Using Blanks in Guided Lecture Notes

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Guided lecture notes are notes that are distributed to students, typically as handouts, that give a framework of what will be discussed in class. Spaces are included for students to write and work examples during the classroom discussion. Providing students with guided lecture notes paves the way for them to leave class with higher quality notes (Kiewra, et al, 1988) and can lead to improved student organization and engagement. Furthermore, studies have shown the use of guided lecture notes improves students' performance on quizzes and exams (Austin, et al, 2002) and improves academic performance (Hamilton, et al, 2000). The practice of using blanks in place of key words or concepts to be filled in by students during classroom discussion was the focus of a classroom research study conducted in two different college-level math courses. Does using blanks in place of key information improve student learning? Does using blanks improve students' perceptions of their learning? The results of this study seem to indicate that although students perceive that use of blanks as described in this manuscript does improve their learning, no measureable improvement in student learning was observed, as compared to using guided notes without blanks.

Introduction

Numerous studies have demonstrated positive effects of guided lecture notes on student learning. Their use has been shown to enable students to leave class with higher quality notes (Kiewra, et al., 1988) and improves academic performance (Austin et al., 2002; Hamilton et al., 2000). In addition, use of guided lecture notes produces greater academic gains for students with learning disabilities, as well as for students without learning disabilities (Lazarus, 1991). Students have reported use of guided lecture notes helps them stay focused and feel more engaged in the learning process, while reducing their anxiety during class (DiBattista, 2005). In a study conducted with engineering students, 53% preferred guided notes to

traditional note-taking and 43% said use of guided notes improved their problem-solving skills (Lawanto, 2012).

So what are guided lecture notes? Guided lecture notes are notes that are distributed to students by the instructor. These notes provide a skeleton of what is covered in class including key points and results with spaces left for students to take notes and/or work problems during class (Austin, 2002; Heward, 1997; Lazarus, 1991). Guided lecture notes can be distributed as handouts during class or posted electronically before class, in which case students are encouraged, or even required by some instructors, to print them before coming to class.

There are definite advantages to using guided lecture notes. First and foremost, students leave class with more complete notes. This provides students with a rich reference useful in studying for tests, quizzes, working on projects, writing papers, and carrying out any number of other assignments using the concepts presented in class. Many of the concepts are included in the notes, allowing more class time to be spent actually using those concepts. More of the student learning taking place in class can be higher level learning, furthering student understanding and internalization of concepts. Student engagement appears to improve with the use of guided lecture notes, however, this author has observed student engagement affected both ways. Nearly all students appear to be more engaged and are able to focus on the concepts being presented with guided lecture notes, allowing them to shift their focus from harried note-taking to understanding. Rather than centering their attention on sorting important facts from less important facts and struggling to get the most important ones down in their notes, they are able to center their attention on the concepts being discussed, furthering their comprehension. The occasional student, however, takes the fact that the notes provide most of the key concepts as an excuse to zone out and not follow. These students are in a strict minority.

How Blanks are Used

The practice of using guided lecture notes was used prior to conducting this study by the first author. She began incorporating the use of blanks in place of key words for the purpose of not “giving away the punch line.” Various situations for using blanks were tried and instances in which using blanks seemed to provide the most benefit to students fell into two

categories. In both, the goal was for students to be able to fill in the blank independently.

Review – The first is in cases where the material was a review of something students "should have" learned previously – either earlier in that course or in a preceding course. In this case, the goal of using the blank(s) was to encourage students to recall this previously learned knowledge.

Generalization – The second is in instances where a definition or result is preceded by examples from which generalizations can be drawn. Here, the goal was to have students see the examples and then be able to come up with the key words in the definition or result themselves.

Figure 1. shows an example of a definition that students would be expected to have learned in a previous course; it is presented both with and without blanks.

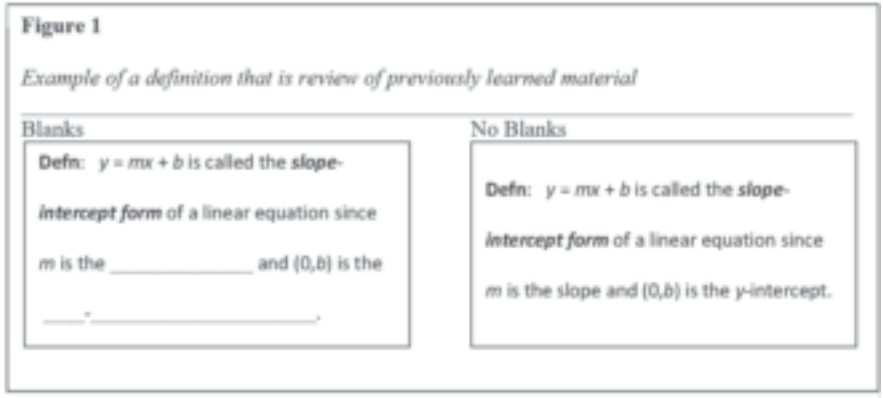


Figure 2 illustrates how having students do an example first, followed by guiding questions, helps them generalize and come up with the general formula. Again, this is presented both with and without blanks in the final result.

