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Study Strategies and Generative Learning: What Works?

One hundred nine college students participated in an experiment that involved reading a passage and responding to a 20-item multiple choice test. The students were randomly assigned to one of four groups. The four conditions involved reading and copying, reading and highlighting, reading and taking notes, and reading and generating questions. Students who generated questions performed better than two of the three other groups on the test. The authors attributed this improved performance to generative learning.

Students use many different strategies when reading and studying text-based material, although some strategies produce better results than others. Strategies that have been investigated include highlighting, underlining, note-taking, generating questions, and using instructor-generated questions. Self-questioning, a form of monitoring strategy, has long been recognized as an effective method for increasing comprehension and learning (Davy & McBride, 1986; Gourney, 1999; King, 1992). A number of researchers have found that when students generate specific questions ahead of time about information they are seeking in a given passage, they learn more than when they respond to questions provided by others (i.e., teachers: Hartman, 1994; Palincsar & Brown, 1984; Paris, Wixson, & Palincsar, 1986). Generating questions prior to reading in a familiar content area has a history of demonstrating increases in motivation and, at times, comprehension.

However, when students are reading about unfamiliar material, at-

tempting the same question generation strategy may be less helpful. Students have more difficulty generating appropriate pre-reading questions when they are unfamiliar with the material. They often generate very narrow questions or questions that don't pertain to what is in the reading selection. Unfortunately, many students who use underlining or highlighting as they read don't actively think about what they are reading—they still read passively. They engage in mindless marking and rarely distinguish important information from unimportant information which leads to little learning and understanding (Long & Long, 1987; Gourney, 1999).

Study strategies that involve student-generated activities have been more effective than passive study strategies. Most question-generation techniques focus on teaching students to generate questions as a pre-reading activity (Gillespie, 1990). We expected that for college students reading unfamiliar material, the strategy of generating questions after a passage is read would be a more successful study strategy based, in part, on experimental findings of the generation effect.

The generation effect is typically found in experimental studies where individuals who cognitively manipulate stimulus material display better retrieval than those who simply read the same material (Foos, Mora, & Tkacz, 1994). Slamecka and Graf (1978) found that students can better retain information that they generate in the form of questions or notes on their own, as compared to information that is only read. Despite further research on the generation effect which demonstrates that many forms of generation are more effective than simply reading (e.g. Dee-Lucas & DiVesta, 1980; Donaldson & Bass, 1980; Nairne & Widner, 1987), little application of the generation effect has been used on authentic text material in applied settings. Foos (1989) did find that students who generate their own questions scored higher on later tests than students who did not generate questions. Foos, Mora, and Tkacz (1994) also found that students consistently scored higher on targeted items (items for which they had generated a question) than on non-targeted items.

The strategy of generating questions in the margin of the text requires students to identify the important information after reading a passage, generate questions about any point that they think could be on a test, and mark the answers to the questions. The students would then quiz themselves on the information using their own questions as a review strategy. This provides students with both a mechanism to get actively engaged in their reading and a framework for generating text-based questions. Finally, it allows them to monitor both their comprehension of the material and their memory of the important information. In this study we attempted to demonstrate that generating questions in the margin

of the text would be a more effective study strategy than would other generative strategies such as note-taking and non-generative strategies such as copying and highlighting.

Method

Participants

One hundred nine first-year college students enrolled in Introduction to Psychology volunteered to participate in this study. They were predominantly 18- and 19-year olds. The volunteers were awarded two research participation points for their efforts.

Design and Procedure

All 109 participants read a 1,000 word passage titled "The Sense of Control" from an introductory psychology text (Wade & Tavris, 2003) which discusses the research on locus of control. Each volunteer was randomly assigned to one of four conditions. In group 1 (n = 31) the participants first read the passage and then used the remainder of the 20 minutes to copy it. In group 2 (n = 26) the participants were given 20 minutes to read and highlight the passage. They were then permitted to reread or review their highlighting until time had elapsed. Students in group 3 (n = 23) first participated in a 25-minute training session where they were taught to highlight effectively and then take notes on text material. They were also told that after taking notes they should cover the details in their notes and try to recite them using the headings as cues, then check to see if they were correct. The training session used materials from an economics textbook. Once the training was completed the students were given 20 minutes to read, highlight, and take notes on the psychology passage. Volunteers in group 4 (n = 26) first participated in a 25-minute training session where they were given the same directions on how to highlight text material as group 3, taught to generate possible questions in the margin, and underline the answers in the text. They were also told that after generating the questions they should cover the text material and recite the answers to their questions, and then check to see if they were correct. The training session used the same economics passage as the note-taking group. Once the training was completed, the participants in this group also had 20 minutes to read and highlight the psychology text material, generate questions, and practice answering them until time had elapsed. All 109 participants completed the study by taking a 20-item multiple-choice test on material from the same psychology passage they had all read.

