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Challenges of Shaping Student Study Strategies for Success: Replication and Extension

ABSTRACT

We replicated and extended Maurer and Shipp's (2021) intervention to teach students the successive relearning study strategy and encourage its use in preparation for course exams. This mixed-methods project was conducted in partnership between the faculty member teaching the course and an undergraduate student enrolled in the course. Results were similar to those reported by Maurer and Shipp (2021) but differed in meaningful ways. In this investigation, students reported more spaced practice in studying for the exam, demonstrated both greater confidence and greater mastery of the targeted course concept and closer alignment of confidence and mastery. They also reported greater unprompted metacognitive awareness of their own need to learn better study strategies. Qualitative responses from students aligned with the recommendation from SoTL literature that interventions to teach students to adopt more effective study methods need to both provide information and research evidence about more effective methods to students. The responses also aligned with the recommendation from SoTL literature to scaffold students through how to use the methods with opportunities to practice them. Time management issues emerged as the largest student-identified barrier to adopting successive relearning.

KEYWORDS

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

INTRODUCTION

This project uses a mixed-methods (though more quantitatively-oriented) approach to further explore the effect of an in-class intervention to teach undergraduate students more effective study skills. The intervention's impact was determined through students' self-reported study strategies and students' learning of foundational course material. It is a replication and extension of Maurer and Shipp's (2021) investigation and similarly asks a "What works?" question in Hutchings' (2000) typology in meaningful partnership with students (Felten et al. 2013; Werder, Thibou and Kaufer 2012).

Scholars of SoTL and learning science have been prolific in their investigations of the effectiveness of students' study strategies, students' beliefs about the effectiveness of different strategies, and students' use (or lack thereof) of specific strategies. Generally speaking, this research has consistently classified students' study strategies into high-utility, moderate-utility, and low-utility categories, with recall-based retrieval practice (e.g., self-testing) and spaced practice (e.g., across multiple days) among the most consistently effective strategies and re-reading or highlighting among the least effective on direct assessments of learning (Brown-Kramer 2021; Dunlosky and Rawson 2015). The combination of retrieval practice and spaced practice, known as successive relearning, appears to be

especially effective (Dunlosky and O'Brien 2020; Hartwig and Malain 2022; Rawson, Dunlosky and Sciartelli 2013). However, this research has also established a widespread misperception among students that the highest-utility strategies are ineffective and the lowest-utility strategies are the most effective (Morehead, Rhodes and DeLozier 2016; Persky and Hudson 2016). Correspondingly, students frequently self-report significant use of the lowest-utility strategies and less use of the highest-utility strategies (Hora and Oleson 2017; Persky 2018).

The ability to recall needed information (e.g., foundational knowledge) is a prerequisite for other forms of learning and higher-order skills like application, analysis, and synthesis (Brown, Roediger, and McDaniel 2014; Sternberg, Grigorenko, and Zhang 2008), so helping students to study more effectively is an important goal in higher education. Interventions designed to change students' study behaviors have met mixed success, and effecting significant long-term change in students' study behaviors can be exceptionally difficult (Oreopoulos et al. 2019; Oreopoulos and Petronijevic 2019). Prior literature has documented that simply educating students about the benefits of more effective study methods to correct their misperceptions is insufficient to change their behavior and that scaffolding on how to use the methods and repeated opportunities to practice them are required (Dunlosky and O'Brien 2020; Dunlosky and Rawson 2015; Rodriguez et al. 2018). Multiple recent assessments of interventions that simultaneously focused on both retrieval practice and spaced practice have consistently shown that despite the method of intervention, students are more likely to adopt retrieval practice methods than spaced practice methods (Brown-Kramer 2021; Brown-Kramer 2022; McCabe et al. 2021; Rowell, Frey, and Walk-Shannon 2021). Difficulties with time management have been identified by students as a major barrier to using high-utility strategies in general (Beattie, Laliberté, and Oreopoulos 2018; Biwer et al. 2020; Blasiman, Dunlosky, and Rawson 2017). This would disproportionately affect the use of spaced practice and successive relearning, as both require time management skills to schedule and adhere to relearning sessions (Dunlosky and O'Brien 2020). Indeed, this is precisely what Maurer and Shipp (2021) uncovered in their investigation: when shown research on and a classroom demonstration of successive relearning's effectiveness, a majority of students who previously reported that they would be willing to adopt successive relearning if they were shown such research and/or a classroom demonstration still did not adopt successive relearning to study for the first exam, because they procrastinated or otherwise did not manage their time effectively enough to have time to use it.

