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# Challenges of Shaping Student Study Strategies for Success

## ABSTRACT

This paper reports results from a mixed-methods intervention conducted in partnership between a faculty member and an undergraduate to shape student study strategies for success in an introductory course. The instructor provided students with information on the effectiveness of the successive relearning study strategy, conducted an in-class demonstration of the strategy, and explained how students could apply the strategy to their study plan for the first exam. Students were asked about their planned study behaviors for the first exam before the intervention and exam and about their actual study behaviors for the exam after the intervention and exam. Students were asked before the intervention what an instructor could do to convince them to try a new strategy, and again after the intervention whether or not they adopted the new strategy and why. Quantitative results indicated that the intervention had no effect on students' study behaviors, contrary to the predictions of the prior literature. Qualitative analyses suggested that students were open to learning more effective ways to study and thought that interventions like the one used in this investigation would convince them to try a new strategy. However, students were unable to use successive relearning because of procrastination and time management issues.

## KEYWORDS

successive relearning, study methods, students as partners, retrieval practice, spaced practice

## INTRODUCTION

This mixed-methods project explores the effect of a pedagogical intervention on student self-reported study strategies for learning course material as well as actual student learning of the course material. In Hutchings' (2000) typology of SoTL questions, this project represents a "What works?" question in so far as it is focused on assessing the effectiveness of an intervention to get students to adopt a new study method and to explore what made the intervention more or less effective. The project also asks students, "What do you think *would* work to convince you to use a new study strategy?" and in this way attempts to partner meaningfully with students as critical stakeholders in their own learning for the improvement of the teaching and learning environment (Felten et al. 2013; Manor et al. 2010; Otis and Hammond 2010; Werder, Thibou, and Kaufer 2012; Werder et al. 2010).

A large body of cognitive and learning research has established the varying effectiveness of different study strategies, with some strategies being highly effective in promoting long-term retention of information and other strategies being less effective, and a fair amount of consistency across studies as to which strategies are most and least effective. The study strategy known as "successive relearning" has emerged as one of the most efficient and effective ways to promote long-term retention of material

(Dunlosky and Rawson 2015; Karpicke, Butler, and Roediger 2009; Rawson, Dunlosky, and Sciartelli 2013). Successive relearning integrates two study strategies, both of which can potentially be effective on their own: self-testing (also known as "retrieval practice") and spaced or distributed practice (as opposed to massed practice or "cramming"). Self testing, as the name implies, occurs when a learner continues to test themself until they are able to reliably answer correctly. This commonly manifests in forms such as quizzing oneself though the use of flashcards or practice test questions to determine if one knows the correct answer to the question, with the learner continuing to test themselves until they are able to answer the question correctly. Spaced practice is spreading out one's study time over multiple days or even weeks in smaller study blocks rather than massing or "cramming" studying the day or even the night before an exam. Both self-testing and spaced practice are highly effective strategies and are "inexpensive" educational techniques in the sense that instructors can share this information with students with little cost (Roediger and Pyc 2012).

Successive relearning integrates these two strategies into a new strategy that is more effective than either strategy by itself: the learner engages in self-testing that is spaced across multiple days or weeks, with the same material self-tested in multiple study sessions, but overall the same amount of time spent on studying. For example, instead of spending eight hours the night before the exam in self-testing, the learner would spend one hour per day every other day for 16 days before the exam engaging using the same self-testing strategies. Successive relearning is especially effective if the self-testing involves recall (e.g., define the term or fill in the blank questions) rather than recognition (e.g., multiple choice questions), and the study intervals are distributed across multiple days with non-study days in between (Dunlosky and Rawson 2015). In contrast, other study methods, like "cramming," rereading the text or notes, and highlighting the text, are known to be significantly less effective in promoting long-term learning (Dunlosky and Rawson 2015).

Another body of related research has established that students are typically ignorant of the findings of that first body of research and often erroneously believe that less effective strategies like rereading or highlighting are highly effective, and vice versa (Hartwig and Dunlosky 2012 Karpicke, Butler, and Roediger 2009; McCabe 2011; Morehead, Rhodes, and DeLozier 2016; Persky and Hudson 2016). As a result of this misperception, the study strategies that most students typically employ are largely ineffective for long-term learning. Karpicke, Butler, and Roediger (2009) suggest that these student misperceptions are not random error or even mere ignorance, but a specific flaw in student metacognition which they describe as "illusions of competence." As Putnam, Sungkhasettee, and Roediger (2016, 657) write, "The challenge here is that you cannot necessarily trust your judgment about what works and what does not" (Bjork, Dunlosky, and Kornell 2013). Rereading something can create the impression that you know it well because it seems familiar. However, that does not necessarily mean that you can retrieve that information when asked to write an essay about the topic. In short, rereading can lead to overconfidence about how well you will know the information in the future (e.g., Roediger and Karpicke 2006)." Mueller (2019, para. 6) notes, "Metacognition feels like it takes a lot of time when you first start doing it because it makes the learner deal with the difficult parts of a subject matter. Students, myself included, want the act of acquiring new information to be rewarding, quick, and an affirmation of their competency of the material." This is echoed by Kornell and Bjork (2007, 221) who note, "spacing practice and self-testing…are desirable difficulties—that is, manipulations that introduce difficulties during study, but enhance long-term learning (Bjork 1994). The very fact that desirable difficulties introduce challenges and can decrease a student's perceived rate of learning may

