Examining the Benefits of Teaching Active Study Strategies as a Part of Classroom Instruction

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ABSTRACT

When students self-regulate their learning, those using more active strategies demonstrate greater learning than those using passive strategies. The article examines whether teaching active study strategies in a first-year seminar can improve test performance in another course. Using a quasi-experimental approach in two studies, 18 students enrolled in a first-year seminar course received study instruction and selected another course to use these methods. Eighteen control students in a first-year seminar course did not receive study strategy instruction. Results show that when the study-strategy students were required to study for Test 2 using active strategies, they improved more than control students. In Study 2, when study-strategy students were not required to study actively for Test 3, they no longer performed better. This suggest requiring students to study actively improves performance, but research needs to examine how to encourage students to continue studying actively.

KEYWORDS

Active Studying, Effective Studying, First-Year Seminar, Self-Regulated Learning, Study Strategies

INTRODUCTION

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Students often start college expecting to do well; however, some students fail to meet their expectations (e.g., McGrath & Burd, 2012; Tinto, 2017). When entering college some students are better prepared for the academic rigor, unique social situations, and challenges of a college environment than others (Tinto, 2006). Students who are less equipped for the transition to college often have less successful academic careers and are less likely to graduate from college (e.g., Tinto, 2006, 2017). As universities hope to retain students and promote student persistence, they continue exploring and promoting initiatives that support student success. Numerous models of retention have shaped university policies aimed at retaining students (e.g. Spady's undergraduate dropout model, Tinto's model of student departure, and Bean's model of student attrition), and they all highlight the complexity of factors that influence whether students persist (e.g., Aljohani, 2016). Regardless of which model, all recognize the importance of being academically prepared and developing appropriate learning tools (e.g., Aljohani, 2016). A goal of this paper is to highlight the need to help students with one of these necessary tools—effective studying, and to offer an ecologically valid example of how universities could help students cultivate these skills.

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Teachers play an important role in encouraging student success. Most teachers put great thought and time into preparing lectures and assignments in hopes of developing courses that optimize student learning. However, educators may give less consideration into whether students know and use effective study strategies. When surveying students about their study habits, researchers report only 20% to 36% of students used a particular study strategy because a teacher taught them to use it (Hartwig & Dunlosky, 2012; Kornell & Bjork, 2007). This may be because few professors spend class time teaching students how to study effectively (McConnell Rogers, Goldman, Jordan, & Steele, 2011). When students prepare for exams, they must decide what to study, how long to study, and how to study (Bjork, Dunlosky, Kornell, 2013; Kornell & Bjork, 2007).

When deciding what to study, students may select the most difficult material (Thiede & Dunloksy, 1999; Undorf & Ackerman, 2017), they may choose the material they believe they have the best chance of mastering (Metcalfe, 2002), or they may select the material that is due the soonest (Hartwig & Dunlosky, 2012; Kornell & Bjork, 2007). When deciding how long to study the material, students must decide how far in advance to begin preparing for the exam as well as decide when they have acquired enough material to meet their learning goal (Kornell & Bjork, 2007). Numerous studies report that students make poor metacognitive decisions in this process. For example, students seldom space their learning (Barzagar Nazari & Ebersbach, 2018; Benjamin & Bird, 2006; Taraban, Maki, & Rynearson, 1999), they often fail to recognize additional time studying would prove beneficial (Koriat, 1997), and they demonstrate poor monitoring by overestimating their comprehension and cease studying too early (e.g., Dunlosky & Rawson, 2011; Peverly, Brobst, Graham, & Shaw, 2003). Although studying correct material for a sufficient amount of time is critical for student success, these studies consistently demonstrate students do not always make the best study choices.

Study Strategies

When students decide how to study, they may choose from a variety of study strategies with varying degrees of effectiveness. For example, students may reread or copy their notes or textbook, highlight important information, outline the material, test themselves, generate example of concepts, and create notecards (Dunlosky, Rawson, Marsh, Nathan, & Willingham, 2013). Based on cognitive principles of learning, students can study using active or passive study strategies. Active study strategies, like self-testing and elaborative learning, require students to manipulate the material as they study and think about the meaning of the material. These strategies tend to lead to better long-term retention, test performance, and GPAs than do passive strategies (e.g., Bartoszewski & Gurung, 2015; Dunlosky et al., 2013; Pepe, 2012; VanZile-Tamsen & Livingston, 1999). Passive strategies, like highlighting and rereading, require the student to minimally process the material and result in minimal gains in test performance (Dunlosky et al., 2013). In a review of 10 different study strategies, students received the most benefit on exam performance when studying using self-testing and distributed processing. Students who test themselves using techniques such flashcards, online quizzing, practice exams, and who study across time performed better across subject matter (Dunlosky et al., 2013; Rawson & Dunlosky, 2011).

