

Increasing Text Comprehension and Graphic Note Taking Using a Partial Graphic Organizer

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ABSTRACT In 3 quasi-experiments using intact classrooms and 1 true experiment using random assignment, students completed partially complete graphic organizers (GOs) or studied complete GOs that covered course content. The partial task led to increased overall examination performance in all experiments. Also, the authors measured students' note-taking style (linear vs. graphic) at the beginning and end of the course. In all experiments, GO note taking increased. The increases were greatest when the authors presented the partial task in a computer environment with a timed, forced-choice task. Implications for using the partial GO task in the classroom, as well as future note-taking research directions are discussed.

Key words: graphic organizers, note taking, text comprehension

For most high school and college students, taking notes while listening to a lecture or reading a textbook is necessary for optimal test performance. Over 30 years ago, DiVesta and Gray (1972) concluded that note taking serves two functions: encoding and external storage (see also Hartley, 1983; Kiewra, 1989). When students take notes, as compared with those who do not, they generally comprehend better because note taking requires that students selectively attend to the information, and that activity assists in encoding. Also, when students review notes, as compared with those who do not, they comprehend better because they can spend additional time on the more important content. Both note-taking functions highlight the selective attentive nature of note taking; notes simply direct students to pay more attention to important details and less attention to trivial details presented in lectures or textbooks.

Merely instructing students to take notes and later review them would seem to allow students to benefit from encoding and external storage functions. That simple solution to text and lecture comprehension fails miserably, however, because most students are poor note takers; they typically record less than half of the critical ideas presented in lectures (Hartley & Cameron, 1967). Thus, when students

take notes (encoding function) and then subsequently review these incomplete notes, they do not benefit from the external storage function.

One possible solution to the note-taking problem is for students to take their own notes; later, instructors would replace them with more complete notes for the students to review. Unfortunately, students would learn quickly that their notes are not needed and would invest less effort into note taking, resulting in no encoding advantage. The other option is for instructors to train students to take complete notes. However, even when students do take comprehensive notes, they often do so in a format that is not optimal for review. Most students take notes by using an outline format (Robinson & Kiewra, 1995). However, the kinds of complete notes that have received the strongest empirical support are spatial, rather than linear, forms (Robinson, 1998).

One type of spatial display of text information is the graphic organizer (GO). Several researchers have found that when students are provided with GOs (see Appendix A) to study along with text, they perform better on tests that measure knowledge of concept relations and application than if they studied text with outlines (e.g., Alvermann, 1980, 1981; Coward, Robinson, & Hsu, 2004; Kiewra, Dubois, Christian, & McShane, 1988; Kiewra, Kauffman, Robinson, Dubois, & Staley, 2001; Robinson & Kiewra, 1995; Robinson & Schraw, 1994). GO notes do not just assist students by directing their attention to important information, but, rather, they help students notice important cross-concept relations that are not as apparent when viewing linear forms of notes. Thus, taking and reviewing GO notes involve attention-directing and relation-revealing advantages.

To capitalize on the advantages of GOs, several researchers provided students with GO frameworks for note taking. The

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merit of the system has been shown in the meta-analysis conducted by Moore and Readance (1984), who found that student-constructed GOs had an effect size of .38 standard deviations (*SDs*), compared with .15 *SD* for teacher-constructed GOs. Also, Horton, Lovitt, and Bergerud (1990) gave secondary students either GOs that contained only headings (student-constructed GOs) or instructed them to study on their own. Student-constructed GOs resulted in better performances than did self-study for learning-disabled (LD), remedial, and regular education students. Similarly, Kiewra and colleagues (1991) found that providing students with skeletal GO frameworks helped them outline frameworks for learning across-concept connections.

Other researchers have gone beyond providing skeletal frameworks, and, instead, have provided students with partially complete (about half of the cells) frameworks. Russell, Caris, Harris, and Hendricson (1983), who first explored the partial approach by providing students with partially completed outlines, found that these were useful. Bean, Singer, Sorter, and Frazee (1986) were the first researchers to provide students with a partially completed GO. Students selected a topic sentence, then developed a GO and a concluding statement. Students in GO groups had more positive attitudes about using the strategy than did those in outline groups.