lead the student to avoid rather than select such techniques." These "illusions of competence" are also known as the Dunning-Kruger effect (Kruger and Dunning 1999), wherein those of lowest competence most overestimate their abilities because of poor metacognition. This may also explain why a student who uses one ineffective study strategy (e.g., cramming) is more likely to use other ineffective study strategies (Hora and Oleson 2017): they don't realize the strategies are ineffective because of a lack of metacognitive awareness. Further, additional research has demonstrated that students' judgments of their own learning are typically the same for massed and spaced practice (i.e., students do not realize that they learn better from spaced practice); and even after students are told explicitly about the benefits of spaced practice and can see it in their own learning, they still significantly underestimate their learning from spaced practice (Logan et al. 2012).

Although articles in the higher education press have reported that student learning increases when faculty teach students validated learning techniques explicitly (Boser 2019), and doing so is recommended because it is a relatively inexpensive educational intervention (Roediger and Pyc 2012), the research suggests that changing students' study behaviors may actually be quite difficult. Those students who know about the greater effectiveness of study strategies like spaced practice typically don't use them because they procrastinate and, as a result, have insufficient time to use them (Blasiman, Dunlosky, and Rawson 2017; Morehead, Rhodes, and DeLozier 2016). Additionally, although students in general have a high propensity to procrastinate, and as a result, typically study significantly less per week than they plan to (Oreopoulos and Petronijevic 2019), the tendency is pronounced more substantially for struggling students who are already at greater risk of failure (Beattie, Laliberte, and Oreopoulos 2018).

Further, even students who are taught about more effective strategies and subsequently adopt them do not always see improvement in their learning. For example, Rodriguez, Rivas, Matsuura, Warschauer, and Sato (2018) reported an intervention in which students in an experimental group received a 10-minute lecture about the benefits of self-testing and spaced practice, though not successive relearning specifically. Students in both the experimental group and the control group reported no change in their use of ineffective study behaviors after the intervention in the experimental group. Students in the experimental group who did not use self-testing and spaced practice at the beginning of the course but adopted it after the lecture intervention still did not see an increase in course grades. Rodriguez, Rivas, Matsuura, Warschauer, and Sato (2018) argued that students have difficulty changing their study behaviors and need repeated practice using new strategies to use them successfully on their own, not just information on their effectiveness (see also Dembo and Seli 2004; Hattie, Biggs, and Purdie 1996). As Oreopoulos and Petronijevic (2019, 3) have observed, "nudging students toward improving study habits and attitudes has proven more challenging because it requires a sustained change in behavior over a prolonged period." This is echoed by Dunlosky and Rawson (2015) who note that it is not enough to tell students about successful strategies; instructors have to scaffold how to use them. Scaffolding is needed because in order to use a spaced practice technique like successive relearning, students need to plan a study schedule well in advance of an exam with multiple, weekly study sessions (at least three to four sessions total).

Unfortunately, evaluations of such scaffolding and demonstrations of effectiveness have not yet appeared in the literature. There are numerous examples of instructors who have assessed the impact of student learning from self-testing and spaced practice or both using actual course content as opposed to

laboratory or theoretical testing of the effects, but these evaluations typically do not include providing students with information about the effectiveness of the methods or modeling the methods to students before their use (e.g., Dobson 2011, 2012, 2013; Dobson and Linderholm 2014). The closest example is Dobson and Linderholm (2015) who had students study different reading passages in class using three different techniques, one of which was self-testing, then complete an assessment. The material was not from the course itself, but related content from the next course in the course sequence. Once the authors had analyzed the data, which revealed significantly more learning from the self-testing condition, they shared the findings with the students, encouraged them to self-test, and "showed the students how they could develop such a studying technique by simply modifying the ... strategy they had already practiced" (p. 155). However, the authors did not share information about the findings from the literature on the effectiveness of the technique, nor did they address the importance of spacing studying and self-testing or address successive relearning. The authors collected additional data that indirectly suggested their intervention may have resulted in students adopting a self-testing approach to studying: students who received the instruction scored better on the remaining three exams in the course than students who had not received the instruction. However, the students were not asked explicitly if they increased their self-testing study behaviors, so causal attributions are difficult to make.

Thus, the question still unanswered by the literature is this: To what extent can an instructor convince students to change their study habits from massed practice and rereading to successive relearning by demonstrating the effectiveness of successive relearning on students' own learning in that course? Further, what do students think instructors need to do to convince them to use more effective study strategies? For this investigation, the material selected to be learned was Developmentally Appropriate Practices (DAP), a foundational concept in the course selected. DAP is not a difficult or lengthy concept, but it is a very detailed and highly specialized description that is used extensively in the field of the course. A person fluent in the concept could succinctly articulate the elements clearly at a conversational pace in 15 seconds. For example, one of the components is: knowledge of each child's individual interests, abilities, and needs. To be accurate, each element (i.e., "each child's," "interests," "abilities," and "needs") must be present.

