coordinator throughout the semester. SI leaders were compensated as student workers by the UNK Learning Commons.

Participation in SI was voluntary, and no extra credit or other incentive was offered. Students could attend SI as frequently or infrequently as they liked. As such, SI participation is self-selected and is an important factor to consider when drawing conclusions. This issue will be discussed at length below.

The project was approved by the UNK Institutional Review Board (UNK; IRB # 020321-1). UNK is a primarily residential undergraduate institution with a total enrollment (undergraduate and graduate) of approximately 6,400 students. Hispanic students comprise the largest minority population at approximately 15% of the undergraduate student body, and 86% of the student population is under age 25.

Participants in the study were students enrolled in the first semester of a two-semester, sophomore-level anatomy and physiology course (BIOL 225) from fall semester 2013 through fall semester 2020. Over the study period 63.3% of the students enrolled in BIOL 225 were classified as sophomores (28-57 credits completed) with 22.8% classified as juniors, 9.3% as seniors, 3.6% as freshmen, and 1.0% as post-graduates. The course has a prerequisite of either completion of a college-level chemistry course or sophomore status. Students classified as "freshmen" were in their second year of university study but had not yet accumulated 28 credits. These students were permitted into the class to keep on track with their career goals. Fall semester 2018 was excluded from hypothesis testing, as SI was not available to students that semester. Enrollment in the course ranged from 194-224 students (average = 206 students) during the study period.

Our study focused on the impact of SI on individual exam performance and not the final overall grade in the class for two reasons. First, the composition of the individual exams

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was consistent from 2013-2020 while the composition of the final exam, which constituted approximately 20% of the final grade, changed significantly. Second, approximately 35% of the final grade in the class was from the laboratory component and SI did not address laboratory objectives.

Exams consisted of both multiple choice and short essay questions. For the comparison of in-person and remote SI, the exams had the same multiple-choice questions, which comprised 80% of each exam, and comparable essay questions. Students taking the exams in-person (2019) were proctored and had a time limit of 55 minutes. Students taking the exams remotely (2020) were required to use the Respondus Lock-Down Browser® with camera on and had the same 55-minute time limit. In each case the exams were closed book.

The data set was created by merging course records with SI attendance data collected and archived by the UNK Learning Commons. As such, the resultant data set included the date of each attended SI session for every student, along with exam scores. For students who took the course multiple times, only the first attempt was used for analysis. Similarly, data for students who took the course for the first time prior to the window of the study were not included in the study. Finally, students who withdrew from the course were not included.

In testing Hypotheses 1 and 2, the data set was derived from 860 students completing the course between 2013 and 2017. Across that span, 339 of the students chose not to attend the optional SI sessions. The remaining 521 (60.5%) students attended at least one session during the course and 82.0% of them attended up to as many as seven sessions throughout the semester.

Data used to test Hypotheses 3 and 4 were gathered for 326 students completing the course in 2019 and 2020. These two years were selected to allow for a comparison between traditional in-person (FTF) and online session formats, necessitated by the COVID-19 pandemic. In 2019, SI sessions were offered in-person, but in 2020, SI sessions were offered only in an online format (via Zoom). In 2019 (FTF) approximately 40% of students attended at least one SI session with 35% attending prior to exam 1, 22% between exams 1 and 2, 12% between exams 2 and 3, and 16% between exams 3 and 4. In contrast, in 2020 (remote) approximately 32% of students attended at least one SI session with 14% attending prior to exam 1, 19% between exams 1 and 2, 11% between exams 2 and 3, and 7% between exams 3 and 4.

All hypotheses were tested using linear mixed modeling to allow assessment of the relationships of interest. Linear mixed modeling is a hierarchically structured approach that allows for nesting individual participants into categories of SI session attendance, on a per exam basis, allowing for an aggregated assessment of the role SI attendance plays in exam performance. Two such analyses were conducted. The first tested Hypotheses 1 and 2, highlighting the impact of incremental SI attendance prior to each exam. The second tested Hypotheses 3 and 4, incorporating session format and its interaction with SI attendance prior to each exam. Rather than imposing theoretical structures, unstructured models were used to remove constraints on covariance matrices.