Results

The outcome measure was a 20-item, four-option multiple-choice test. The items were primarily written at the knowledge and comprehension level. The overall mean on the test was 15.18 with a standard deviation of 2.74. That mean translates to an average score of 75.9% correct. An internal consistency measure was computed using all 109 participants, KR20 = .61 (Kuder & Richardson, 1937). Although this test only displayed moderate internal consistency reliability, it is within the range one would expect on a 20-item classroom test (Oosterhoff, 2001).

A one-way ANOVA on the test scores revealed a significant main effect, F (3, 102) = 17.14, $p < .001$ (Tables 1 and 2, Figure 1). Follow-up multiple comparisons using Tukey's HSD indicated that the students in the generating question group performed significantly better on the test than the students in the read and highlight group, $p < .05$, and the students in the read and copy group, $p < .001$. They also had higher scores than the students in the read and note-taking group, although that difference was not significant, $p = .311$. In addition, the read and note-taking group performed significantly better than the read and copy group, $p < .001$. Finally, the read and highlight group also performed significantly better than the read and copy group, $p < .001$.

Foos, Mora, and Tzack (1994) suggested that when looking at the effectiveness of a study strategy it is important to differentiate between targeted and non-targeted items. For example, we would only expect students in the generate-question group to have improved performance if they generated questions on the same ideas or concepts that we included on the test. The method should not result in improved performance if the students did not target material we placed on the test. Therefore, we reviewed the protocols for the 26 students in the generate-question group and identified which test items they targeted and which they did not. We used a conservative approach. An item was only considered targeted if the student wrote an appropriate question in the margin and underlined the correct answer in the text, or if the generated question itself contained the information necessary to answer that question on the test. Students varied in the total number of questions that they generated; some generated few questions whereas others generated many questions. From all of the questions that they generated, students targeted between 5 and 16 of the 20 quiz items, $M = 9.96$, $SD = 2.95$. On the quiz, they averaged 89.14% correct on the targeted items and 79.88% correct on the non-targeted items (see Figure 2). Using a two-tailed t-test for dependent groups this difference was significant, t (25) = 2.76, $p < .02$.

Table 1
Scores on the 20-Item Multiple-Choice Test

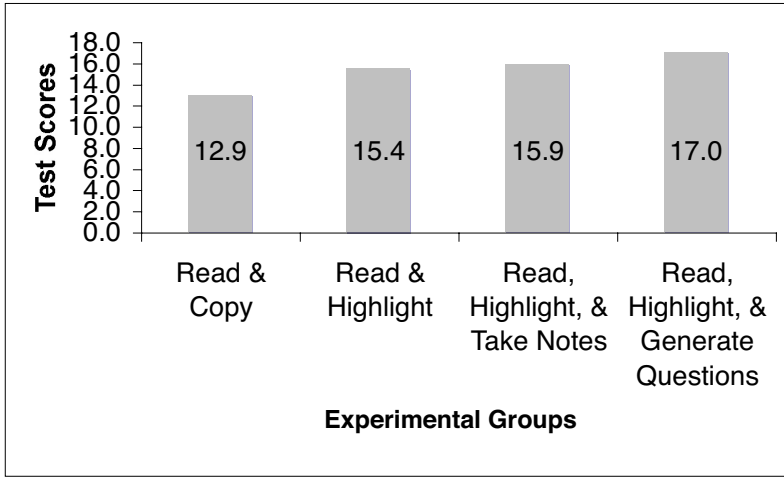
Group	Sample size	Mean	Standard deviation
Read & Copy	31	12.90	2.57
Read & Highlight	26	15.39	1.94
Read, Highlight, & Take Notes	23	15.91	2.41
Read, Highlight, & Generate Questions	26	17.04	2.03

Note. With the Tukey HSD follow-up procedure a difference in mean scores between any two groups of 1.60 items was required for significance at $p < .05$.