## RESEARCH QUESTIONS

There are five questions this project investigates:

1. To what extent will students increase their self-reported use of successive relearning after a classroom demonstration of its effectiveness as a study strategy for the course material?
2. To what extent will students decrease their self-reported use of less effective study behaviors (e.g., massed practice, rereading) after a classroom demonstration of the effectiveness of successive relearning?
3. To what extent will students demonstrate an increase in confidence in their ability to recall a specific course concept after a classroom demonstration of successive relearning applied to that concept?
4. To what extent will students demonstrate an increase in correct recall of a specific course concept after a classroom demonstration of successive relearning applied to that concept?

5. What do students say an instructor would need to do in order to convince them to use a new study strategy?

## METHOD

### Participant selection

Institutional Review Board (IRB) approval was obtained for this investigation. Students from three sections of an introductory child development course taught by the first author were invited to participate in the research. Each section was taught in a different semester and each section used a different recruitment method. In all three sections, students were invited to participate in the first week of class, before any relevant material had been introduced, and one week after the first exam the same method was used to invite students to complete the post-test. The procedure of asking students about their study behaviors in the first week of the course and then after an exam has been used in prior research using similar measures (Blasiman, Dunlosky, and Rawson 2017). In the first semester, students were invited to participate through an announcement on the course Learning Management System (LMS) and an in-class oral announcement directing students to the LMS announcement. The LMS announcement included a link to an online Qualtrics questionnaire pre-test.

Because of insufficient response rates, the recruiting strategy was changed with permission of the IRB for the second semester. In the second semester, when the oral announcement was made in class, the instructor also distributed a written hard copy recruitment announcement that included a QR code that could be scanned with a phone and would direct participants to the online Qualtrics questionnaire.

Again, response rates were insufficient, so the recruiting strategy was changed a second time with the permission of the IRB for the third semester. In the third semester, the announcement on the course LMS was not used and instead the instructor distributed hard copies of the questionnaire with the in-class announcement. Students were instructed that any student who did not wish to participate could work on other tasks quietly and should turn in a blank questionnaire at the end of the time period so as not to reveal whether or not they had participated. After distributing the questionnaires and placing a collection envelope at the front of the room, the instructor left the room for 10 minutes to maximize participant anonymity and minimize the risk of coercion. At the end of that time, the instructor returned to the room and collected the envelope.

### Sample and context

This research was conducted at a southeastern U.S., public university classified as an R2 in the Carnegie classification system. The institution has a total enrollment of approximately 27,000 students. Institutional data (Georgia Southern University, n.d.) indicates that the modal university student spends 6-10 hours per week on out-of-class academic work for all classes combined.

In the first semester of this project, 17 students (of 45 enrolled) completed the pre-test and five completed the post-test (two of whom had completed the pre-test). The two students who completed both questionnaires represented a response rate of 4.4 percent. In the second semester, 13 students (of 40 enrolled) completed the pre-test and three completed the post-test (two of whom had completed the pre-test). The two students who completed both questionnaires represented a response rate of 5 percent. In the third semester, 41 students (of 42 enrolled) completed the pre-test and 27 completed the post-test (26 of whom had completed the pre-test). The 26 students who completed both questionnaires represented a response rate of 61.9 percent, but one of those students had a significant

amount of missing data on the pre-test. All student responses from all semesters were considered in the qualitative analyses, but only the 25 students who had completed both the pre-test and post-test fully in the third semester were included in the quantitative analyses.

To help maintain anonymity, demographic information about participants was not collected. However, in terms of general context, the enrollment in this course is typically 90-95 percent students who present as women, similar numbers of "traditional age" students (i.e., 18-24 years old), and approximately 60 percent of students who appear phenotypically White, 30 percent who appear phenotypically African-American, and 10 percent who appear phenotypically of other racial and ethnic groups. Approximately 45 percent of the students enrolled in the course are Child and Family Development majors, 45 percent are Child and Family Development minors, and 10 percent are neither.