However, Maurer and Shipp (2021) used a design from the literature (Blasiman et al. 2017) that compared pretest self-reported planned study behaviors and posttest self-reported actual study behaviors, so their findings could not speak to changes in study behaviors from one exam to the next as a result of their successive relearning intervention. This is an important distinction because the most common metacognitive problem for students is overconfidence and students typically expect to perform much better on exams than they actually do (Carpenter, Witherby, and Tauber 2020). That overconfidence could be challenged by poor performance on the first exam and create conditions motivating students to be more responsive to an intervention in preparation for a second exam than a first exam. It is that possibility that this replication and extension project will explore. Because SoTL is highly contextual (Friberg 2018), replications and extensions that can use very similar contexts when exploring intervention differences are extremely important. As such, the material selected to be learned for the classroom demonstration in this project was the same as that used in Maurer and Shipp's (2021) investigation: Developmentally Appropriate Practices [DAP]. This is a foundational concept in the

course selected, as it was for Maurer and Shipp (2021), but the concept has been revised since their investigation (National Association for the Education of Young Children 2022). A person fluent in the revised concept could succinctly list the three core considerations clearly at a conversational pace in five seconds.

Consistent with Felten's (2013, 123) guidelines that good practice in SoTL, "requires engaging students in the inquiry process," and with Maurer and Shipp's (2021) approach, this project attempted to meaningfully partner with students in two ways. First, it explicitly asks students pre-intervention what instructors would need to do to convince them to adopt new study strategies and subsequently post-intervention to identify why they did or did not adopt the demonstrated successive relearning strategy. Bringing student voices forward in this way is essential to exploring how students understand the issues involved. Second, the project is conducted as a collaboration between the faculty member teaching the course (Maurer) and an undergraduate student enrolled in the course (Cabay), with the student conducting all qualitative analyses of student responses and co-writing this manuscript.

Research questions

Because this replication and extension involves changes to the experimental design used by Maurer and Shipp (2021) as detailed above, we did not formulate specific hypotheses. Instead, we asked three research questions:

After a classroom demonstration of successive relearning's effectiveness as a study strategy for the course material, to what extent will students,

1. Change their study strategies for the next exam?
2. Demonstrate an increase in confidence and accuracy in their ability to recall the specific course concept used in the classroom demonstration? and
3. What do students say influences their choices to adopt more effective study strategies?

METHOD

Participant selection

This investigation received exempt approval from the Institutional Review Board (IRB). Students in two sections of an introductory child development course taught by Maurer were invited to participate in the research. Each section was taught in a different semester during the same academic year but was otherwise identical in content and delivery. Students were invited to participate in the study by the instructor during a class period approximately one week after the first exam. The instructor distributed copies of the questionnaire to all students in the class and explicitly instructed them that participation was optional and anonymous. The instructor announced that any student who did not wish to participate could work on other tasks quietly during the administration 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. After 10 minutes, the instructor returned to the room, collected the envelope, and began the successive relearning demonstration described below.