Building on the idea of partial notes, Katayama and Robinson (2000) compared the relative merits of providing students with complete, partial, or skeletal GOs or outlines to accompany a chapter-length text. The partial study notes contained about half of the information provided in the complete notes, whereas the skeletal notes contained only concept names and attribute headings. (Appendix B shows a partial GO in which half of the cell information is missing.) Students who received the partial or skeletal study notes had to search the text to find the missing information and then write it in the empty spaces. Katayama and Robinson hypothesized that instructors could provide some (partial) but not all (complete) or none (skeletal) information to encourage students to use the encoding function of note taking, and, at the same time, not overwhelm them with a task that may appear too taxing (skeletal).

Katayama and Robinson (2000) found that the partial GO condition, rather than the skeletal or complete conditions, permitted the students to learn the most concept relations and apply that knowledge when they identified newly learned concepts in novel situations. Partial GOs may be the optimal study notes for two reasons. First, it is well documented that GOs are advantageous to outlines for learning concept relations because of their spatial format (e.g., Kiewra, Dubois, Christian, & McShane, 1988; Robinson & Kiewra, 1995). Second, partial study notes permit students to become actively involved in note taking without being too difficult to complete.

We attempted to extend the findings of Katayama and Robinson (2000) by (a) comparing partial and complete GOs in a classroom environment in which student partici-

pation was relevant to learning course content, as opposed to simply receiving research participation credit and (b) examining whether students can be trained to take GO notes. A considerable number of researchers have investigated the instructional potential of providing students with complete GOs (e.g., Bera & Robinson, 2004; Robinson, Katayama, Dubois, & Devaney, 1998; Robinson & Schraw, 1994). We wanted to determine whether the advantages of partial versus complete GOs reported by Katayama and Robinson would (a) hold true in a classroom setting and if they would (b) help students perform better on tests of text comprehension. Ultimately, our goal was to have students take and review GO notes on their own. Thus, we asked, "Does performing several partial GO tasks over the course of a semester enable students to take GO notes on their own?"

EXPERIMENT 1

In Experiment 1, we provided students with one of two types of GOs (partial vs. complete) in an undergraduate educational psychology course. We measured students' text comprehension by their performance on a final examination. We also measured students' note-taking style (linear vs. graphic) before and after they received the sets of notes. Efforts to train students to take graphic notes have been limited. Holley and Dansereau (1984) trained students to construct semantic networks; however, students' tendency to use this training later in a different learning context was not examined. The partial GO format allowed students to gradually construct more of their notes as the semester progressed. We hoped that this scaffolding procedure, in which greater assistance was provided early then gradually removed, would better enable students to take GO notes on their own without such scaffolding.

Method

Participants and Design

Participants were 114 students enrolled in two sections of an undergraduate educational psychology course taught by the same instructor at a southern state university. The course typically consisted of about 90% women. One of the sections took place during the fall semester (complete GO group, $n = 60$); the other section was offered the following spring semester (partial GO group, $n = 54$). Sections were assigned to experimental condition by a coin flip. We used the quasi-experimental, separate-sample pretest-posttest, control-group design (Campbell & Stanley, 1966) to avoid possible treatment diffusion caused by students sharing their study notes.

Materials

We constructed 35 pages (8 $\frac{1}{2}$ " \times 11") of complete GO notes from 12 chapters of the textbook *Human Learning*

(Ormrod, 1999). To construct the partial GO notes, we replaced cells of information with underlines. We gradually removed scaffolding at the end of the partial notes. For the first pages of the partial notes, we deleted about one fourth of the information, whereas for the following pages, we deleted a greater amount of information so that by the last page, the partial GOs contained only one column heading. Each complete and partial GO notes set consisted of two chapters, creating six sets of notes. We constructed two short texts (500 words each) to measure students' note-taking style. The topic of one text was bats, and the other topic was the earth's interior. We constructed tests from each text that included six multiple-choice comprehension items.

Procedure

The course was taught over a 15-week semester. On the first day of class, the bats text was distributed, and students were told to read it and take notes on a separate blank sheet of paper because they would be tested later in the class period. Thirty minutes later, students had 2 min to review their notes; then they completed the 6-item test in 1 min without the notes present. Two days later, students in both sections received their respective packets of study notes. Students were told that the notes contained the information from the textbook that would be covered in the quizzes. The students in the partial-notes group had to complete the missing information in the notes.