Despite research consistently demonstrating strategies that require active processing of the material result in greater learning, not all students use these strategies. Students report a wide range of strategy use. Some strategies, like rereading the material, are endorsed by many students, but other strategies, like self-testing, are endorsed by fewer students (e.g., Hartwig & Dunlosky, 2012; Karpicke, Butler, & Roediger, 2009; Kornell & Bjork, 2007). Students with high academic achievement goals are more likely to report using effective strategies like self-testing and distributed processing than do students with lower achievement goals (e.g., Geller, Toftness, Armstrong, et al., 2018; Rovers, Stalmeijer, van Merrienboer, Savelberg, & de Bruin, 2018). When examining students' knowledge of studying, many students endorse strategies with little evidential support and fail to recognize the benefit of more optimal strategies like distributed practice (e.g., McCabe, 2011; Morehead, Rhodes, & Delozier, 2016). Students also perceive their peers to be more likely to use ineffective strategies,

such as highlighting than effective strategies, such as interleaved practice (Anthenien, DeLozier, Neighbors, & Rhodes, 2018). Even when students indicate a plan to use effective study strategies at the start of the semester, they often revert to ineffective strategies crammed into the night before the exam (Blasiman, Dunlosky, & Rawson, 2017). It is important to note that a recent study paints a more optimistic picture of student study choices and suggests many students may move from rereading material to self-testing later in the learning process (Kuhbandner & Emmerdinger, 2019). However, a wide range of studies indicate that many students do not make the best studying choices when selecting how to study.

Given that many students report using passive study strategies and many professors may not spend much time teaching students active strategies, students could benefit from formalized instruction on study methods. There are many potential avenues for teaching students how to study effectively. Instructors could incorporate it into their classroom curriculum, students could participate in tutoring or educational support programs, or students could learn study strategies as a part of first-year seminars or courses dedicated to teaching study skills. McCabe (2011) found that students enrolled in an upper level cognition and education seminar had better metacognitive awareness of effective study strategies. While the improved metacognition of these students suggest other students could benefit from formalized instruction, the best avenue for teaching them is unclear. If professors incorporate study strategy instruction into their curriculum, they sacrifice class time teaching disciplinary content. Furthermore, not all professors can promote optimal strategies as many professors also endorse the same inaccurate beliefs about studying that their students endorse (McConnell Rogers et al., 2011; Morehead, et al., 2016). Also, although most likely helpful, it is unrealistic to hope all university students enroll in upper level cognition courses with a studying expert and relevant course content and objectives. When students struggle academically, many institutions encourage students to attend academic support centers (Ballmer, 2017; Grillo & Leist, 2013; McCabe, 2018). However, recent research suggest even academic support centers may not always endorse the most effective evidence-based strategies (McCabe, 2018). Furthermore, referring students to an academic support center is often a reactive approach used when students are already struggling academically. Student should benefit from a more proactive approach that targets university students early in their collegiate career.

Many universities require incoming freshman to enroll in a first-year seminar to help them transition successfully into college. This type of course may be a good avenue for teaching students active study strategies because first-year students starting university are likely less knowledgeable about the best strategies to use when preparing for university style exams. For example, secondary school students largely report using suboptimal strategies, such as rereading and summarizing and seldom report using optimal strategies, such as elaborative learning (Hubertina Dirkx, Camp, Kester, & Kirschner, 2019). Additionally, newer university students possess less metacognitive awareness than students further in their college career (McCabe, 2011). Given the importance of using empirically validated study methods (e.g., Bartoszewski & Gurung, 2015; Morehead, et al., 2016), researchers need to examine whether incorporating instruction on effective study techniques into university curriculum would improve test performance. Through an examination of two exploratory studies this paper aims to examine whether first-year seminar style courses may be an effective avenue for teaching students active study techniques. These small studies could serve as examples for how other instructors could teach effective studying, a model for how universities could incorporate study strategy instruction, and offer a potential methodology for larger scale experimentation.