Sample and context

This research was conducted at a multi-campus public university that is classified as an R2 in the Carnegie classification system (American Council on Education 2022). It is located in the southeastern United States with an enrollment of approximately 27,000 students. A total of 90 students were enrolled in the course, 45 each semester. Of those 90 students, 72 (80.0%) provided quantitative data at either pretest, posttest, or both: 42 (46.7%) provided data at both pretest and posttest, 22 (24.4%) provided data at pretest only, and eight (8.9%) provided data at posttest only. However, one of the students did not answer most of the quantitative questions at pretest and was dropped from the quantitative analyses (final N = 41). A total of 70 (77.8%) students provided qualitative data: 33 (36.7%) provided both pretest and posttest responses, 29 (32.3%) provided responses only at pretest, and eight (8.8%) provided responses only at posttest. All student responses were included in the qualitative analyses. Demographic information about participants was not collected in order to facilitate anonymity. The enrollment in this course is typically majority female, "traditional age" (i.e., 18–24 years old), and White.

Both the first and second exam in this course contained 50 multiple choice questions. Both exams contained a mixture of factual, conceptual, theoretical, and applied questions, and they covered approximately the same amount of content.

Measure

The instrument used in this investigation was adapted from Maurer and Shipp (2021). The questions were reframed from asking prospectively about plans to study for the first exam and then retrospectively about actual studying for the first exam to retrospectively about studying for the first and second exams to align with the different design of this investigation. Both exams were equally weighted (20% of final course grade each). The data was kept anonymous but linkable by having participants create a unique ID from a combination of the last four digits of their phone number and birth month.

The pretest questionnaire contained seven questions, most of which were related to the first exam: 1) how many days prior to the exam they began studying for the exam, 2) the total number of different days on which they studied for the exam, 3) the total time in minutes that they spent on each of nine different study strategies (e.g., rereading the textbook) when preparing for the exam, 4) the total time in minutes they spent on successive relearning (definition provided) in studying for the exam, 5) their confidence that they could correctly list the three core considerations of DAP, 6) their actual ability to list the three core considerations of DAP, and 7) "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?"

The posttest contained eight questions. The first six questions were the same as those on the pretest, except that questions 1–4 referenced the second exam. The last two questions read, "Answer the question below that applies to you:" 7) "If you used successive relearning to study for the last 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 8) "If you did not use successive relearning to study for the last 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 at the start of a class period approximately one week after the first exam. This administration time was selected instead of immediately after the exam (to ensure all students had time to complete the measures and to help protect anonymity) and instead of the class period after the exam because of anticipated higher absenteeism that period (Maurer et al. 2009). After completion of the pretest questionnaires, the instructor began a successive relearning classroom demonstration process that continued for four class periods, similar to that used by Maurer and Shipp (2021). In this project, students had already been introduced to the three core considerations of DAP in the first unit of the course, and that material was covered on the first exam. Instead, the demonstration began with the first self-assessment, asking students to recall from memory on a blank sheet of paper the three core considerations of DAP. As in Maurer and Shipp (2021), the instructor next reviewed the three core considerations and told students not to change what they had written on their papers. However, students were encouraged to note any of the items they had missed and what the correct answers were next to their responses. Students were then instructed to fold the paper in half, put it away, and keep it for future class periods. For the next three class periods, after the scheduled start of class quiz over the assigned daily readings, the instructor repeated this assessment and follow-up. In the fourth period, the instructor then asked each student to compare and contrast their own answers for each of the four class periods silently. This individual reflective work was followed by a class discussion of how students' answers changed and what they thought caused that change, including attention to student confidence in their knowledge of the material, the increasing speed and ease of recalling it, and their perceived likelihood of retaining this material long term.

Next, the instructor introduced research on successive relearning and explained how the demonstration was successive relearning in practice. This presentation included Dunlosky and O'Brien's (2020) figure illustrating the successive relearning study cycle, how to apply the method to studying for the upcoming exam (including how to adapt existing self-testing methods like flashcards), and research on the ineffectiveness of other common study methods like rereading. The instructor also spoke about the importance of creating a study schedule now, far in advance of the exam, so that students could ensure that procrastination would not prevent them from having enough time to use successive relearning. Approximately one week after the second exam, students completed the posttest questionnaire.