Ninety-three days later, students received the earth's interior text and the same instructions that they received for the bats text. Thirty minutes after turning in their notes, the students received their notes again for 2 min; the students then completed the 6-item test in 1 min. Two days later, students received the sixth (final) quiz that covered information in the last two chapters. Each quiz contained 30 multiple-choice items.

In all the experiments, two of the authors scored notes blindly (without knowledge of group affiliation) as being either graphic or not. We assessed interrater reliability (.87 [198/228], .94 [226/240], .92 [202/220], .96 [167/174] for Experiments 1–4, respectively) by dividing the number of agreements by the total number of notes. The two raters resolved all disagreements by discussion between themselves.

Results and Discussion

Students who received the partial GO notes ($M = 138.62$, $SD = 11.94$) scored higher on the quizzes than did students who received the complete GO notes ($M = 133.13$, $SD = 12.40$), $t(112) = 2.41$, $p < .05$, $d = .45$. Table 1 displays the types of notes that students took at the beginning and end of the course. At the beginning of the course, the proportions of students who took graphic versus nongraphic notes did not differ between the partial and complete groups, $\chi^2(1, N = 114) = 1.06$, $p = .30$, $\phi = .10$. We also found that a greater proportion of students in the par-

tial group switched from taking nongraphic notes to graphic notes at the end of the course than did those in the complete group, $\chi^2(1, N = 114) = 12.83$, $p < .001$, $\phi = .34$.

Experiment 1 demonstrated course performance advantages for the partial GO condition. Perhaps more important, Experiment 1 revealed an advantage for the partial GO condition in terms of training students to take graphic notes. A larger proportion of students who completed the partial notes learned how to take GO notes than did those students who did not perform the activity. Unfortunately, we were able to successfully convert (change from being linear to graphic note takers) only half of the students.

EXPERIMENT 2

We designed Experiment 2 to fine-tune the partial GO intervention so that we could successfully train students to take graphic notes on their own; we presented the activity in a computer environment. With the help of the ActiveInk Corporation, we designed a multimedia tool that allowed students to complete partial GO assignments by selecting appropriate information that belonged in a particular cell from among other distracters. For example, in a GO that compared three concepts with their definitions and examples from the textbook, five of the nine cells were complete, whereas four were incomplete. Students clicked on the empty cell boxes and a window appeared that listed the cell choices. The students then clicked on the correct choice and moved on to the next empty cell.

We hoped that this select, rather than supply, method of completing the partial GOs would be more user friendly and more motivating for students to complete. We also hoped that students would construct their own GOs first before completing the assignments so they would learn to take GO notes on their own.

Method

Participants and Design

Participants were 120 students enrolled in two different sections (taught by the same instructor) of the same undergraduate educational psychology course used in Experiment 1. One of the sections was offered during the fall semester (complete GO group: $n = 60$); the other section was offered the following spring semester (partial GO group, $n = 60$).

Materials

We constructed 18 partial GOs from the same 12 chapters of the textbook used in Experiment 1. Similar to the first experiment, we deleted about one fourth of the information for the first few partial GOs, whereas for the remaining GOs, we deleted a greater amount of information so that the last GO contained only one column heading. Unlike the partial GOs in Experiment 1 that appeared on paper, we

replaced cells of information by red rectangles rather than underlines. We used the same two short texts and corresponding tests used in Experiment 1 to measure students' note-taking style at the beginning and end of the course.

Procedure

The procedure was identical to the one used in Experiment 1, except where noted. Two days after taking notes and being tested on the bats text, students in the control group received a set of 18 complete GOs, whereas students in the treatment group received the following directions for completing the partial GO assignments with the ActiveInk network:

1. Log onto the ActiveInk network, click on the appropriate course, then click on the appropriate tab that corresponds to the chapter that you are studying.
2. Click on the Graphic Organizer tool.
3. Read the instructions, close the instructions panel, and review the elements in the graphic organizer. Some of the organizers extend beyond the right margin of the tool; make sure you scroll vertically and horizontally to see the full matrix.
4. As you only have one chance to complete the graphic organizer activity, it is recommended that before you begin, you complete the graphic organizer on paper by finding the information in your textbook. Have this paper available when you complete the activity.
5. When you are ready, click Begin. Click on the red-colored cells and select the best option for each cell. Incorrect selections will be counted against you. You must complete the activity by filling in every red cell. Aborted attempts will be recorded.