Study 1

The specific objective of Study 1 is to examine whether teaching students active study strategies and requiring them to use these techniques will boost test performance compared to control participants.

Method

Participants and Design

Eighteen students from a small private liberal arts university in the pacific northwest enrolled in a required first-year seminar course participated in Study 1. All participants were also enrolled in a psychology course. The university's first-year seminar curriculum was designed to help students transition to college successfully, but a studying unit was not included in the university wide curriculum. In this quasi-experimental design, the quasi-independent variable was whether participants received study strategy instruction and the dependent variable was performance on two unit exams in a psychology course. The nine students who received study strategy instruction were all registered for the same first-year seminar section. They were registered for this section because of schedule availability. None of the nine students in the control group were in that section of first-year seminar, and they were in various sections also based on schedule availability. The control participants did not receive study strategy instruction in their first-year seminar curriculum.

The students in the control condition were selected as a matched control. Their psychology instructors selected them because they earned a Test 1 score most similar to the test score of a study-strategy student in their course section. Most of the participants (seven study-strategy students and seven control students) were enrolled in an introductory to psychology course, and four participants (two study-strategy students and two control students) were enrolled in a 200-level social psychology course. There were seven other students enrolled in the first-year seminar course who did not participate in this study because they did not meet the requirements to participate. These students were not enrolled in another course that had a Test 1 prior to the study strategy unit in first-year seminar.

Materials

Study Strategy Lecture

The first-year seminar study strategy lecture differentiated active and passive studying through power point slides, discussions, and demonstrations. The lecture defined active studying as studying that requires mental effort and manipulating the material, and passive studying as absorbing the material without a need to focus on understanding the concepts. The content of the lecture focused on teaching students how to study actively by engaging in elaborative learning, active reading, self-testing, and distributed learning. The elaborative learning lecture concentrated on creating examples, applying the material, explaining the content to others, and comparing and contrasting key concepts. The active reading content promoted asking questions while reading and briefly summarizing each section the text. The self-testing content emphasized creating practice questions, answering questions provided by the instructor and textbook, rearticulating class notes, and quizzing classmates. The distributed processing lecture highlighted the science behind distributed processing.

Study Strategy Assignment

The study strategy assignment incorporated the active study techniques stressed in the lecture. The first assignment required students to create an elaborate outline that organized the course material while also creating examples of concepts. The second assignment instructed students to create elaborate notecards that included the definition of the concept, the students' own example of the concept, and a brief description of connected concepts. The third assignment required students to create 10 four-alternative multiple-choice practice questions with a detailed answer key. The fourth assignment directed students to fill out a weekly planner for one week.

Unit Exams. Students completed two unit exams in the psychology course they selected to study actively for. The four different instructors of those courses created the exams independently from this study. Exams differed in content and length. However, the instructors all indicated the exams consisted of multiple-choice and short answer questions. The questions largely centered on Bloom's taxonomy of understanding and applying (Bloom, Engelhart, Furst, Hill, & Krathwohl, 1956). The

multiple-choice questions largely required students to recognize key concepts illustrated in vignettes. The short answer questions largely required students to connect and analyze important concepts.

Procedure

Five weeks into the fall semester the study-strategy students in the first-year seminar course received instruction on effective study strategies during two 55 minute course periods over a 2-week time-span. Students learned both how to use the study strategies and the cognitive theory behind why they should be effective. During class students practiced these techniques on material provided by the instructor, and they were required, as an assignment, to select another course to practice these techniques. The lectures began after Test 1 in their selected psychology course. Two students selected social psychology and were in the same course section, and seven students selected introduction to psychology and were in three different course sections.

For the study strategy practice, the students completed the homework assignments designed to encourage them to study actively in their selected psychology course. The first-year seminar instructor reviewed the students' study materials and gave feedback on their outlines, notecards, and practice questions. After completing the 2-week study strategy unit in their first-year seminar course, the instructor did not discuss study strategies again for the remainder of the semester. The students all had a second unit test in their selected psychology course within a few weeks after the study strategy unit in first-year seminar.