**Measure**

The instrument used in this investigation was adapted from multiple prior investigations documenting student study strategies (Blasiman, Dunlosky, and Rawson 2017; Gurung, Daniel, and Landrum 2012; Karpicke, Butler, and Roediger 2009). Data from pre-test to post-test was kept anonymous but linkable by having participants create a unique ID from a combination of their phone number and birth month. The pre-test contained seven questions. The first question asked participants, "The first exam in this class is about 5-6 weeks away. Realistically, how many days before the first exam do you plan to start studying for that exam?" and provided a free response box. The second question asked, "On how many different days do you plan to study for the exam? That is, what is the total number of days on which you plan to spend any time studying for the exam?" and provided a free response box. The third question asked, "Please list the total amount of time in minutes that you plan to spend on each of the study strategies listed below in preparation for the first exam (enter "0" if you do not plan to use that strategy)." and listed the following choices, all with free response boxes: a) rereading notes, reading guides, or textbook, b) highlighting notes, reading guides, or textbook, c) memorizing, d) rewriting notes, e) making outlines from the notes, reading guides, or textbook, f) studying with another student or students, g) making up real-life examples to understand the material, h) making up mnemonic/memory devices (acronyms, rhymes, etc.), and i) practicing recall (self-testing with definitions, fill in the blank, short answer, etc.). The fourth question read, "'Successive relearning' is the name for one study strategy that combines practice recalling material (self-testing) with spacing studying across multiple study sessions so that a student would test themselves over the same material on multiple days before an exam. Some students are familiar with this method, but others are not, so I wanted to ask a separate question about it. How many minutes do you plan to spend using successive relearning to study for the first exam (enter "0" if you do not plan to use it)" and provided a free response box. The fifth question asked, "On a scale of 0-100%, how confident are you that you could correctly list the 3 components of DAP. (If you do not know what DAP is, please write '0 %.')" and provided a free response box. The sixth question read, "Without consulting your notes or any outside materials or other people—just off the top of your head—list the 3 components of DAP in a numbered list. (If you do not know what DAP is, please leave the space empty.)" and provided a free response box. The final question read, "Imagine that your course instructor knows about an extremely effective study strategy that dramatically boosts long-term retention and learning of the course material. What would your course instructor need to do to convince you to stop using your existing study strategies and instead use this new study strategy?" and provided a free response box.

The post-test contained eight questions. The first three questions were the same as the first three questions from the pre-test, except that they were rephrased to inquire about actual study behavior instead of anticipated study behavior. For example, the first question read, "How many days before the first exam did you start studying for that exam?" and provided a free response box. The fourth question was likewise rephrased to inquire about actual study behavior, but the first section of the question was changed to, "'Successive relearning' is the name for the study strategy your instructor demonstrated in class that combines practice recalling material (self-testing) with spacing studying across multiple study sessions so that a student would test themselves over the same material on multiple days before an exam."

The fifth and sixth question were identical to those from the pre-test. The remaining portion of the questionnaire read, "Answer the question below that applies to you:" and provided participants with two options, each with a free response box: a) "If you used successive relearning to study for the first exam, please explain why you chose to do so; if this is the first time you have used it to study for an exam, please explain what convinced you to try it.", and b) "If you did not use successive relearning to study for the first exam, please explain why you chose not to do so and what the instructor could have done to convince you to try it."

**Procedure**

Students were invited to participate in the study on the first day of class. On the second day of class, the instructor began a successive relearning classroom demonstration process that continued for four class periods, hereafter referred to as P1-P4. On P1, as part of the lecture material for the day, students were introduced to the three components of DAP. After instructing students in this material, the instructor spent approximately 20 minutes on the topic of developmental domains, including 10-15 minutes of video. Then, the instructor asked students to take out a blank sheet of paper and put away all their notes. The instructor stressed that the upcoming question would not be graded and no one—not the instructor or any of their classmates—would ever see their responses. Students were told just to be honest and do their best. The instructor asked students to write "#1" in the top right- hand corner of their papers. Next, the instructor asked them to write a list with the numbers 1, 2, and 3 on the left-hand side of the top half only of the sheets of paper. Then, the instructor asked them to list the three components of DAP, one after each number on their list, as best as they could recall. Students were given one minute to complete the task. At the end of that time, the instructor told them not to change what they had written down, but instead look at their answers as the instructor reviewed the three components. Students were encouraged to write off to the side of their answers any information they had missed. When the instructor finished, students were instructed to fold the sheets of paper in half (top down to bottom) and put them away, but keep it with their notes as they would use them again in the future.

On P2, after the regularly scheduled quiz at the start of class (~10 minutes), the instructor told students to put away all their notes and take out the sheets of paper they had saved from the last class, but not to open it or look at what they had written before. This time, on the back of the top half of the sheets of paper, the instructor asked them to write "#2" in the top right-hand corner and again write a list of 1, 2, and 3, on the left side of the paper. Again, the instructor asked them to list the three components of DAP and gave them one minute to complete the task. At the end of that time, the instructor told them

again not to change what they had written down (though they were encouraged to annotate to the side of their answers), but instead look at their answers as the instructor reviewed the three components. When the instructor finished, students were told to fold the sheets of paper in half again, this time right to left, and again save it.

On P3, the procedure for this class period was identical to P2, except that the instructor asked students to write "#3" on their paper and fold it top to bottom at the end. On P4, the procedure for this class period was be identical to P2, except that the instructor asked students to write "#4" on their paper and told them not to fold it anymore. After reviewing the three components of DAP, the instructor asked the students to unfold their papers and compare their answers from P1-P4 (silently to themselves). Students had one minute to do this. Next the instructor asked the class how their answers from P1-P4 compared and why they thought their successive attempts resulted in more correct recall. The instructor also asked students if they were more confident that they knew this material now than they did on P1 and if they thought they would be more likely to retain this material long-term after making successive attempts. Then the instructor introduced the concept of successive relearning and explained how this activity was a demonstration of successive relearning in practice (i.e., a combination of the testing effect and spaced practice, although the testing should continue on each occasion until correct recall is achieved).