Results

Hypotheses 1 and 2 were tested by examining the relationship between the number of SI sessions attended and subsequent exam performance using linear mixed modeling. The analysis revealed that number of SI sessions accounted for a significant proportion of variance in exam scores, F (4,2660.13) = 16.59, $p < .001$, $\eta_p^2 = 0.01$ (Table 1). Post hoc analysis using a Bonferroni correction was conducted to identify differences in exam performance across the number of SI sessions attended (Figure 1). Pairwise comparisons indicated that students attending any number of SI sessions performed significantly better on the associated exam than did students who did not attend any such sessions ($p < .001$). Furthermore, there were instances of significant increases

Parameter	Estimated *B*	*S.E.*	*df*	*t*	*p*	95% Conf. Interval	
						Lower	Upper
Intercept (Four or More Sessions Attended)	81.121	1.236	3200.210	65.611	---	78.697	83.545
No Sessions Attended	-7.457	1.221	2907.580	-6.105	< .001	-9.852	-5.062
One Session Attended	-5.430	1.223	2842.110	-4.439	< .001	-7.829	-3.031
Two Sessions Attended	-4.268	1.219	2700.087	-3.502	< .001	-6.658	-1.879
Three Sessions Attended	-2.066	1.332	2626.353	-1.551	0.121	-4.678	0.546

Note: Significance testing compares each number of sessions to "Four or More Sessions Attended," which is represented by the intercept in this model.

Table 1. *Estimates of the Effect of SI Session Attendance on Exam Performance.*

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in exam performance when students attended more sessions. Specifically, these differences were noted between attending a single versus three or four sessions, and between attending two versus four sessions ($p < .01$). No significant difference in exam performance was found between those who had attended exactly three sessions and those who had attended four or more sessions ($p = 1.00$), indicating that optimal benefits for SI participation seem to emerge with three or more sessions attended. Hypotheses 1 and 2 were supported by the data.

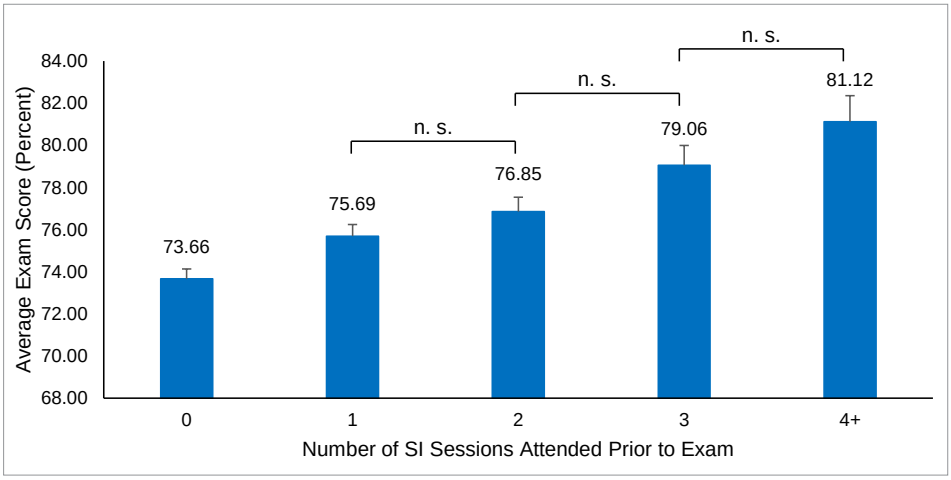

Figure 1. *Effect of number of SI sessions attended prior to exam on estimated mean exam scores. Except those designated as non-significant (n.s.), all differences were significant ($p < .01$). For example, students attending one SI session performed significantly better than those attending no sessions, but significantly worse than those attending three or "four or more" sessions.*

To test Hypotheses 3 and 4, a second linear mixed model analysis examining the unique and combined relationships between SI attendance, course and session format, and exam performance was conducted. Individual participants were nested within both course format and attendance or non-attendance of SI prior to each exam. The analysis revealed that students attending SI prior to exams ($M = 78.97$, $SE = 0.74$) performed significantly better on those exams than did students who did not attend any such sessions ($M = 77.29$, $SE = 0.97$), $F(1,896.52) = 4.46$, $p < .001$, $\eta_p^2 = 0.005$. Hypothesis 3 was supported by the data.

Hypothesis 4 was tested by examining the interaction between dichotomized SI attendance and session format on exam performance. The analysis revealed no significant interaction between the variables, $F(1,896.52) = 0.30$, $p = .587$, $\eta_p^2 = 0.0003$. The non-significant interaction suggests that presentation format, online or FTF, did not moderate the effectiveness of SI sessions (Figure 2). Hypothesis 4 was not supported by the data.