RESULTS

Analytic strategy

All data was entered by Cabay. Initial data cleaning revealed that one student listed more days of studying than were possible given the number of days before the exam that they said they started studying, so we coded the number of days studying as missing for that participant. In cases where students listed a range in their response (e.g., 30–60 minutes), we chose to consistently record the lower number in the range reported.

Data about all non-successive relearning methods was summed to preserve statistical power and facilitate comparisons to successive relearning (hereafter referred to as "non-successive relearning study times"). Significant skewness and kurtosis was present for most project variables (see Table 1). We examined the Mahalanobis distance for each student to determine if any outliers needed to be dropped, but none met the threshold for exclusion at the $p < .001$ level. We selected the Wilcoxon Signed-Ranks

test for the analyses because of the significant deviations from normality in the data. To maintain a conservative estimate, effect sizes were calculated using the simple difference formula (Kerby 2014) counting scores of zero (i.e., no change from pretest to posttest) as unfavorable outcomes.

Quantitative analyses: Research questions 1 and 2

Wilcoxon Signed-Ranks analyses revealed no change from pretest to posttest in students' non-successive relearning study times, $Z = -0.87$, *ns*, successive relearning study times, $Z = -0.21$, *ns*, or total number of study days, $Z = -0.97$, *ns*. However, the number of days before the exam that students started studying did increase from pretest to posttest, $Z = -.298$, $p < .01$, $r = 0.34$. Students' confidence in their ability to correctly list the three core considerations of DAP also increased significantly, $Z = -5.04$, $p = 0.000$, $r = 0.90$. Students' answers to the question about the core considerations of DAP were scored by the second author on a scale from 0–3, with a score of three representing correctly listing all three core considerations. Analyses indicated significant improvement from pretest to posttest in students' knowledge of DAP, $Z = -5.18$, $p = 0.000$, $r = 0.87$. At the pretest, 78% of students were unable to list even one core consideration of DAP and only 12% were able to correctly list all three. At the posttest, only 10% of students were unable to list even one core consideration and 78% were able to correctly list all three.

Qualitative analyses: Research question 3

Student responses to the three open-ended questions about successive relearning were coded by the second author. Cabay was selected for coding both because as an undergraduate student currently enrolled in the course, it was anticipated that she might view and interpret the student responses in a more authentic way than Maurer (the course instructor) and for consistency with Maurer and Shipp's (2021) approach.[1] Participating in the intervention as a student in the course gave her an emic perspective on the intervention: she could better understand the perspective of her peers and more accurately identify certain language cues, thus promoting validity. Students' perspectives broaden the diversity of experiences brought to the inquiry (Felten et al. 2013) and can help minimize overlooked factors, especially with replications (Maurer et al. 2021)

Cabay used an inductive content analysis approach to identify emergent themes for each question (Patton 2002), facilitated by NVivo software. After the first round of coding, the authors discussed the second author's initial codes, including conceptualizations of each code and rationale for assigning selected responses to particular codes. Cabay subsequently refined the initial codes and completed the qualitative analyses.

Table 1. Descriptive statistics for variables

								Skewness		Kurtosis	
Variable		N	M	SD	Median	Minimum	Maximum	Statistic	SE	Statistic	SE
Non-successive relearning minutes		40									
	Pre		462.2	963.7	225	12	6,060	5.21	0.4	29.98	0.7
	Post		443.9	578.5	270	7	2,940	2.94	0.4	9.8	0.7
Successive relearning minutes		41									
	Pre		50.68	87.45	10	0	420	2.76	0.7	8.47	0.7
	Post		41.73	61.03	10	0	210	1.63	0.4	1.65	0.7
Days before exam		40									
	Pre		3.9	2.46	3	1	14	1.99	0.4	5.98	0.7
	Post		5.12	2.93	4	1	14	0.88	0.4	0.69	0.7
Total days studying		40									
	Pre		4.03	2.51	3.5	1	12	1.58	0.4	2.31	0.7
	Post		4.2	2.75	3	1	14	1.61	0.4	3.12	0.7
Confidence %		40									
	Pre		25.44	35.36	1	0	100	1.11	0.4	-0.24	0.7
	Post		84.38	30.28	100	0	100	-1.91	0.4	2.39	0.7
DAP score		41									
	Pre		0.54	1.08	0	0	3	1.68	0.4	1.13	0.7
	Post		2.51	1	3	0	3	-1.83	0.4	1.84	0.7