Next, the instructor reviewed the research on the effectiveness of successive relearning and the ineffectiveness of other popular study methods (e.g., rereading, highlighting, etc.). The instructor explained how students could apply the successive relearning method of studying in preparation for the first exam (23 days away). As part of this explanation, the instructor clarified to students that successive relearning could be used with existing self-testing methods like flashcards (i.e., answers could be given orally and did not have to be written). Finally, the instructor discussed with students the importance of setting a study schedule early in the process of preparation for the exam so that they would have sufficient time to plan and execute successive relearning.

The post-test was administered in class seven days after the exam. The reason seven days post-exam was chosen for the post-test is because it represented two class periods after the exam and prior research has indicated that attendance during the class period immediately following an exam is unusually low (Maurer et al. 2009).

## RESULTS

### Quantitative analyses

Because of the small number of participants in the sample, analyses were condensed to preserve statistical power. Data from the first two questions about total days studying and when students started studying were not included. Data from question three about all non-successive relearning methods was summed. An examination of the descriptive statistics for each variable revealed significant skewness and kurtosis for most of the project variables (see Table 1). To determine if any outliers needed to be dropped from the sample, we examined the Mahalanobis distance for each student, but none of the cases met the threshold for exclusion at the $p < .001$ level. Because of the significant deviations from normality in the distributions of the data, we chose the non-parametric Wilcoxon Signed-Ranks test for the analyses.

**Table 1. Descriptive statistics for variables (N = 25)**

| | | | | | Skewness | | Kurtosis | |
|---|---|---|---|---|---|---|---|---|
| Variable | *M* | *SD* | Minimum | Maximum | Statistic | *SE* | Statistic | *SE* |
| Non-successive relearning minutes (Q3) | | | | | | | | |
| Pre | 485.40 | 496.18 | 100.00 | 2280.00 | 2.60 | 0.46 | 7.34 | 0.90 |
| Post | 528.80 | 444.58 | 70.00 | 1740.00 | 1.22 | 0.46 | .97 | 0.90 |
| Successive relearning minutes (Q4) | | | | | | | | |
| Pre | 75.60 | 54.85 | 0 | 240.00 | 1.37 | 0.46 | 2.12 | 0.90 |
| Post | 80.40 | 101.26 | 0 | 420.00 | 1.87 | 0.46 | 4.12 | 0.90 |
| Confidence percent (Q5) | | | | | | | | |
| Pre | 1.20 | 6.00 | 0 | 30.00 | 5.00 | 0.46 | 25.00 | 0.90 |
| Post | 58.08 | 36.03 | 0 | 100.00 | -0.52 | 0.46 | -1.19 | 0.90 |
| DAP score (Q6) | | | | | | | | |
| Pre | 0 | 0 | 0 | 0 | — | — | — | — |
| Post | 1.00 | 1.38 | 0 | 4.00 | 1.13 | 0.46 | -0.12 | 0.90 |

*Note.* Question number is indicated in parentheses after each variable.

Analyses indicated no change from pre-test to post-test in either students' non-successive relearning study times, $Z = 0.82$, *ns*, or successive relearning study times, $Z = -0.28$, *ns*. Students' confidence in their ability to correctly list the three components of DAP did increase significantly from pre-test to post-test, $Z = 4.11$, $p = 0.000$, $r = 0.96$. Effect sizes were calculated using the simple difference formula (Kerby 2014), counting scores of zero (i.e. no change from pre-test to post-test) as unfavorable outcomes to maintain a conservative estimate. Students' answers to the question about the components of DAP were scored on a scale from 0-6, with a score of six representing correctly listing all of the elements of all of the components (i.e., one point was given for each correct element). The second author scored all student responses. Analyses indicated significant improvement from pre-test to post-test in students' knowledge of DAP, $Z = 2.96$, $p = 0.003$, $r = 0.35$. At pre-test, no student was able to correctly list any element of any component of DAP. At post-test, no student scored higher than four of the six points, and 56.0 percent of students scored zero.

### Qualitative analyses

All student responses to the open-ended questions about successive relearning on the pre-test and post-test were subjected to qualitative analyses conducted by the second author. The second author was selected for the task of coding because as an undergraduate and former student in the course, it was anticipated that she might view and interpret the student responses in a more authentic way than the first author/the course instructor (e.g., she had first-hand experience navigating the course material for the first time as a student in the course which may have yielded particular insight). The second author used NVivo software to code student responses using a content analysis approach to identify salient patterns or themes emerging from the data for each question (Patton 2002). A total of 76 students provided qualitative data: 30 provided both pre-test and post-test responses, 41 provided responses only

at pre-test, and five provided responses only at post-test. Responses were typically a single sentence and no response received more than one code.