Students received a point for every cell they got correct, giving them a score out of a possible 89 points. No student scored lower than 76 points. Although students' first attempts were the ones recorded for their points, they performed the task as many times as they wished without penalty.

Results and Discussion

Again consistent with Experiment 1, students who completed the partial GO notes activities ($M = 140.31$, $SD = 10.86$) scored higher on the quizzes than did students who received the complete GO notes ($M = 134.08$, $SD = 10.50$), $t(118) = 3.19$, $p < .05$, $d = .58$. Table 1 displays the types of notes that students took at the beginning and end of the course. At the beginning of the course, the proportions of students who took graphic versus nongraphic notes did not differ between the partial and complete groups, $\chi^2(1, N = 120) = .54$, $p = .46$, $\phi = .07$. Also consistent with Experiment 1, a greater proportion of students in the partial group than in the complete group switched from taking nongraphic notes to graphic notes at the end of the course, $\chi^2(1, N = 120) = 70.61$, $p < .001$, $\phi = .77$. The size of the

note-taking switchover effect (.77) was considerably larger than the one in Experiment 1 (.34), suggesting that the computer environment was more effective than presenting the partial GO task on paper. Rather than converting only about half of the students from linear to GO note takers, in Experiment 2, we converted about 80% of the students.

EXPERIMENT 3

The results of Experiment 2 were encouraging in terms of getting students to change from taking linear notes to taking graphic notes. Experiments 1 and 2 employed quasi-experimental designs rather than experimental designs to control for treatment diffusion (students who were in the treatment group within a classroom sharing their materials and knowledge with students who were in the control group). Because we did not randomly assign students to conditions (instead we assigned classrooms to conditions), the possibility remains that the classroom (i.e., semester offered, type of student who enrolls in a particular course) could be a plausible explanation for differences between groups rather than experimental treatment. One approach to control for that possibility is the use of some measure of content knowledge as a covariate. We designed Experiment 3 to incorporate such a measure.

Method

Participants and Design

Participants in Experiment 3 were 110 students enrolled in two different sections (taught by the same instructor) of the same undergraduate educational psychology course used in Experiments 1 and 2. One of the sections was offered during the summer semester (complete GO group: $n = 49$) and the other was offered during the following fall semester (partial GO group: $n = 61$).

Materials

Experiment 3 materials were identical to those used in Experiment 2, except that we created a pretest to use as a covariate. Of the six 30-item multiple-choice quizzes, we selected 5 of the best items from each quiz (those that had an item discrimination index of at least .5 and item difficulties ranging between .3 and .7, according to data from the previous two semesters) and created a pretest consisting of those 30 items, randomly arranged. We designed the pretest quiz not only for the purposes of this study but also to inform students about how much they already knew about the course material. The pretest was not graded and performance did not affect students' grades.

Procedure

The procedure in Experiment 3 was identical to that used in Experiment 2, except that on the first day of class, students

in both groups registered with *WebCT*, a course management system, so they could take the pretest online. *WebCT* allows instructors to control the amount of time that students have to take a particular online quiz. We did not want students to be encouraged to look up the correct answers using their textbooks, so we limited the amount of time to 30 min. We told the students that the pretest would assess how much they knew about the course so that the instructor would know which information to spend the most time on. We did not tell the students that the pretest contained quiz items that they would see in the upcoming quizzes.

Students in the control group received the set of complete GOs 1 day after taking the bats test because classes in the summer session were Mondays through Fridays, as compared with the fall semester classes on Tuesdays and Thursdays. Also, because the summer session lasted 5 weeks, compared with the 15-week fall semester, students in the control group took the earth's interior test 36 days after the bats test; the treatment group took it 96 days after the bats test. Students in the treatment group again received a point for every cell of the online partial GOs they got correct, giving them a score out of 89 possible points. No student scored lower than 78 points.