The control participants were students enrolled in various other sections of a first-year seminar course and enrolled in the psychology course a study strategy student selected. The control students did not receive any direct manipulation from the researcher. Their psychology instructor selected them as a matched control based on their Test 1 score, and importantly, did not receive instruction on active and passive studying or any other studying techniques in their first-year seminar course. The control students prepared for Tests 1 and 2 without any intervention as a part of this study or from their first-year seminar instructor.

The use of control students helps clarify the benefit of receiving study strategy instruction. To examine the potential benefit of receiving formal instruction on study strategies, the researcher compared the performance on the Unit 1 Test to the performance on the Unit 2 Test. If the students' performance increased from Test 1 to Test 2, one may assume that students benefited from the formal instruction. However, the study-strategy students may improve on a second test for reasons other than the formal study strategy instruction. For example, students may improve on a second test because they are more familiar with the course and have a better expectation of what they will find on the second test. Because of this, the researcher included the control group that did not receive formal study strategy instruction. In summary, both the study-strategy students and control students were enrolled in a first-year seminar course and a psychology course; however, only the study-strategy students received instruction on active and passive studying. To examine the potential benefit of receiving study strategy instruction, the researcher examined the test scores for study-strategy students compared to the control students both before (Test 1) and after (Test 2) the study-strategy instruction.

Results

See Figure 1 for average Test 1 and Test 2 grades for the study-strategy and control participants in Study 1. Because data such as test scores often violate the assumptions of normality and homogeneity of variance, an arcsine transformation was applied on the data prior to analysis. All significance tests statistics present analyses using the transformed variable as the dependent measure and met the assumptions for an ANOVA and *t* tests. Descriptive statistics presented in the figures use the raw percentages to retain interpretability. See Table 1 for test scores in 95% confidence intervals presented with arcsine transformation and raw data for Studies 1 and 2. A 2 (test: test 1, test 2) X 2 (study-strategy instruction (study-strategy, control) MIXED ANOVA revealed a statistically significant interaction between test and study-strategy instruction, $F(1,16) = 7.59$, $MSE = .23$, $p = .01$, $\eta^2 = .32$.

It also revealed a main effect of test, with participants performing better on Test 2 than Test 1, $F(1,16) = 4.53$, $MSE = .13$, $p = .049$, $\eta^2 = .22$, and no main effect of study-strategy instruction, $F(1,16) = 1.26$, $MSE = .28$, $p = .28$, $\eta^2 = .07$. When examining the significant interaction between test and study-strategy instruction, an independent sample t test revealed no differences on Test 1 between the study-strategy participants and the control participants, $t(16) = .13$, $p = .90$, $d = .06$; however, on Test 2, the study-strategy participants performed statistically significantly better than did the control participants, $t(16) = 2.87$, $p = .01$, $d = .83$. To further examine the interaction, dependent sample t test revealed that the study-strategy participants were statistically significantly better on Test 2 than Test 1, $t(8) = 2.89$, $p = .02$, $d = .99$, while the control participants were not statistically significantly different on Test 2 compared to Test 1, $t(8) = .59$, $p = .57$, $d = .09$.