The responses from the 71 students who completed the pre-test yielded four themes: 1) in-class guidance (n = 34, 47.9 percent), 2) research and proof of effectiveness (n = 29, 40.8 percent), 3) other students' experience (n = 5, 7.0 percent), and 4) not open to change (n = 3, 4.2 percent). Examples of the in-class guidance theme included, "I would like the instructor to introduce the strategy in class, and practice the strategy in class;" "Allow students to have a chance to try using this new study method with a practice test that will not affect grades, to see how effective it is;" and "Maybe set up a 'study hour boot camp' to show this new strategy." Examples of the research and proof of effectiveness theme included, "Show me successful research studies done on this technique;" "Show me % improvement in others, then I will try it for myself;" and "Give me statistics of other students that used my way of studying and changed to the new way and how their grades improved." Examples of the other students' experience theme included, "I would like to hear a thorough example of a student who decided to change their own personal study habits to this new one, while hearing about the success of this new method and/or any comments that the student has;" "He/she could show me the data or have other students testify on its behalf;" and "Show improvement for others and show the process of changing." Finally, three student responses were coded in the not open to change theme, "I do not think there is anything my professor could do that can convince me to study any differently than I am doing now;" "I don't know if there is anything that you can do. I tend to procrastinate a lot, so come the week before the test I make a Quizlet and rewrite notes, then I usually wait two days before the exam and study. I usually end up pulling an all-nighter before the exam. I know it's not healthy but I make A's [sic] on the exams so it seems to work;" and "It is easier for me to just reread the notes and then try to memorize."

The 35 post-test responses were divided into two categories depending upon whether students responded to the question about using successive relearning to study for the exam or the question about not using successive relearning to study for the exam. Nineteen students (54.3 percent) reported using successive relearning. Three themes emerged from their responses: 1) personal achievement (n = 9, 47.4 percent), 2) in-class guidance (n = 7, 36.8 percent), and 3) open to new strategies (n = 3, 15.8 percent). Examples of the personal achievement theme included, "I have used this method before and it is the most beneficial for me. It allows for more mastery of the material and more time to actually learn and understand;" "I used it because it allowed me to allocate time to study and to rest, allowing me to not overwork myself while also studying more effectively;" and "It was close to the method I already used to study, it just seemed more perfected/organized." Examples of the in-class guidance theme included, "I chose this method because it helped me to remember the components of DAP in class, which in turn, helped me realize that it would likely be a successful study strategy;" "[Instructor] explaining test results after showing us the successive relearning model convinced me and made me choose to check it out;" and "I heard about it in class and decided it was a good method to try for the way that I learn." Finally, three student responses were coded in the open to new strategies theme, "I barely used it, which is my fault, but I am determined now to use it and study ahead of time;" "I wanted to do well because this class is hard;" and "I wanted to ensure I could grasp the material I was learning on a day-to-day basis."

Sixteen students (45.7 percent) reported not using successive relearning. It should be noted first that most students who answered this question did not address the second part of the question about what the instructor could do to convince them to try it. Three themes emerged from the student responses: 1) not open to change (n = 8, 50.0 percent), 2) time concerns (n = 7, 43.8 percent), and

3) research and proof (n =1, 6.3 percent). Examples of the not open to change theme included, "I chose the study method that helps me the most. I don't think you could do anything because my method is similar and usually successful;" "It's hard for me to try a new way of studying. I'm always afraid of wasting time on something that is ineffective when I can just study the ways that I know will work;" and "There was probably nothing he could do to convince me because I start to study at the last minute." Examples of the time concerns theme included, "I just did not have the time to use it with my schedule," "I had a lot of homework so I got it all out of the way and started studying for this test the weekend before, and I find that I do better when I put myself in a time crunch;" and "I just did not have time to spend that many days studying." The research and proof response was, "The instructor should tell people consequences of not using the plan or not studying in general to get more students motivated."

Further analysis was conducted on the subset of 12 students who completed both the pre-test and post-test and reported not using successive relearning. Seven of these students (58.3 percent) demonstrated a particularly interesting pattern. At pre-test, these students indicated that for the instructor to convince them to use a new study method, the instructor would need to provide evidence of the effectiveness of the method and/or a classroom demonstration of its effectiveness (i.e., exactly what the protocol in this investigation did), yet at post-test, these students reported not using the successive relearning method that was demonstrated. Four of these seven students reported that the reason they did not use the successive relearning method was because they procrastinated or otherwise had insufficient time to use it (time concerns). Two of the seven reported that they preferred to use their existing study strategies (not open to change). The remaining student was both the research and proof student.