Table 2
Analysis of Variance for Test Scores

Source	*SS*	*df*	*MS*	*F*	η	*p*
Between Groups	263.94	3	87.98	17.14	.58	< .001
Within Groups	523.65	102	5.134			
Total	787.59	105				

Figure 1
Mean number of test questions answered correctly (out of a total of 20) for each experimental group.



Discussion

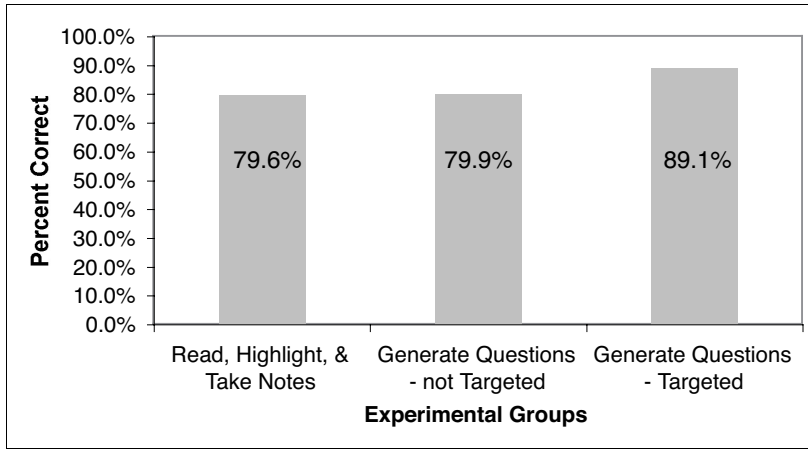
This study demonstrates that certain study strategies are more effective than others when learning from authentic text material. Study techniques that require the student to generate information (e.g. generate questions and take notes) appear to be more effective than those limited to reading and highlighting or a combination of both. Even though generative strategies may take students more time than some strategies that do not require generation, their greater effectiveness is not solely related to more time-on-task since time-on-task was the same for all four groups in this study.

Many who teach reading and study strategies to high-school and college students stress that active strategies are frequently much more effective than passive strategies, such as simply reading and copying text material. The more active strategies are likely more effective because they require the students to generate information on their own. In order to generate questions, students need to think about the material and decide what it is that they want or need to learn for a quiz or exam. That information becomes the answers to their questions. So, to generate questions on that material, they must act on it. They have to interpret what is said about the material and rephrase it to formulate a question to which that information serves as an answer. Although, in this study, the note-taking strategy clearly improved memory retention, the generating-question strategy appeared to have best enhanced test performance (especially when students targeted material that appeared on the quiz), perhaps because it closely mimics memory recall strategies required when taking a test. However, both note-taking and question generation are likely effective because they each involve elaborative rehearsal, which involves actively working on material to make it personally meaningful and memorable (Wittrock, 1986).

There are also a number of other reasons why the generating-questions strategy might be effective. First, it requires students to identify the important information, an essential active reading skill. Second, as students generate questions they frequently rephrase the information making it more personally meaningful and, therefore, more memorable (Doctorow, Wittrock, & Marks, 1978; Wittrock, 1974). Third, as students underline the answers to the questions that they generated, they benefit from repetition of that important information. Fourth, students then review by self-testing using their generated questions which allows them to effectively monitor their learning and understanding (Van Blerkom & Van Blerkom, 2004). Finally, students practice using cues in the generated questions and in the text material which allows them to more easily retrieve answers to the questions.

In this study those students in the question-generation group performed the best on the test, although the difference in the total scores on the test for this group was not significantly different than the scores for the students in the note-taking group. If we compare their performance on targeted versus non-targeted items, however, we see a different picture. The students in the question-generation group performed as well as the students in the note-taking group for non-targeted items. Even though the students in the generate question group did not write questions on some of the tested material, they were able to answer many of those questions correctly. The question-generation strategy requires students to go back and look carefully at all of the material that they highlighted to determine whether or not they should write a question on it. This process could lead to more thought about the material and more repetition of it. It is also possible that the students considered the information to be important but had difficulty formulating a question and, therefore, did not appear to target that information. However, what is notable for the question-generation group, in comparison to their performance on items that they did not target, is that they displayed significantly better performance for items that they targeted (see Figure 2).

Figure 2
Percentage of test questions answered correctly for the note-taking and generate question groups, differentiating targeted and non-targeted items for the generate-question group.