Results and Discussion

The complete and partial GO groups were also similar in terms of their scores on the pretest (complete group, $M = 6.67$, $SD = 1.98$; partial group, $M = 6.74$, $SD = 1.95$, out of a possible 30 points). We used those scores as a covariate and conducted an analysis of covariance on the total quiz

scores. The assumption of homogeneity of regression slopes was supported. Consistent with Experiments 1 and 2, students who completed the partial GO notes activities (adjusted $M = 145.05$, $SD = 12.20$) scored higher on the quizzes than did students who received the complete GO notes (adjusted $M = 140.00$, $SD = 12.30$), $F(1, 107) = 16.33$, $p < .01$, $d = .78$.

Table 1 displays the types of notes that students took at the beginning and end of the course. At the beginning of the course, the proportions of students who took graphic versus nongraphic notes did not differ between the partial and complete groups, $\chi^2(1, N = 110) = .05$, $p = .83$, $\phi = .02$. Consistent with Experiments 1 and 2, a greater proportion of students in the partial group than in the complete group switched from taking nongraphic notes to graphic notes at the end of the course, $\chi^2(1, N = 110) = 63.81$, $p < .001$, $\phi = .76$. The size of the note-taking switchover effect in Experiment 3 (.76) was similar to that in Experiment 2 (.77), and was considerably larger than that in Experiment 1 (.34), suggesting that a computer-based partial activity was more effective than a paper-based activity. Similar to Experiment 2, the conversion rate in terms of getting students to switch from linear notes to GO was about 80% in Experiment 3, compared with 50% in Experiment 1.

EXPERIMENT 4

The results of Experiments 2 and 3 were encouraging in terms of getting students to change from taking linear notes to taking graphic notes. In Experiment 3, we included a measure of general ability as a covariate to control for pos-

TABLE 1. Types of Notes Taken at Beginning and End of Course for Treatment and Control Groups

Group	Beginning of course		End of course	
	Linear	Graphic	Linear	Graphic
Experiment 1				
Complete	55	5	49	11
Partial	52	2	27	27
Experiment 2				
Complete	57	3	52	8
Partial	55	5	6	54
Experiment 3				
Control	44	5	40	9
Treatment	54	7	4	57

Group	Beginning of course		Midpoint (crossover)		End of course	
	Linear	Graphic	Linear	Graphic	Linear	Graphic
Experiment 4						
Complete	27	2	23	6	14	15
Partial	26	3	13	16	11	18

sible selection bias that can occur when using quasi-experimental designs. Also in Experiment 4, we used an experimental design to better control for selection bias (using random assignment) while taking steps to control for possible treatment diffusion.

Method

Participants and Design

Participants were 58 students enrolled in one section of the same undergraduate educational psychology course used in Experiments 1–3. We randomly assigned students to 1 of 12 groups. Students in Groups 1–6 served as the treatment group; Groups 7–12 were the control group. We used a crossover design in which the treatment group used the Web-based GO activity for the first three units, then used the paper-based notes for the last three units. We reversed the order for the control group.

Materials

The materials were identical to those used in Experiments 2 and 3, except that we did not use a pretest. We created a three-item questionnaire in which students were asked whether they shared study materials with other students outside their group (yes or no), with how many students (number), and how often (for how many of the six units).

Procedure

The procedure that we used in Experiment 4 was similar to that used in Experiment 2, except that students were instructed to not work with nor share study materials with anyone outside their group. We told students that the quizzes would cover information that was presented in their group's study materials.

Students in the control group received a set of complete GOs for the first three units, 2 days after taking the bats test. Students in the treatment group used the ActiveInk network to complete GOs for the first three units. There were 11 GOs for the first three units and 7 GOs for the last three units. Students received a point for every cell of the online partial GOs that they had correct. For the treatment group, there were 52 possible points; for the control group, 37 possible points. We revised the GOs representing the later chapters so that they had fewer empty cells like the GOs that appeared in the earlier chapters. Likewise, we made the GOs from the first few chapters more difficult by including more empty cells. We revised both sets of GOs similar to scaffolding so that the first GOs had only a few empty cells, whereas the last GOs had mostly empty cells. All students took the earth's interior test 49 days after taking the bats test. Forty-two days later, they took the bats test again, then they completed the questionnaire.

Results and Discussion

Only 7 of the 58 students indicated that they had shared their study materials with other students outside their group. Of those 7 students, 5 students were in the treatment group and 2 students were in the control group. Four students indicated that they had shared their materials only once, whereas the other 3 students shared two to four times. Each of the 7 students indicated that they had shared their materials with only one person. Unfortunately, we could not determine which groups the other persons were in (whether that person was in a different experimental group). Because only 12% of the students admitted sharing their materials, we did not consider the extent of this sharing to be excessive.