A total of 70 students provided qualitative data: 33 provided both pretest and posttest responses, 29 provided responses only at the pretest, and eight provided responses only at the posttest. Responses were typically a single sentence and nine responses received more than one code. On the posttest questionnaire, one student wrote a response to the question about why they did not use successive relearning in the wrong space on the questionnaire; the response was coded for the correct question. Three students answered both the question about using successive relearning and the question about not using successive relearning on the posttest questionnaire; those were coded as one answer to one of the questions, which was decided by the perceived intention of the student.

The 62 pretest responses to the question about what the course instructor would need to do to convince students to adopt a new study strategy yielded seven themes: a) explain or example, b) evidence or proof, c) awareness of problem, d) better than current method, e) eagerness to try, f) unwilling, and g) did not respond to prompt (see Table 2). Three responses were coded into two themes; all three were coded as both evidence or proof and explain or example.

Table 2. Themes from pretest responses

Theme	N	%	Exemplar quotation
Explain or example	27	41.5	Tell me about it/give me a demonstration so I understand how to use it
Evidence or proof	18	27.7	The professor would have to show me statistics that show me the effectiveness of that strategy
Awareness of problem	10	15.4	I'm open to new ways of studying because mine now aren't too efficient so just telling me how would be enough
Better than current method	4	6.2	Point out the flaws in current study methods
Eagerness to try	3	4.6	I don't know if the course instructor could say anything to convince me because I am eager to try new study skills
Unwilling	2	3.1	Nothing
Didn't respond to prompt	1	1.5	Maybe rewriting my notes, and study more with others

Note. Percentages reflect the percentage of total codes (N = 65), not the percentage of responses (N = 62).

The 41 posttest 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. Fifteen students (36.6%) reported using successive relearning to study for the second exam. Six themes emerged from their responses about why they chose to use it: a) results from demonstration, b) awareness of problem, c) efficiency, d) why not, e) did not respond to prompt, and f) results from literature (see Table 3). One response was coded into two themes: awareness of problem and results from demonstration. Twenty-six students (63.4%) reported not using successive relearning to study for the second exam. Nine themes emerged from their responses: a) time management, b) used other methods, c) awareness of problem, d) forgot method, e) did not respond to prompt, f) ineffective demonstration, g) unwilling, h) evidence or proof, and i) partial method use (see Table 3). Five responses were coded into two themes: two were coded as both time management and used other methods; one was coded time management and awareness of problem; one was coded unwilling and evidence or proof; and one was coded used other methods and ineffective demonstration.

Table 3. Themes from posttest responses

Used successive relearning (N = 15)

Theme name	N	%	Exemplar quotation
Results from demonstration	6	37.5	Going through DAP with successive relearning convinced me that this method really helps to internalize and truly learn material. So, I used it to study material and concepts that I struggled with for the exam
Awareness of problem	3	18.8	I used successive relearning because usually I remember information for the test then forget it, and that is not beneficial to my overall learning. I decided to try it because of the discussion we had in class
Efficiency	2	12.5	I chose to do it so I would be able to recall info[rmation] faster plus correctly
Why not	2	12.5	I thought I would give it a try, I figured it couldn't hurt.
Did not respond to prompt	2	12.5	I felt like quizzing myself over the material was the best way to figure out if I really understood the material
Results from literature	1	6.3	Because the studies to back it up showed improved knowledge and test scores