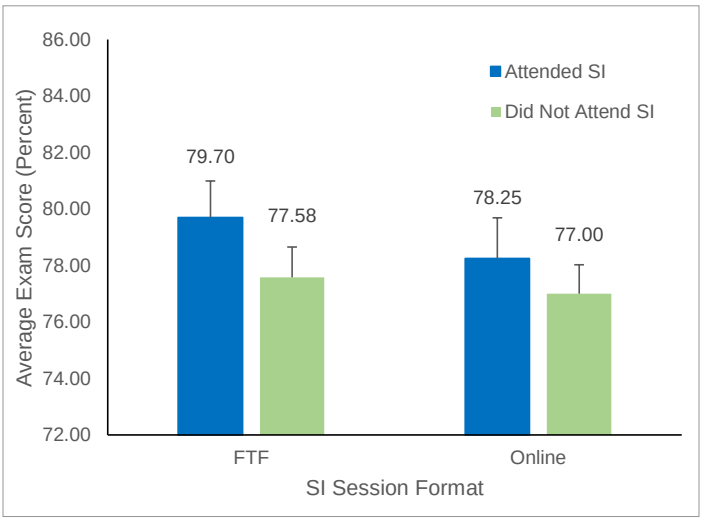

Figure 2. *Non-significant interaction between SI session attendance and session format on average exam scores ($p > .05$).*

Discussion

SI attendance was associated with higher exam scores over the course of the semester. This is consistent with previous research examining the effectiveness of SI on a variety of student outcomes, including course grades (Arendale 1997; Hizer et al. 2017), retention or continued enrollment (Bowman et al. 2021), probability of graduation (Grillo and Leist 2013; Paabo et al. 2003), and cumulative GPA (Grillo and Leist 2013; Ogden et al. 2003). Our data adds to the already strong body of evidence supporting SI as an effective program for student success.

One of the primary objectives of the current investigation was to determine how many sessions a student would need to attend to see the benefits of SI, as well as how much added benefit additional sessions would confer. This type of information is important from a logistical perspective, when SI coordinators and course instructors determine the number

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of SI sessions to offer. The way in which we approached the organization of our data set and the analyses utilized allowed us to address these questions directly. Our data set was structured so that we examined the effect that attending SI sessions prior to each exam had on exam performance. We found that the effect of SI on exam performance increased incrementally with additional pre-exam SI sessions attended. The effect of SI appeared to plateau at the three-session mark, after which no added benefit was seen. This would suggest that, if under logistical constraints from the instructor and SI coordinator end (e.g., finding enough SI leaders, funding for compensation), or those from the student end (e.g., making time to attend SI), three sessions prior to each exam might be sufficient. It is possible, however, that some students may still receive benefit beyond the three-session mark, a possibility which is discussed in more depth below. Furthermore, our data suggests that attending one session prior to each exam is sufficient to see an effect of SI on exam performance.

Our data resulting from testing Hypothesis 2 is consistent with previous research that has found the effect of SI to increase with increasing number of sessions attended. Hizer et al. (2017) determined that attending three sessions over the course of the semester was necessary for the effect of SI to manifest, while Fayowski and MacMillan (2008) reported five sessions to be necessary. Further, Bownman et al. (2021) and Kochenour et al. (1997) reported larger effects of SI as the number of sessions increased, although Bowman and colleagues noted a positive correlation when students attended only one session.

We also noted a significant effect of only one session, but it is important to keep in mind that we measured the effect at the exam level and not with an overall measure, such as course grade. Meanwhile, Grillo and Leist (2013) reported that the number of hours spent at academic support services, which included SI, were positively correlated with GPA and likelihood of graduation. Paabo et al. (2003) found that attending one SI session in a semester was not significantly associated with increased odds of graduation but attending more than two was. Finally, Arendale (1997) saw a positive correlation between the magnitude of the effect of SI and the number of sessions a student attended, with the trend levelling off around the 8-11 sessions-per-semester mark.

Taken together, the effect of SI becomes stronger with an increasing number of sessions attended, to a point, after which the trend plateaus. In fact, the trend is very consistent across studies. We found the plateau mark to be at three or more sessions per exam (i.e., 12 sessions over the course of the entire semester), which is similar to that of 8-11 sessions over the semester reported by Arendale (1997). However, the intricacies of this trend, such as the importance of regular attendance over the course of the semester, as opposed to cramming all the sessions in the last three weeks before the final exam, is less supported by evidence. Indeed, much of the previous research has examined the number of SI sessions at the semester-level. In the present study we examined the effectiveness of SI attendance at the level of individual exams. This gives our data set a level of temporal resolution such that we can confidently conclude that regular SI attendance prior to each exam is important for student success, as measured by individual exam performance.