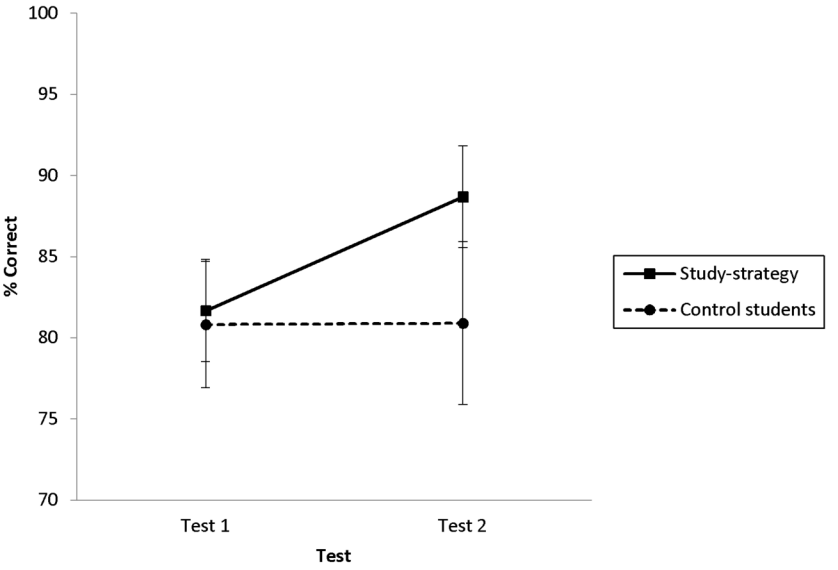
Discussion

Students often use ineffective study strategies and have poor knowledge about how they should be studying (e.g., Hartwig & Dunlosky, 2012; McCabe, 2011; Morehead, et al., 2016). These results suggest that teaching students active study strategies in one class may lead to improved test performance in other courses. Students in the study-strategy condition improved more from Test 1 to Test 2 compared to students in the control condition. This finding suggests that when students are instructed to study using active strategies, their test performance benefits. However, there are limitations in Study 1 that should be addressed to better understand the impact of study strategy instruction. Given the small sample size ($n = 18$) in Study 1, it is necessary to see if these findings can replicate in another study. Additionally, participants in Study 1 were required to study using the assigned strategies; however, it is unrealistic to expect all instructors to require specific strategies for their students to use when studying. Given this constraint, it is important to examine whether students would continue to use

Table 1. Test Scores (in 95% Confidence Intervals) for Study 1 and Study 2

Variables	Arcsine 95% CI	Raw Data 95% CI
Study 1		
Test 1		
Study-strategy	[2.097, 2.520]	[74.311, 90.634]
Control student	[2.078, 2.501]	[73.477, 89.801]
Test 2		
Study-strategy	[2.303, 2.875]	[80.049, 99.067]
Control student	[1.968, 2.540]	[69.938, 88.951]
Study 2		
Test 1		
Study-strategy	[2.042, 2.615]	[70.993, 93.007]
Control student	[2.008, 2.657]	[70.162, 95.123]
Test 2		
Study-strategy	[2.197, 2.834]	[76.344, 100.211]
Control student	[1.796, 2.519]	[60.897, 87.960]
Test 2		
Study-strategy	[2.148, 2.708]	[75.498, 95.502]
Control student	[1.951, 2.586]	[68.587, 91.270]

Figure 1. Test 1 and Test 2 average percent correct for the study-strategy and control participants in Study 1. Error bars represent standard error.



these effective study strategies later in the semester when they are no longer required to do so as a part of their first-year seminar course.

Study 2

The objective of Study 2 is designed to address the limitations from Study 1. Specifically, ascertaining whether the results from Study 1 would replicate with similar methodology, and examining whether study-strategy students would continue showing improved test performance when they were no longer required to use active strategies.

Methods

Participants and Design

Eighteen students from a small private liberal arts university in the pacific northwest enrolled in a required first-year seminar course participated in Study 2. In this quasi-experimental design, the independent variable was whether participants received study strategy instruction, and the dependent variable was performance on three exams in a psychology course. The nine students who received study strategy instruction were all registered for the same first-year seminar section based on schedule availability. None of the nine students in the control group were in that section of first-year seminar, and they were enrolled in various sections also based on schedule availability. The students in the control group again did not receive study-strategy instructions in their first year seminar course. All of the participants were also enrolled in a psychology course. The instructor of the psychology course again selected the participants in the control condition based on matching the Test 1 score. Unlike Study 1, all students in Study 2 were in the same course section of introduction to psychology.

Materials and Procedure

The materials and procedures were largely the same in Study 2. Students in the study-strategy condition again received instruction on active studying and were required to use these strategies when studying for Test 2. The control participants did not receive study strategy instruction. The course exams were again developed by the psychology course instructor independent from this study. The exams used a similar testing format as those used in Study 1.

However, there were four differences in Study 2. First, the study-strategy instruction occurred in three 55-minute class periods over 3 weeks. Second, after Test 2, the first-year seminar instructor encouraged the study-strategy students to continue using the effective study strategies by discussing the results from Study 1 (which was from the previous academic year). The instructor emphasized how using active strategies benefited study-strategy students compared to the control students. Critically, however, students were not required to continue using the active study strategies after Test 2. Third, the students completed a third unit test in their selected psychology course that occurred about one month after Test 2. This allowed the researcher to examine whether study-strategy students would continue to have better test performance when they were no longer required to use active study strategies. Fourth, all students estimated how long they studied for each Test in hours as they began each exam.