Did not use successive relearning (N = 26)			
Theme name	N	%	Exemplar quotation
Time management	13	41.9	It's not that [instructor] wasn't convincing enough. I just didn't manage my time correctly at all and put other priorities over my biggest. I would definitely try successive learning, just not on a night I'm cramming for an exam. That would need to be planned
Used other methods	7	22.6	I did not use it because I have realized that studying with a friend and memorizing has helped me best when it comes to studying. I don't know what could help convince me to use this relearning way
Awareness of problem	2	6.5	I procrastinate and do not have the self-motivation or discipline to do that much studying or put that much effort or time into studying
Forgot method	2	6.5	I forgot about the study method
Did not respond to prompt	2	6.5	I haven't tried it yet
Ineffective demonstration	2	6.5	It did not help me memorize in class
Unwilling	1	3.2	I didn't use it because I usually don't study at all anyway
Evidence or proof	1	3.2	The instructor could have shown me how it benefited a lot of others
Partial method use	1	3.2	I did not do successive relearning for all of the chapter but for a little bit of time I used it on the concepts I was really struggling with just to try something new

Further analysis was conducted on the subset of 12 students who completed both the pretest question about what the course instructor would need to do to convince students to adopt a new study strategy and the posttest question about not using successive relearning. Seven of these students at pretest indicated that they could be convinced through either an explanation or example of the new strategy or evidence or proof of the new strategy's effectiveness (i.e., the designed intervention in this project). However, five (71%) of those seven students at posttest identified time management as the reason they did not adopt successive relearning. This was a higher percentage of students who attributed their failure to adopt the method to time management than Maurer and Shipp (2021) reported (57%).

DISCUSSION

This project used a mixed-methods approach to replicate and extend Maurer and Shipp's (2021) research on the effectiveness of an in-class intervention to teach undergraduate students more effective study skills on students' self-reported study strategies and learning. In contrast to Maurer and Shipp's investigation, the current project assessed changes in study behaviors from the first course exam to the next. Although some similarities in the results between the two studies emerged, there were notable significant differences that offer additional insight into the effectiveness of such interventions.

The results of our quantitative analyses addressing research questions 1 and 2 suggest that the intervention was successful in some respects but less so in others. Students' self-reported use of successive relearning study behaviors, less effective study behaviors, and total days spent preparing for the exam were virtually unchanged from the first to second exam. However, students on average began studying for the second exam one day earlier than the first exam. Studying for an exam one day earlier may not seem like a particularly meaningful result, but given that students began studying for the first exam less than four days before that exam, this difference reflects a more than 30% increase for the second exam. Further, getting students to use more spaced practice, which is what this change suggests, has been one of, if not the most difficult challenges identified in the literature (Brown-Kramer 2021; Brown-Kramer 2022; Dunlosky and O'Brien 2020; McCabe et al. 2021; Rowell, Frey, and Walk-Shannon 2021). This also importantly extends the work from Maurer and Shipp's (2021) investigation, because although they collected data about total days studying and when students started studying, they dropped it from analyses because of insufficient statistical power. The result obtained here offers a glimmer of hope that it may yet be possible to get students to adopt more spaced practice in their studying, and spaced practice is profoundly powerful in boosting learning gains (Brown-Kramer 2021; Dunlosky and Rawson 2015). In addition to the importance of the ability to recall foundational knowledge in its own right in higher education contexts, that ability is required for other forms of learning and higher-order skills (Brown, Roediger, and McDaniell 2014; Sternberg, Grigorenko, and Zhang 2008), so helping students to learn to recall information more effectively could have cascading positive consequences.

