Desirable Difficulties: Study Strategies and Academic Performance

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Abstract

Using effective study strategies is important, but some of the most effective strategies are more difficult to implement. In the present study, we investigated knowledge and use of spaced studying and self-testing by college students and factors associated with greater use of these strategies. Replicating a previous study on spacing, the study expanded to also assess student knowledge and use of self-testing.

Introduction

In college, effective study strategies are important for academic achievement. Researchers have investigated various study strategies. Two of the most effective strategies are spaced studying and self-testing[1,2]

Spacing effect the increase in memory found when material is learned in several study sessions rather than a single session. The spacing effect suggests that spaced studying—studying in shorter sessions over time—is more effective for long-term memory of information than massed practice, also known as cramming.

Self-testing a study strategy involving retrieval of information from memory. Self-testing might include taking practice tests or using flashcards effectively.

Students may shy away from such strategies because they assume that learning should be easy and yield immediate results.[3] Spaced studying and self-testing require a great deal of effort and are harder to implement than some other strategies, they present desirable difficulties.

Desirably difficult learning strategies learning strategies that "require a significant amount of effort but are advantageous in the long run" [4]

The tendency to evaluate one's study strategies and their effectiveness and make changes when necessary is called studying self-regulation.[5] Learners who engage in studying self-regulation tend to be more successful in their learning and academic achievement. It is likely that these learners use more spaced studying and self-testing.

Susser and McCabe (2013)[4] investigated student knowledge of the spacing effect and use of spacing with different circumstances. As expected, they found that students knew about the spacing effect, but were unlikely to space their studying in realistic settings or for easier exams. They also found an association between self-regulated learning and spaced studying. The present study sought to replicate their findings and extend the investigation to address self-testing.

...effective learning can be fun, it can be rewarding, and it can save time, but it is seldom easy. The most effective cognitive processes involves some effort by the learner...
[3]Bjork, Dunlosky, & Kornell, 2013, p. 436

Research Questions

Spacing:
- Do students know about the spacing effect?
- To what extent do students use spaced study while studying on their own time?
- What critical factors contribute to the decision to space or mass study?
- Are there individual differences in metacognitive self-regulation or use of elaboration strategies that are correlated with use of spaced study?
- Do students who space their practice have a higher GPA?

Self-Testing:
- Do students know about the effect of self-testing?
- To what extent do students use self-testing while studying on their own time?
- What critical factors contribute to the use of self-testing?
- Are there individual differences in metacognitive self-regulation or use of elaboration strategies that are correlated use of self-testing?
- Do students who use self-testing have a higher GPA?

Method

Participants

Ninety-five students completed the study, with 52.6% first year students, 26.3% sophomores, 17.9% juniors and 3.2% senior or other. The majority (75.8%) of the sample was female.

Materials

Knowledge of the spacing and self-testing effects:
To assess knowledge of spacing and self-testing participants were asked if they thought studying in shorter sessions or longer sessions were more effective (for spaced studying) or whether self-testing or rereading was more effective (for self-testing).

Use of spaced studying and self-testing:
Participants were asked to indicate on a 1 (never) to 5 (always) scale their use of a variety of study strategies, including spaced studying and self-testing strategies.

Factors contributing to using spaced studying or self-testing:
Participants were asked to indicate what strategy they would use if there were faced with a difficult test, and an easy test, and when they would be more likely to space or self-testing when faced with a number of scenarios.

Metacognitive self-regulation and elaboration strategy use:
To assess individual differences in metacognitive self-regulation and elaboration use participants filled out a portion of the Motivated Strategies for Learning Questionnaire.[6] Twelve items, such as "When I become confused about something I'm reading, I go back and try to figure it out" were used to assess metacognitive self-regulation. Six items, such as "I try to relate ideas from one course to those in other courses whenever possible" addressed elaboration.

Results & Discussion

- **Do students know about the spacing effect?**

91.6% of students reported spacing was more effective
1.1% reported cramming was more effective
7.4% reported both strategies were equally effective
Students do seem to know about the spacing effect.