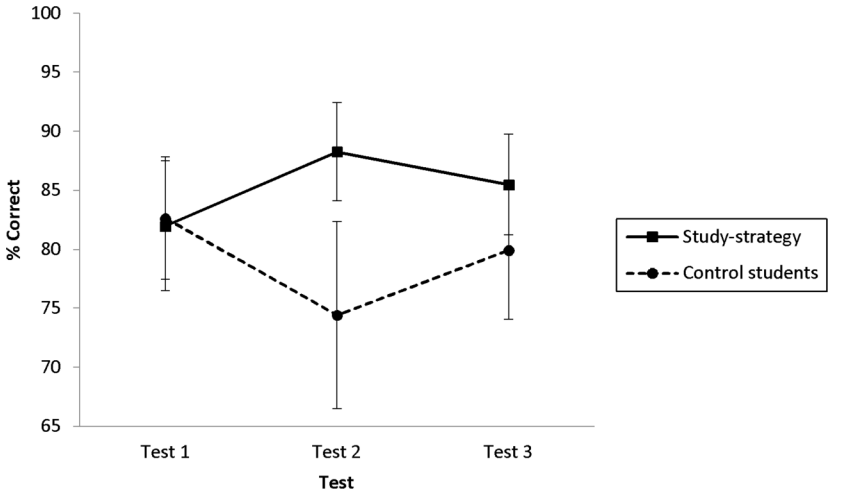
Results

See Figure 2 for average Test 1, Test 2, and Test 3 grades for the study-strategy and control participants in Study 2. Results from Study 2 largely confirmed the patterns from Study 1. A 3 (test: test 1, test 2, test 3) X 2 (study-strategy instruction (study-strategy, control) MIXED ANOVA revealed a significant interaction between test and study-strategy condition, $F(2,28) = 4.70$, $MSE = .13$, $p = .02$, $\eta^2 = .23$. However, there was no main effect of test $F(2,28) = .05$, $MSE = .001$, p = .95, $\eta^2 = .003$, nor a main effect of study-strategy instruction, $F(1,14) = .757$, $MSE = .35$, $p = .40$, $\eta^2 = .05$. Breaking apart the interaction there was no statistical difference between the study-strategy students and the control participants on Test 1, $t(16) = .12$, $p = .91$, $d = .06$; however, the study-strategy students performed statistically significantly better on Test 2 than did the control students, $t(16) = 2.12$, $p = .05$, $d = 1.00$. Unfortunately, this enhanced performance for the study-strategy group disappears on Test 3, $t(14) = .81$, $p = .43$, $d = .41$. Also, to further understand the interaction, a repeated measures ANOVA revealed a statistically significant effect of test for the study-strategy students, $F(2,16) = 9.23$, $MSE = .08$, $p = .029$, $\eta^2 = .36$. Follow up Bonferroni post hoc test, revealed participants performed statistically significantly better on Test 2 compared to Test 1, $p = .004$, but there were no other statistically significant differences. However, when examining the control participants analysis revealed no effect of test, $F(2,12) = 1.35$, $MSE = .06$, $p = .30$, $\eta^2 = .18$. One thing to note is two control participants who performed poorly on Test 1 and Test 2 dropped their psychology course before Test 3. These students were not included in either of the ANOVAs because of missing Test 3; however, they were included in the t-test follow-up analysis for Test 1 and Test 2.

DISCUSSION

The findings from Study 2 confirmed that teaching students active study strategies in a first-year seminar course can lead to improved performance. Students in the study-strategy condition improved on average six percentage points from Test 1 to Test 2; whereas, the students in the control condition were on average 12 percentage points worse on Test 2. To ensure that the study-strategy students did not improve simply because they studied longer, but not necessarily more actively, participants in Study 2 provided an estimate of how long they studied for the test right before completing all 3 tests. See Table 2 for the means and standard deviations for time studied for the study-strategy and control participants. An independent sample *t* test revealed no statistically significant differences between study-strategy students and control students in how long they studied for Test 1 $t(15) = -1.28$, $p = .24$,

Figure 2. Test 1, Test 2, and Test 3 average percent correct for the study-strategy and control participants in Study 2. Error bars represent standard error.



d = -.56; Test 2 $t(13) = 1.21$, $p = .66$, d = -.17; and Test 3 $t(13)$ = -.81, $p = .43$, d = -.49. While this is promising, and a good addition from Study 1, there is some limitation in interpreting these results. Students indicated how long they studied, but it is unclear whether students in the study-strategy condition included the time they spent making their study materials as a part of their first-year seminar homework. They also did not indicate how they studied. While it might prove useful to ask students how they studied, the researcher did not ask either group of students how they studied because of concern the study-strategy students might answer differently than the control students simply because of now knowing the terminology not because they actually studied differently. Because study-strategy students created active study materials as an assignment before Test 2, the improved Test 2 performance demonstrates, at a minimum, that creating these study materials improved performance.