Also in contrast to the results from Maurer and Shipp (2021), from pretest to posttest, students demonstrated a greater confidence in their ability to recall the three core considerations of DAP as well as an actual increase in their demonstrated ability to recall those concepts. Maurer and Shipp (2021) reported a significant increase in both; however, there were meaningful differences between these two investigations. In Maurer and Shipp (2021) at posttest, the average confidence was 58% and the average score was 17%. In this investigation at posttest, the average confidence was 84% and the average score was 84%. There are two important factors to note about these differences: a) in the current investigation, there was much closer alignment between student confidence and student demonstrated mastery in contrast to the false confidence observed in Maurer and Shipp (2021); and b) there were important contextual differences between the two investigations that caution against overinterpreting these differences. This investigation began the pretest after the first exam, meaning after students had initially been taught about and assessed on their knowledge of DAP; in Maurer and Shipp, the pretest was conducted before the content was taught. Further, the concept of DAP was revised after Maurer and Shipp's (2021) investigation but before the current one (National Association for the Education of Young Children 2022), and the revised concept significantly reduced the number of words and specific jargon in a way that likely facilitated memorization.

The results of our qualitative analyses addressing research question 3 largely replicated the findings of Maurer and Shipp (2021) but did generate additional insights. When exploring what students say an instructor would need to do in order to convince them to use a new study strategy, 69% of responses were coded as either explain or example, or evidence or proof. This is similar to Maurer and Shipp (2021) who coded nearly 89% of responses as either "in-class guidance," similar to our theme of explain or example, or "research and proof of effectiveness," similar to our theme of evidence or proof. However, a new theme emerged from our data that was not present in Maurer and Shipp (2021): awareness of problem, which constituted 15% of our responses. That more than one in seven student participants in this investigation had the metacognitive awareness to realize on their own that they needed to improve their study skills is noteworthy and represents an incredible opportunity to engage students in meaningful partnership to improve their learning.

Students who used successive relearning to study for the second exam in this investigation reported somewhat different reasons than those identified in Maurer and Shipp (2021). The largest group in this investigation, just over one third, reported being convinced by the results of the in-class demonstration. Although Maurer and Shipp (2021) reported a nearly identical percentage of students who listed the same reason, they had a larger group of nearly half of the students who used the method for reasons of personal achievement (e.g., as a more efficient way to study and master the material). In this investigation, less than 13% of students listed the efficiency of the method as the reason they adopted it. In contrast, one in five students who adopted the method in this investigation reported doing so because of their awareness of their need to use more effective study strategies. Again, this metacognitive awareness is noteworthy in itself and the fact that it emerged at both pretest and posttest only emphasizes its potential as an opportunity to meaningfully partner with students.

Among students who reported not using successive relearning to study for the second exam in this investigation, the largest group (over 40%) identified time management as the reason why. This is nearly identical to Maurer and Shipp's (2021) percentage who reported this reason, but again, they reported an even larger group: half of their respondents were coded as "not open to change" and instead used other study methods. In this investigation, less than 25% of our respondents reported using other study methods instead. We are cautious against overinterpreting differences between the samples. Clearly, time management was a major barrier to adoption of successive relearning for students in both samples. The smaller percentage of students who were less open to change in their study methods in the current sample is at least consistent with those students' awareness of their need to use more effective study skills. Indeed, in our analyses of student responses to this item, almost 7% of respondents were coded into the awareness of problem theme.

Taken together, these results align with the recommendations of the SoTL literature that interventions to teach students to adopt more effective study methods need to both provide information and research evidence about more effective methods to students and they need to scaffold students through how to use these methods with opportunities to practice them (Dunlosky and O'Brien 2020; Dunlosky and Rawson 2015; Rodriguez et al. 2018). In this investigation, as in Maurer and Shipp (2021), overwhelming majorities of students listed exactly those factors when asked what an instructor would need to do in order to convince them to use a new study strategy, and among the students who adopted successive relearning in this investigation, these factors were the most common reason why students reported adopting it. Similarly, time management issues have emerged in the literature as a major barrier to using spaced practice and successive relearning (Biwer et al. 2020; Dunlosky and

O'Brien 2020; Rowell, Frey, and Walk-Shannon 2021), and as with Maurer and Shipp (2021), large percentages of students in this investigation identified time management as the primary obstacle to adopting successive relearning. The quantitative data documenting the relatively small change in the number of days before the exam that students began studying supports students' attribution of difficulty using the method to time management issues. These results give further confidence that these methods for teaching successive relearning to students align with both scholarly recommendations and student preferences, and that time management continues to pose a significant obstacle to the adoption of successive relearning. However, these results also extend that literature by identifying significantly more student metacognitive awareness about their own difficulties with studying than has emerged from that literature, which suggests opportunities for future interventions and research to meaningfully partner with students to improve their own study skills.