There was only a small difference in performance between the highlight group and the note-taking group. We had anticipated a more

significant advantage of note-taking. Note-taking may have been more effective if the students rephrased material as they took notes. Sometimes students first highlighted reading material and then simply took notes on that material by copying phrases and sentences from their highlighted material. Although this technique may have some positive effect, it is not likely as effective as generating one's own notes by rephrasing the material. This was clearly demonstrated by the students in the copy group who scored significantly lower on the test than students in both the note-taking and question-generation groups. It should also be noted that since the students in each group had exactly the same amount of time to work on the material prior to the test, the students in the highlight group may have spent more time rehearsing the material. In addition, the students in the note-taking group may have simply reviewed their notes rather than having engaged in self-testing because they lacked practice with self-testing strategies. The students in the question-generation group were prompted to use self-testing as a part of the strategy. However, the experimenter noticed that some of the students in this group ran out of time before they completed the question-generation step and others were observed to finish generating their questions as time ran out, precluding opportunities for practice.

Those who teach reading and study strategies to high-school and college students could help many of their students by providing them instruction on how to generate their own questions as a post-reading strategy. Without instruction, many students are ineffective when using question-generation techniques (Gillespie, 1990). The students need to learn how to identify the important material and to generate questions that lead to specific answers. Some students find it difficult to generate questions on the material, whereas others appear to do it with ease. When students are given multiple opportunities to generate questions on authentic text material and get feedback on the quality of their questions, they should be able to improve in their use of this strategy. Students also need to learn how to then self-test. With appropriate instruction students can learn to use question-generation strategies as an effective study technique (Van Blerkom, 2006).

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Appendix 1

Instructions on Generating Questions and Taking Text Notes

At the beginning of the session the instructor explained that she was going to provide some instruction on how to generate quiz and exam questions for text material. She then passed out a one-page excerpt from a college economics text and asked the students to read the first half of the excerpt. Once the students completed that, she showed them how she wrote questions in the margin. She noted that she read all the way to the end of a paragraph, highlighted the material that she thought was important, and then went back and generated questions. She then showed the students her questions using an overhead projector. She explained that they need to go back after reading, put their finger on something that they thought was important, and then develop a question about the material. Although the questions can contain some of the words and phrases used in the text, the questions should force the students to provide answers that contain important pieces of information that they need to recall. Each question should be written in the margin directly across from its answer. Then the answer should be underlined. She also allowed the students to copy some of the questions she wrote. She then demonstrated how they could use the questions to quiz themselves on the text material. She demonstrated this by covering the text material with a piece of paper, reading the questions, and then reciting the answers to the questions. She then moved the paper covering the text down to check each answer.

After this demonstration, the students were then asked to read the second half of the excerpt, highlight the important information, and generate questions in the margin. After they completed that the instructor then showed them the questions that she had generated on that section and allowed the students to compare their questions to the questions that she had generated. She then encouraged them to quiz themselves as had been demonstrated. Finally, she explained that it may take several repetitions to learn the material and that they should practice until they can provide all of the answers without error.

Similar training was provided to the students who took notes on the material. In this case the instructor showed the students her notes for the first part of the excerpt and explained that the students should read and highlight the important information and then go back and take notes on the material. They were shown how to use meaningful phrases and encouraged to use their own words as much as possible. The instructor then showed the students how to quiz themselves on the material by covering the details and reciting the details using the headings as cues. The students were then asked to take notes on the second part of the

excerpt. The instructor then shared her notes with the group using an overhead projector and allowed the students to compare their notes to her notes.

Appendix 2

Sample Test Questions

1. The term, locus of control, is defined as
   A. how individuals feel about the overall quality of their lives.
   B. general expectations about how well you can control things that happen to you.
   C. the extent to which you have real control over the things that happen in your life.
   D. the ability to control those who made decisions about you and your life.

3. Jason, who has an internal locus of control, likely believes that his success in college is a result of
   A. many of his classes being rather easy.
   B. his lack of anxiety about being successful.
   C. his hard work.
   D. the help he gets from his tutors.

11. A researcher suggested that college professors likely display fewer symptoms of stress than do those in many other lines of work. Based on this passage, what argument could the researcher make to support his hypothesis?
   A. College professors have greater control over their work activities.
   B. Working with college-aged students reduces stress.
   C. College professors frequently work alone rather than in groups.
   D. Earning a moderate salary reduces stress.

19. Research has shown that that those who recovered from heart attacks the most quickly believed that their heart attacks were caused by
   A. hereditary factors.
   B. bad luck.
   C. bad habits.
   D. economic pressures.

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