In a similar study to our own, Price et al. (2012) examined whether peer-assisted study session (i.e., SI) attendance prior to individual quizzes in an introductory psychology course impacted quiz performance. Attendance was dichotomized, however, giving rise to just two groups—attendees and non-attendees, and the analyses were performed on just one semester's worth of data. In general, those students who attended the study sessions scored better on the quizzes and the final exam than did students who did not attend the study sessions. The authors interpreted these results to suggest that peer-assisted study sessions are effective both in the short-term (i.e., individual quizzes) and the long term (cumulative final exam).

Meanwhile, Ogden et al. (2003) reported that SI participation in an introductory political science course was associated with gains in course grade, as well as overall GPA during the quarter of SI participation, but only for those students who were conditionally enrolled at the university. Conditional enrollment meant that these students were expected to meet a certain number of requirements before receiving full-enrollment status. Interestingly, the conditionally enrolled students who were attending SI were indistinguishable in terms of GPA from those traditionally enrolled students not attending SI. One way to interpret this result would be that SI has the capacity to help students who are lacking in college-preparedness to match the performance of their better-prepared peers. The authors also noted, however, that over time, and by the next year, the cumulative GPA of this group tended to drop, suggesting that perhaps an SI "booster" is necessary to see continued long-term benefits from the program. Taken together, it appears that SI has both short-term and long-term benefits, and as our data suggests, regular attendance appears to be very important.

Another key objective for the present investigation was to determine whether offering SI in an online format would be as effective as the traditional, in-person setting. First, we again predicted that both online and in-person SI would show significantly higher exam scores relative to no SI. This hypothesis was supported by our data, such that students who attended SI had significantly higher exam scores than those students who did not attend SI. After validating the SI treatment in these years, we could then examine the role of SI format on exam performance.

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Communication has been identified as an important aspect of proper SI implementation (Adebola 2020). As such, we expected that channels of communication would be negatively impacted when SI was offered online during the fall of 2020 due to the COVID-19 pandemic. However, the format in which SI was offered, online or in-person, did not affect the effectiveness of SI in those semesters examined. This result was somewhat unexpected, given that tutoring was reported to be less effective in an online setting compared to a tradition in-person format (Price et al. 2007). Hizer et al. (2017), however, reported only minor differences in effectiveness between in person and online SI formats. This is consistent with the results that we report. Further, it is also possible that teachers, students, and SI leaders have become better equipped to teach, learn, and communicate in an online setting because of inadvertent practice in that setting stemming from the pandemic, which first moved education online in the spring of 2020.

In terms of limitations, we would be remiss to avoid discussion of an inadvertent problem with research involving SI. Namely, selection bias has been identified as a serious problem to studying the effects of SI. While differences can be seen between groups, it is hard to parse out selection bias to the SI group (Etter et al. 2000). Are the effects of SI attendance really all due to the intervention, or do other variables, such as motivation, explain the between-group differences? In other words, are students who choose to attend SI more likely to succeed, regardless of the SI intervention itself?

While previous research has shown that accounting for covariates (e.g., GPA, ACT scores, high school GPA) does reduce effect sizes, the effects of SI do persist (Bowman et al. 2021; Hizer et al. 2017). Furthermore, Hizer et al. (2017) concluded that there was no selection bias for SI attendance in their study, using GPA as a covariate, and Bowman et al. (2021) determined that ACT scores were similar for SI attendees and non-attendees, although SI attendees did tend to have higher high school GPAs. Grillo and Leist (2013), however, reported that high school GPA, SAT score, and ACT score were not significantly correlated with graduation likelihood in their study. Moreover, Fayowski and MacMillan (2008) still saw a medium effect of SI attendance on final grade in a calculus class after accounting for pre-GPA and gender.

Peterfreund et al. (2008) examined course grades for roughly 12,000 students in STEM courses over several years and found that SI participants did not have higher SAT scores or high school GPAs and tended to be worse in these areas. Further, Kochenour et al. (1997) found no correlation between high school GPA nor ACT scores and SI attendance, indicating that there is not a significant difference between students who attend SI and those who do not. These same researchers also found no correlations between number of hours that a student worked each week, nor the number of credit hours enrolled, and SI attendance. Similarly, Arendale (1997) found no differences between SI participants and non-participants over several demographic variables, including "gender, age, working status, high school rank, standardized test scores, ethnicity, or other factors" (p. 35). Finally, Malm et al. (2018) found the effects of SI attendance to persist after accounting for gender and prior academic achievement. Taken together, the data cited here suggest that the effect of SI attendance, while perhaps moderated by other factors, is indeed an effect of the SI intervention.