Reflective critique

Although this project addressed many of the limitations of Maurer and Shipp's (2021) investigation, there were still notable limitations. Like Maurer and Shipp (2021), the sample size was fairly small for the quantitative analyses, which may have made it difficult to detect small effects. Further, only 41 of the 90 students enrolled in the two course sections completed both the pretest and posttest questionnaires, so it is unknown if the results would be generalizable to the majority of students who missed one or both of those class periods. However, the likelihood that such students also missed one or more of the four days of the intervention is fairly high, so the value of data from such students in understanding the project research questions may already be limited.

Additionally, because the data was collected anonymously, it was not possible to link student data to their performance on graded course assessments, including overall exam performance or specific exam questions about DAP. However, given that 78% of students were unable to list even one of the three core considerations of DAP at pretest, which was approximately one week after the exam that included assessing that knowledge, it is unlikely that significant variance in their exam scores on those questions would have been present.

Reflection on co-inquiry

Student co-inquirers' learning from the collaboration (Maurer 2017) and faculty co-inquirers' learning from the collaboration (Maurer and Shipp 2021) are both important aspects of SoTL scholarship that should be made public as part of the research. Below, each co-inquirer provides their reflections on this scholarly collaboration.

Student co-inquirer reflection

As a research assistant participating in a co-inquirer project with a mentor, my expectations for learning and growing professionally were exceeded. My involvement in this project created lasting skills and improved abilities on many of Willison's Researcher Skill Development Framework facets, as recommended by Maurer (2017). I gained experience with data analysis software, professional writing, oral presentation, and scholarly collaboration. Having both the freedom and the responsibility to create my own schedule provided development in self-motivation and time management. While being guided through many steps in the research process, I cultivated skills in following complex directions and proactively soliciting feedback to improve my skills. On the other hand, independently learning how to

use NVivo allowed increased proficiency in critical thinking and problem solving. Data entry and analysis provided insight into the need to improve and refine my organizational skills, which gave me the opportunity to adapt and progress. As more challenges came to light, I was able to seek guidance while also developing independence. Specifically, I learned statistical terminology, modified my writing style to incorporate discipline-specific language, quickly altered presentations based on audience, implemented note taking in data analysis, and acquired a sense of confidence in my ability to provide unique and valuable insight to a scholarly project. The biggest learning experience within the SoTL process was the solidification of interest in continuing my journey as a student in the field of research and psychology.

Faculty co-inquirer reflection

I have been working with undergraduate research assistants for nearly a quarter-century and each new experience provides me with multiple opportunities to learn. This collaborative co-inquiry was unlike any other I have participated in before. In this case, the student sought me out for a mentored research experience while enrolled in the course where this intervention was taking place. In the past, my concerns about power imbalances and inequities have kept me from considering students in my courses where the SoTL research data is being collected as potential co-inquirers. This experience has encouraged me to reconsider that approach and at least allow for the possibility of such collaborations (with necessary attention to power issues, of course). Additionally, this student co-inquirer has been uniquely gifted in their ability to proactively solicit specific and meaningful feedback from me about their execution of and performance on project tasks. There is an unmistakable focus on learning beyond just performance in every question she has asked me, and this has provided me with unique insight into the teaching and learning process of mentoring that has empowered me to be a significantly better mentor to all future students. It is my privilege to document this new knowledge that has emerged from this project beyond the research questions and I believe it represents the very best of what SoTL, and co-inquiry with students, can accomplish.

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NOTES

1. The second author completed the questionnaires in class, but those questionnaires were not included in the analyses in this project.

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