Although, the study-strategy students improved more on Test 2, the benefit largely disappeared when examining performance on Test 3. The Test 3 performance of the study-strategy students was not statistically significantly different than that of the control participants. This suggests receiving study strategy instruction, practicing effective studying techniques, and learning the benefit of using these strategies may not be enough to motivate students to continue using them when it is no longer required. It is critical to better understand this because any potential benefit of study strategy instruction necessitates students employing effective studying during future self-regulated learning. It is important to note that the ability to discover any potential benefit on Test 3 was impaired by 2 control students who did poorly on Test 2 dropping the course. This cautiously, may highlight the potential real life importance of teaching students effective study strategies because the matched study-strategy students who performed similarly on Test 1, improved on Test 2 and did not drop the

Table 2. Estimated Time Studied (Hours) on Test 1, Test 2, and Test 3 for Study-Strategy Students and Control Students in Study 2

	Test 1	Test 2	Test 3
Condition	*M*(*SD*)	*M*(*SD*)	*M*(*SD*)
Study-strategy	3.00 (2.71)	5.00 (4.72)	4.58 (2.17)
Control students	4.27 (1.75)	5.64 (2.43)	5.83 (2.85)

course as did their counterparts in the control group. However, the lack of clear benefit on Test 3 suggests educators need to think carefully about how to motivate students to use these study strategies and is discussed in detail in the next section.

SUMMARY AND CONCLUDING DISCUSSION

Students have many choices when studying, and they do not always make the right choice. Students often choose not to space out their studying (e.g., Barzagar et al., 2018; Taraban et al., 1999), they believe they know the material when they do not (e.g., Dunlosky & Rawson, 2011), and they believe passive strategies are as effective as active strategies (Blasiman et al., 2017; McCabe, 2011). Some students find that success in high school does not always translate to success in college. For example, Balduf (2009) tracked highly successful high school students and found a sizable minority performed poorly during their first-year in college. Many students attributed their lack of success to feeling unsure about how to study effectively at the college level.

Students could benefit from formalized instruction, and these studies aimed to examine whether students who received study strategy instruction in a first-year seminar would benefit compared to control students. The results from the current studies suggest that teaching students in a first-year seminar may be a good avenue. Teaching first-year students active study strategies may be particularly useful because McCabe (2011) found that newer college students had poorer metacognitive knowledge than did seasoned students. Many schools require study strategy courses for struggling students (McKeachie, Pintrich, & Lin; 1985), but given the findings from Kornell and Bjork (2007) and McCabe (2011), a broader range of students should benefit from receiving formalized instruction.

Study 2 aimed to examine whether students would continue using active studying when it was no longer required as a part of their own self-regulated learning. Examining the test performance of students on Test 3 illuminates important challenges in encouraging students to use more active studying. Students need to be able to regulate their own studying to perform well throughout college (e.g., Bartoszewski & Gurung, 2015; Bjork et al., 2013; Kornell & Bjork, 2007). However, instruction on active studying alone may not be sufficient to ensure all students will use effective study strategies (e.g., VanZile-Tamsen & Livingston, 1999; Winne, 1995). In the current study, students not only received instruction on effective study strategies, they were required to use these strategies when studying for the second exam. When required to use the active study strategies, students performed better than students who did not learn about active studying. Unfortunately, when students in Study 2 were encouraged, but not required, to continue using active studying when preparing for the third exam, their performance was not statistically significantly better than the control group. While there was a moderate effect size of $d = .41$, any potential benefit of receiving study strategy instruction was much weaker on Test 3 than Test 2.