Consistent with Experiments 1–3, students who completed the partial GO notes activities ($M = 75.14$, $SD = 9.25$) scored higher on the first three quizzes than did students who received the complete GO notes ($M = 70.00$, $SD = 8.80$), $F(1, 56) = 4.71$, $p < .05$, $d = .28$. That effect is not as large as that found in Experiments 1–3 (range of .45 to .78). That finding is not surprising, however, given that the treatment was shorter (only 11 of the 18 GOs). After the crossover occurred (when the complete group received the partial GOs and the partial group received the complete GOs), we again compared quiz performances for the two groups on the last three quizzes. This time there was no difference between the first partial group, second complete group ($M = 74.38$, $SD = 8.59$), and first complete, second partial group ($M = 73.24$, $SD = 8.08$), $F(1, 58) = 0.09$, $p = .77$, $d = .04$. That null finding is also not unexpected because both groups had been exposed to the treatment for the same amount of time. We also conducted a repeated-measures analysis of variance to compare the two groups in terms of the change in quiz performance from the first treatment to the second treatment. The first complete, second partial group significantly improved their quiz scores once they received the treatment, $F(1, 28) = 38.81$, $p < .001$, whereas the first partial, second complete group did not improve once the treatment had been withdrawn, $F(1, 28) = 1.12$, $p = .14$.

Table 1 shows the types of notes that students took at the beginning and end of the course. At the beginning of the course, the proportions of students who took graphic versus nongraphic notes did not differ between the partial and complete groups, $\chi^2(1, N = 58) = .22$, $p = .64$, $\phi = .06$. Similar to Experiments 1–3, a greater proportion of students in the partial group switched from taking nongraphic to graphic notes after the three units than did those in the complete group, $\chi^2(1, N = 58) = 7.32$, $p < .01$, $\phi = .36$. The size of the note-taking switchover effect in Experiment 4 (.36) was smaller than the effects in Experiment 3 (.76) and Experiment 2 (.77), most likely because the treatment was much shorter. After the crossover, both groups were again similar, $\chi^2(1, N = 58) = 0.63$, $p = .43$, $\phi = .10$, because they were exposed to the treatment. The conversion rate

for all students in Experiment 4 from the beginning to the end of the course was 53%, which is lower than the conversion rates in Experiments 2 and 3 (80%), likely because of a shorter intervention.

GENERAL DISCUSSION

We investigated whether the partial GO task developed by Katayama and Robinson (2000) could be used in a classroom environment, rather than in a laboratory setting, to help students (a) comprehend course material and (b) learn to take GO notes, rather than linear notes. The results of four experiments provide support for the use of partial GOs to accomplish those goals. In the four experiments, students who completed partial GOs instead of writing summaries or viewing complete GOs scored higher than did complete GO students on examinations and quizzes that covered course content.

We also measured students' note-taking style at the beginning and end of the course. In Experiment 1, a larger proportion of the undergraduates in the partial GO condition took GO notes at the end of the course than did students in the complete GO condition. The greatest gains in converting students from taking linear notes to taking GO notes occurred in Experiments 2 and 3, in which we presented the partial GO task in a computer environment. Rather than having students fill in the missing cell information, the computer partial GO task asked students to select the appropriate cell information from other distracters. To perform the task quickly and to compete for bonus points, students likely completed the GOs first on paper, then performed the computer task with their "cheat sheet" in front of them. Students could look at the partial GO before attempting to complete it, so they could complete paper versions before performing the task. Compared with Experiment 1 in which almost half of the students switched from taking linear notes to taking GO notes, in Experiments 2 and 3, about 80% of the students who were in the partial GO group switched to taking GO notes. In each experiment, a few students in the complete GO groups also converted from linear to GO note taking, likely because of simple exposure to the complete GO notes. (We note here the possible confound in Experiments 2–4 of the paper-versus-computer presentation of materials.) It is possible that some advantage was caused by the presentation format rather than type of task. Presenting the complete GOs on the computer in future studies would address this prospect.