Meanwhile, Guarcello et al. (2017) used coarsened exact matching to minimize selection bias. The method matches students in the SI group to students in the non-SI group based on a series of co-variates. SI participation was then assessed as a function of likelihood of passing the course. The SI group was 2.2 times more likely to pass the course with a C or better. The authors did report that, prior to addition of the coarsened exact matching model, the SI group scored better for three of the four exams in the course. After the model was added, significance was only reached for one of the exams. While the effect size was reduced, this analysis further bolsters the conclusion that much of the positive student outcomes associated with SI attendance can be attributed to SI itself.

In the present study we did not account for any factors other than the SI intervention, and thus our results must be interpreted with caution. Yet, as has been discussed above, previous research would suggest that much of the effect of SI seen is more than likely attributable to the SI intervention. Regarding motivation specifically, Arendale (1997) reported that motivation plays a role as highly motivated students performed better than students with less motivation. Still the bulk of the effects seen with SI attendance were not explained by motivation.

Furthermore, it appears that students high in self-efficacy and students low in self-efficacy attended SI at higher rates than those students somewhere in the middle (Price et al. 2012). This complex relationship between self-efficacy and SI attendance could perhaps explain the plateau in SI benefits after a certain number of sessions that we and other researchers have reported. Indeed, Arendale (1997) discussed that, upon talking with those students who attended the maximum number of sessions, it was determined that that group contained a subset of students who had intentions of withdrawing from the course but were seemingly able to push through to the end by attending many SI sessions. It could be that the students who attend very high numbers of SI sessions are indeed benefiting, and perhaps for some of these students, high levels of SI attendance could be protecting against course withdrawal. As we did not include any such measures nor had any way to talk with students about their individual experiences, our interpretation is limited to speculation.

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Despite the limitations discussed above, there are some important strengths to our study. Our analysis included several years of student data with consistent patterns across all four exams, indicating that the effect of SI at our institution is robust and temporally stable. Along with this, the anatomy and physiology course was taught by the same instructor for the duration of the study period, with the course format, exam format, and course content remaining very consistent. This gives continuity to our dataset and made it easy and logical to coalesce the data from across years into one master data set for analysis. Further, the detailed records kept by the UNK Learning Commons, when merged with course exam data, allowed for a very detailed examination of SI attendance and subsequent exam performance. Thus, our data set boasts a high temporal resolution regarding SI attendance. For this reason, we can draw conclusions regarding the importance of regular attendance of SI on individual exam performance, over the course of the semester.

Meanwhile, the COVID-19 pandemic and subsequent shift to a remote learning space allowed for a serendipitous opportunity to examine the effectiveness of online SI delivery in Hypothesis 4. Given the results of Hypotheses 1, 2, and 3 we were able to, with confidence in the effectiveness of SI at our institution, compare the traditional in-person SI format in 2019 to the online format in 2020. This allowed us to directly address the question of effectiveness of online SI, which is of especially high relevance in a post-COVID-19 collegiate education system.

Conclusion

SI has been utilized to aid in undergraduate education for nearly five decades. Much research over that span of time has found SI to be an effective program to aid in student success, and the data we present here strengthens that conclusion. Our investigation also offers insight as to the relationship between the number of sessions attended and the benefit conferred from them, as well as regarding the effectiveness of SI in an online format. Specifically, the results of Hypotheses 1 indicate that students who attended SI prior to any given exam scored significantly better on that exam than students who did not attend SI. Further, in testing Hypothesis 2 we determined that the effect of SI increased in magnitude with the number of sessions attended prior to each exam, up to three or more sessions, and this trend was consistent and significant across all 4 exams. Finally, we were also able to test the effectiveness of SI in an online format. The results of Hypotheses 3 and 4 found that the effect of SI on exam performance was not significantly moderated by format, whether in-person or online. As such, at our institution, online SI delivery was as effective as in-person, FTF SI delivery.

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About the Authors

Blase Rokusek completed his BS in Psychobiology from UNK in 2021 and is currently working on his master's degree in Biology at UNK. Emilee Moore also graduated from UNK with a BS in Psychobiology in 2021 and is currently working on her doctorate in Occupational Therapy at St. Ambrose University. Christopher Waples, PhD, is an associate professor of Psychology at UNK. He teaches courses in statistics and research methods and his research interests include measurement and performance feedback. Janet Steele, PhD, is a professor of Biology at UNK. She teaches undergraduate anatomy and physiology and directs online MS programs in STEM Education and Health Sciences.

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