## DISCUSSION

This mixed-methods project sought to explore the effect of a pedagogical intervention on student self-reported study strategies for learning course material as well as actual student learning of the course material. It also sought to partner meaningfully with students—both students enrolled in the course and the student co-inquirer—as critical stakeholders in their own learning for the improvement of the teaching and learning environment. The prior literature suggested that students needed instructor scaffolding and repeated practice using successive relearning, not just information on its effectiveness, if students were to adopt successive relearning as a study strategy (Dembo and Seli 2004; Dunlosky and Rawson 2015; Hattie et al. 1996; Rodriguez et al. 2018). The results of the quantitative analyses addressing the first four research questions in this project suggest that instructor scaffolding and repeated practice may not be enough, at least in the way they were operationalized and executed in this project. Students reported no increase in their use of successive relearning study behaviors after the classroom demonstration nor any decrease in their use of less effective study behaviors. Further, although students did report a substantial increase in their confidence in their ability to recall a specific course concept after the demonstration, the actual absolute increase in correct recall of that concept was quite small and certainly below mastery of the concept. In fact, the classroom demonstration may have done more harm than good in so far as it may have given students a false sense of confidence in their understanding of the course material.

Although "null" results are sometimes considered to be of little scholarly value, in this instance, there are four specific reasons why they are noteworthy: 1) although the prior literature recommends

instructors scaffold successive relearning and give students repeated practice with using it, there does not appear to be any prior evaluation of actually doing so in that literature and this investigation directly assesses the effectiveness of that approach, 2) the evidence from this investigation suggests that the recommended approach might actually be harmful in so far as it appears to boost false confidence in understanding of the material (i.e., giving students "illusions of competence," Karpicke, Butler, and Roediger 2009), 3) as Hattie (2009) has noted, nearly 95 percent of educational interventions have a significant influence on student achievement, so null results are actually quite unusual and may suggest unique future research directions for the phenomena under study, and 4) the fact that the approach recommended in the literature failed to yield the expected results suggests that scholars are missing something about what will get students to adopt successive relearning and we need to partner with students better to understand what the barriers are.

In anticipation of that last possibility, this project did attempt to partner with students by asking them directly what they thought an instructor would need to do in order to convince them to use a new study strategy (i.e., the fifth research question). This data turned out to be the most insightful of the project. Among the most encouraging findings was the fact that at pre-test, only four percent of students said that nothing could change their study habits, suggesting that nearly all students were open to learning about more effective ways to study. Further, at pre-test, 88 percent of students said that what would convince them to adopt a new method was in-class guidance (e.g., scaffolding and repeated practice) or research and proof of effectiveness, which is consistent with the recommendations from the literature. Additionally, at post-test, over one-third of the students who used successive relearning said they chose to use it because of the in-class guidance they had received. This data suggests that the scaffolding and repeated practice approach used in this investigation is not without merit, but it may not be effective enough to overcome significant barriers to change that students confront.

Further evidence that students may encounter significant barriers to adopting successive relearning can be found in the explanations given by the 58 percent of students who did not use successive relearning despite getting exactly what they said at pre-test would convince them to use it. The majority of these students listed procrastination and time management issues as their reason for not using successive relearning. As noted by Robles and Roberson (2014), three-quarters of students report doing "a good bit" or more of their studying for an exam during the last two days or fewer before that exam. Although the in-class scaffolding in this project was designed to help students develop a study plan to prevent procrastination-related barriers to using successive relearning, as recommended by the literature (Dunlosky and Rawson 2015), it clearly was not effective in overcoming that barrier. This finding is not dissimilar to that of Oreopoulos and Petronijevic (2019), who reported that interventions designed to make students realize that more effort is needed to get higher grades did not result in more study hours per week or even a reduction in the amount by which students studied less than they had originally planned to. Instead, their intervention caused students to adjust their grade expectations downward to reflect their current level of effort. Contrary to common assertions that students "don't have time" to spend more hours studying because of work or other obligations, time-use surveys reveal that many students spend substantial amounts of time in socializing and recreation and are *choosing* not to spend that time studying (Oreopoulos et al. 2019). More intense interventions may be required to get students to choose to make the large changes in study habits that are required to improve student performance (Oreopoulos et al. 2019).

**Reflective critique**

This project was not without significant limitations. First, the final sample size was relatively small, limiting statistical power to detect small-but-significant quantitative effects. Second, the recruitment methodology had to be changed twice because of low response rates, although these changes did provide valuable insight into the effectiveness of different recruitment approaches. Third, the pre-test/post-test design used, though adapted from prior research (Blasiman, Dunlosky, and Rawson 2017), only allowed for comparisons between pre-test self-reported *planned* study behaviors and post-test self-reported *actual* study behaviors, so it could only provide indirect evidence to answer the first two research questions. Stronger evidence could be obtained by comparing two, self-reported, actual study behaviors assessments after separate exams, with the successive relearning intervention taught after the first exam and assessment. Additionally, investigating the extent to which students used (or did not use) successive relearning on subsequent exams in a course could yield insight into the longer-term effects of the intervention. Fourth, because students remained anonymous for this data collection, it was not possible to triangulate their answers on the pre-test/post-test assessments of DAP knowledge with their exam answers over that content. Future investigations that could triangulate that data, especially in comparison to students who did not receive the successive relearning intervention, could provide stronger evidence.