- **To what extent do students use spaced study while studying on their own time?**

Study Strategy	Mean use from 1 = never to 5 = always
Distribute studying over multiple session	3.62
Study all material in one session	2.49
Self-test (practice recalling material)	4.39
Make and use flashcards	3.13
Do practice problems	3.43
Reread notes	4.08
Reread textbook	2.34
Reference material to myself	3.79
Make outlines or study guides	3.65
Use mnemonic devices	2.93

When scores on spacing (distributing studying) vs. cramming (all in one session) were compared, participants showed a greater endorsement of engaging in spacing (M = 3.62) than in cramming (M = 2.49), $t(94) = 5.96$, $p < .001$. This suggests that when studying on their own they do space their practice.

- **What critical factors contribute to the decision to space or mass study?**

When preparing for a difficult test 74.7% report spreading out studying (2.1% study all in on session, 23.2% study the same way), while 5.3% report spreading out studying when preparing for an easy test (64.2% study all in on session, 30.5% study the same way).

Factors in the decision to space studying	1 = spread out studying 5 = study in one session
Multiple choice test	3.40
High value of the material for future courses	1.78
Other academic commitments	3.19
Other social commitments	3.03
High confidence in ability to learn material	3.32
Material is interesting	2.41
Heavily weighted test	1.61
A lot of material to learn	1.73

How important a test is for success in the present class and in future learning is related to greater use of spaced studying.

- **Are there individual differences in metacognitive self-regulation or use of elaboration strategies that are correlated with use of spaced study?**

Students with stronger metacognitive self-regulation do seem to use more spaced practice, $r(94) = .36$, $p < .001$, and less massed practice, $r(94) = -.38$, $p < .001$. Those who use more elaboration are also more likely to use more spaced practice, $r(93) = .27$, $p = .01$, and less massed practice, $r(93) = -.21$, $p = .03$.

- **Do students who know spaced practice is an effective strategy have a higher GPA?**

Students reporting using more spaced practice had a higher GPA, $r(93) = .28$, $p = .006$. In contrast, those who reported doing more studying in one session had a lower GPA $r(93) = -.25$, $p = .018$.

- **Do students know about the effect of self-testing?**

65.3% of students reported self-testing was more effective
2.1% reported re-reading material was more effective
28.4% reported both strategies were equally effective
4.2% reported neither strategy is effective
Students do seem to know about the value of self-testing, however, there is a significant minority who believe the strategies are equally effective.

- **To what extent do students use self-testing while studying on their own time?**

When scores on self-testing (general self-testing, use of flashcards and practice problems) vs. rereading (notes and textbooks) were compared, participants showed a greater endorsement of engaging in self-testing (M = 10.95) than in rereading (M = 6.42), $t(94) = 17.95$, $p < .001$.

- **What critical factors contribute to the use of self-testing?**

When preparing for a difficult test 55.8% report self-testing (22.1% spend more time rereading, 22.1% study the same way), while 20.0% report self-testing when preparing for an easy test (15.8% spend more time rereading, 64.2% study the same way).

Factors in the decision to self-test	1 = more likely to self-test 5 = less likely
Multiple choice test	2.04
High value of the material	1.72
Have ample time for studying	2.24
High confidence in ability to learn material	2.77
Material is interesting	2.20
Heavily weighted test	1.45
A lot of material to learn	1.63

As with spacing, students were more likely to engage in self-testing when the material was more important for success in the current and future classes.

- **Are there individual differences in metacognitive self-regulation or use of elaboration strategies that are correlated use of self-testing?**

Students with stronger metacognitive self-regulation do seem to use more self-testing $r(91) = .38$, $p < .001$, however, those who use more elaboration are not more likely to engage in self-testing, $r(90) = .17$, $p = .11$.

- **Do students who know self-testing is an effective strategy have a higher GPA?**

Students reporting using more self-testing had a higher GPA, $r(90) = .22$, $p = .03$. In contrast, re-reading was not associated with GPA $r(90) = -.01$, $p = .93$.