Researchers in several recent studies have examined the efficacy of computer-based note taking. Katayama and Crooks (2003) found that computer-based partial notes were better than were complete notes on application measures, after a 1-week delay. Katayama, Shambaugh, and Edmonds (2005) compared copy-and-paste versus typed note taking and found that typed notes were better after a 1-week delay on transfer tests. Igo and colleagues (e.g., Igo, Bruning, McCrudden, & Kaufmann, 2003; Igo, Bruning, &

McCrudden, 2005a, 2005b) also investigated the potential of copy-and-paste Web-based note taking. They found that that type of note taking can be enhanced by (a) using GOs rather than outlines, (b) providing cues (topics and categories) in the GO, and (c) restricting the amount of text that students are allowed to paste. The GO-based, forced-choice method that we used in Experiments 2–4 is consistent with the recommendations from those studies.

The partial GO computer task can be implemented in almost any course in which students are required to learn from textbooks, assuming that the students have access to a computer. If an instructor does not have the technological skills to create the partial GO tool, another option would be to work with a company that creates Web-based curriculum tools such as ActiveInk (to contact them, access www.activeink.net). GOs can be constructed from textbook chapters; for the first few partial GO tasks, about half of the cells should be empty. Students should be allowed to view the partial GO before they complete the online assignment to encourage them to take their own paper-based GO notes. Then, armed with a complete GO, students can perform the computer-based partial task quickly and accurately. In all, that is a fairly easy task for K–12 teachers to create. The task simply involves having students search their textbooks for missing information in the notes; while doing so, students learn about text structure—an important component in text comprehension.

Although we trained a large proportion of students to take GO notes, we did not examine how students outside of the course might use this training. We are currently designing a study in which we will track students who receive GO training to determine whether they can perform more effectively in other courses. Ultimately, we would like to assess what role, if any, such GO training may play in study skills courses. However, the partial GO task can be used in virtually any course that requires students to understand conceptual relations; any lasting effects of the activity may not be course dependent.

Instructors commonly make their lecture notes available to students prior to their lecture on a course Website (e.g., by using a slideshow program such as PowerPoint). Some students print pages of the notes and bring them to class, leaving blank lines next to the provided information so that they can complete them during the lecture. Although that practice encourages students to take notes from a lecture, perhaps it is not optimal for learning. We also are designing a study in which we compare providing students with either complete or partial notes prior to a lecture.

Finally, with the increasing popularity of virtual or cyber high schools (i.e., ones in which students take all of their courses in online environments; e.g., Chaika, 1999), activities such as the partial GO task may help students learn textbook content without the aid of instructors. The GO task can be assigned prior to reading so that students can be cued about the text structure and then take notes while they read. Once their notes have been completed, students

can use them to finalize the GO task online while they compete with classmates for speed and accuracy to receive bonus credit. Thus, the GO task may help teach students not only course content but also important metacognitive skills, such as identifying text structure. We hope that researchers will investigate many more online learning activities regarding their potential for assisting K–12 students in both learning content and learning to learn.

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APPENDIX A
Example of a Complete Graphic Organizer Used in Experiments 1–4

Gestalt Psychology Laws:	Proximity	Similarity	Closure	Pragnanz
Definition:	People tend to perceive as a unit those things that are close together in space.	People tend to perceive as a unit those things that are similar to one another.	People tend to fill in missing pieces to form a complete picture.	People tend to organize their experience as simply, concisely, symmetrically, and completely as possible.
Example:	A teacher perceives 15 students on a playground as three groups of five students due to how close they are to each other.	A person sees the word Texas in a stadium because some fans are wearing orange shirts, whereas others are wearing white shirts.	John looks at a faded photo and is still able to make out the person's identity even though nearly half the ink is gone.	Mary falsely remembers that a shape she saw was round when it actually was oval.

APPENDIX B
Example of a Partial Graphic Organizer Used in Experiments 1-4

<i>Gestalt Psychology Laws:</i>	Similarity	Pragnanz
<i>Definition:</i> People tend to perceive as a unit those things that are close together in space.	_____ _____ _____	People tend to fill in missing pieces to form a complete picture.
<i>Example:</i> _____ _____ _____ _____ _____	A person sees the word <i>Texas</i> in a stadium because some fans are wearing orange shirts, whereas others are wearing white shirts.	_____ _____ _____ _____ _____

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