Fifth, one reviewer pointed out that the use of the word "realistically" in the measures may have influenced students' responses in a potentially biasing fashion. The measures used in this investigation were adapted from existing measures to facilitate comparisons, and as such, we retained the same language as much as possible. Although we do not have data to evaluate the possibility that such language could bias student responses, we acknowledge that it may be possible.

Finally, one reviewer suggested we use the qualitative data to make recommendations for instructors and/or hypotheses for future research including what instructors should do to help students use effective study techniques and what other SoTL scholars should examine in future projects. As the authors, we believe that the most important thing we have learned from this project is the humility to recognize that existing scholarship seems to be "missing something" about what would help students to adopt these techniques. We know that teaching students about the benefits of more effective study methods is insufficient (Rodriguez et al. 2018). Our project suggests that scaffolding such study methods (Dunlosky and Rawson 2015) in addition to sharing information about their effectiveness, may also be insufficient. Prior work on "nudging" suggests that student study behaviors may be remarkably resistant to change (Oreopoulos et al. 2019; Oreopoulos and Petronijevic 2019), and that a possible culprit is procrastination (Beattie, Laliberté, and Oreopoulos 2018; Blasiman, Dunlosky, and Rawson 2017; Morehead, Rhodes, and DeLozier 2016), which is consistent with our findings. However, we do not know conclusively that procrastination is the major barrier, nor do we know what kind of intervention would be necessary to overcome it if it were. In this investigation, for the post-test question that asked students, "If you did not use successive relearning to study for the first exam, please explain why you chose not to do so and what the instructor could have done to convince you to try it," most students who answered this question did not address the second part about what the instructor could do, yielding no real insight into what these students thought might be more effective in getting them to adopt successive relearning. Although it is possible that these students really had no thoughts on what might be more effective, it's also possible that if this question were asked in interviews or focus groups—

especially if conducted by fellow students who were co-inquirers in the project—that students might be able to offer some insight into alternative methods that might convince them to try successive relearning (or overcome procrastination if that is the barrier). For future research, we encourage SoTL scholars to try to engage in meaningful partnership with students, both as co-inquirers and as "participants," to explore these issues mutually.

**Student reflection on co-inquiry**

As Felten (2013) notes, good practice in SoTL, "requires engaging students in the inquiry process" (p. 123). The SoTL literature has also suggested that "student collaborators' own learning from the process" of co-inquiring in collaborative faculty-student projects be documented when the scholarship is made public (Maurer 2017, 5). To that end, what follows is a reflection of the second author, and undergraduate student co-inquirer, on her learning from the process.

Collaborating on this project allowed me to develop an improved understanding of the research process. I gained first-hand experience with the development of research questions, the preparation of a methodological design, and the presentation of findings across a variety of mediums. I also developed strong critical thinking skills as I independently learned how to utilize NVivo to code the qualitative data for our project. This learning process also strengthened my ability to organize and to understand incoming data in light of existing research. Thus, I gained a better understanding of how to read and use the current literature, which will allow me to continue to ask more questions and to strive for a better understanding of the work being done in my field. Furthermore, I improved my ability to present and communicate research findings greatly. I now understand that an effective presentation involves pulling from the existing literature to both enhance and support the information collected in a current project. As an example, one presentation of this project led to a near-collaboration with the First Year Experience Office at our university. To improve student learning outcomes, we planned to include the successive relearning study strategy alongside some of the methodological components of our project. Thus, my increased ability to communicate this study design and its results led me to ask more application-based questions about the project. Most importantly, I learned the importance of maintaining an open mind amid unforeseen circumstances. I clearly understand that all stages of the research process require one to think critically and to prepare to adapt for what could come next.

**Faculty reflection on co-inquiry**

During the review process a suggestion was made that the faculty researcher/instructor also reflect on the co-inquiry to add balance to the student reflection and to offer an exemplar of how to work in collaboration and as partners. I am delighted to have the opportunity to do so. Without a doubt, the most meaningful thing I learned from this collaboration is just how much more we stand to learn from SoTL projects that are conducted in partnership with students. The way I as a course instructor with decades of teaching experience would have read, interpreted, and organized the students' responses to the open-ended questions would have been very different from the way the undergraduate co-inquirer did. I am not sure that my analyses would have even identified the same barriers to getting students to adopt successive relearning and that insight into students' study habits was one of the most important takeaways for this project, both for this manuscript and for my teaching. For example, I am not confident that I would have seen the same distinctions between the "not open to change" and "time concerns" themes with the level of granularity that my co-inquirer did.

Additionally, the frequent exchange of ideas between the undergraduate co-inquirer and me, both about the data and its implications and about future SoTL projects to explore this further, enriched not only my scholarship, but also my teaching. None of this would have been possible without the humility to recognize that students see and know things that I not only do not, but cannot, and that if I truly care about their learning, I need to invite them more fully into the teaching and learning process in ways that are new, different, and even frequently uncomfortable for me. I have engaged in a number of projects with student co-inquirers before, but this is the one where I finally learned to be comfortable with that discomfort.

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## ETHICS

The research was approved by the Georgia Southern University Institutional Review Board (IRB). Participation was voluntary and all students consented to participate.

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