These findings suggest educators need to consider how to motivate students to study effectively and to better understand the forces that prevent students from using effective strategies. One important factor to consider is the mental effort required when studying actively. While more active strategies, such as elaborative learning should not take more time than less optimal strategies, such as rereading, active studying certainly requires more mental effort (e.g., Bjork, 1994). People tend to avoid mental effort in a wide range of tasks, such as decision making (Tversky & Kahneman, 1974) and problem solving (Nagase, Onoda, Foo, et al., 2018). For example, when engaged in problem solving, students were less likely to continue with a strategy that required greater mental effort even though the effortful strategy would more likely lead to success (Baars, Wijnia, & Pass, 2017). Effort aversion likely impacts study choices as well. When Blasiman and colleagues asked students to report both their intended and actual study strategies, students frequently reported they intended to use more optimal strategies but reverted to less optimal strategies as the test neared. Additionally, students reported spending less time and were more likely to use massed studying than they initially planned (Blasiman et al., 2017). It is unsurprising that these students studied less and later than intended and supports

several studies showing students often report procrastinating (e.g., Ariely & Wertenbroch, 2002; Perrin, Miller, Haberlin, Ivy, Meindl, & Neef, 2011). In the current study, students similarly may have begun studying after their intended goal, which could lead them to revert back to the seemingly easier passive strategies. Students may also not recognize the limitation of these passive strategies and may incorrectly attribute greater learning to these less effective techniques. In Blasiman et al. (2017) students additionally reported how effective they perceived each strategy, and participants ranked the less optimal strategies like rereading as more effective than better strategies like self-testing. If students do not recognize the benefit of more effortful active strategies, they may be more likely to revert back to passive strategies during a busy semester.

Struggling students fail to change their studying behavior, despite hopes of improving. This aligns with a wide range of research demonstrating people often fail to change behaviors despite good intentions (e.g., Prochaska, et al., 1992). Change theory suggests people are more likely to change specific behaviors if they are motivated intrinsically, value the task, recognize change is not immediate, and set smaller but obtainable goals across time (Prochaska, et al., 1992). Similarly, students who are motivated to learn and have higher self-efficacy perform better academically and report using more effective study strategies (Pintrich & de Groot, 1990; Tanaka & Tanaka, 2008). Students who value the task may also be more likely to use effective study strategies (VanZile-Tamsen & Livingston, 1999). While lower achieving students are less likely to exert strategic effort when studying (VanZile-Tamsen & Livingston, 1999). To increase the likelihood of students using effective study strategies after receiving formal instruction, future research should examine how to incorporate elements of behavior change theory into an examination of effective studying. The results from the current study suggests future research could start by focusing on how to better highlight the value of active study methods and whether this encourages active strategies during self-regulated learning. Another potential avenue worth exploring is whether distributing the studying strategy instruction throughout a semester may result in more sustained change than the current studies' consolidated approach. Research demonstrates that behaviors are more easily changed gradually over time (e.g., Prochaska & Velicer, 1997), and reminders across time help keep goals in mind (e.g. Pirolli, Mohan, Venkatakrishnan, Nelson, Silva, & Springer, 2017). This previous research suggest students may be less likely to revert to old habits with a distributed instructional approach. These directions could help refine how to best incorporate study strategy instruction into the curriculum.

Although the results of Study 1 and Study 2 offer some promising implications of teaching students active studying, there are several limitations in the studies that necessitate caution in our interpretations and possible implications. These studies were conducted as a part of real classroom instruction to enhance the ecological validity of the findings; however, this type of quasi-experimental design did lead to limitations. Most importantly is the small sample size in both Study 1 ($n = 18$) and Study 2 ($n = 18$). This small sample size means the results from these studies should be not be viewed as conclusive experiments but more as a starting argument for further examination on how to best teach active study strategies. These studies were incorporated into existing first year-seminar courses at a smaller university with small class sizes. Although it is promising that both studies produced the same pattern of results, given the small sample sizes, the students in these classes may not represent students at other types of universities, such as larger state universities. Given these limitations, future research should examine whether these findings replicate with a larger sample size at other types of learning institutions.

Cognitive and educational psychologists have increased our understanding of human memory and thinking, and these findings have real application in classroom learning. As teachers look for more avenues to support student learning, students may benefit from learning about study strategies. The findings from the current studies suggest one applicable method for improving student learning is to incorporate specific instruction on empirically validated study methods into the curriculum, and that existing first-year seminar programming could be a natural fit for this instruction. Critical next

steps include incorporating the sample methodologies from these exploratory studies into larger scale experiments, and to develop methodologies that further ensure students implement these strategies into their self-regulated learning.

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