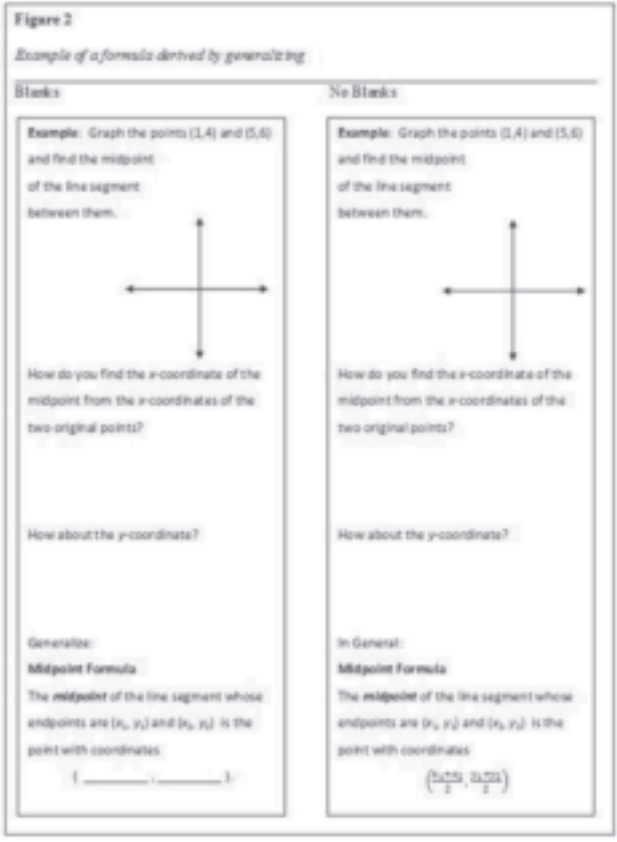


Figure 2

Example of a formula derived by generalizing

Blanks

Example: Graph the points (1,4) and (5,6) and find the midpoint of the line segment between them.

How do you find the *x*-coordinate of the midpoint from the *x*-coordinates of the two original points?

How about the *y*-coordinate?

Generalize:

Midpoint Formula

The ***midpoint*** of the line segment whose endpoints are (x_1, y_1) and (x_2, y_2) is the point with coordinates

(_____ , _____)

No Blanks

Example: Graph the points (1,4) and (5,6) and find the midpoint of the line segment between them.

How do you find the *x*-coordinate of the midpoint from the *x*-coordinates of the two original points?

How about the *y*-coordinate?

In General:

Midpoint Formula

The ***midpoint*** of the line segment whose endpoints are (x_1, y_1) and (x_2, y_2) is the point with coordinates

$$\left(\frac{x_1+x_2}{2}, \frac{y_1+y_2}{2}\right)$$

The Study

The focus of this classroom research study was the practice of using blanks in place of key words or concepts in guided lecture notes. Two questions were explored in this study in a mathematics classroom:

1. Does using blanks in guided lecture notes improve student learning?
2. Does using blanks in guided lecture notes improve student *perceptions* of their learning?

Table 1

Mean Quiz Scores and Standard Deviation of All Participants in Phase 1

Version	Mean	Standard Deviation
Blanks	8.173	2.011
No Blanks	8.061	2.145

Phase 1 of this study took place in spring semester 2014 when the first author taught two sections of a course entitled *Math of Social Choice*. Phase 2 occurred in spring 2015 term with student participants in two sections of a course entitle *Foundations of Quantitative Reasoning*. Both of these courses are freshmen level terminal math courses for liberal arts students. Approximately 25 students were enrolled in each section.

In each of these courses, two versions of guided lecture notes were written and distributed to students in class as handouts. One version of the notes (the No Blanks version) presented all results and definitions completely; while the other version (the Blanks version) presented results and definitions with blanks in place of key words or phrases to be filled in during class.

Methodology

There were 43 participants in Phase 1 (Spring 2014) of this study and 36 participants in Phase 2 (Spring 2015). Students became aware of this research study close to the end of the semester. At that time, participants gave informed consent and completed a questionnaire. This study was approved by the Institutional Review Board of the university.

Each week, the students in one section of the course were given the Blanks version and the other section received the No Blanks version; the control group and treatment group choice was determined randomly and careful records were kept. At the end of each week the same quiz was given to both sections of the course. At the end of the semester, mean quiz scores for the two different versions were compared.

To gather students' perceptions on the use of blanks and their learning, a questionnaire consisting of fourteen Likert scale statements and three short answer questions was conducted close to the end of the semester.

Results – Quiz Score Comparison

Table 1 shows the mean quiz scores and standard deviation of all participants in Phase 1 with and without blanks. These comparisons are based on the scores from seven 10-point quizzes. In addition, the mean quiz scores and standard deviation of those participants consistently preferring the use of blanks was compared. Those results are given in Table 2.

Table 1

Mean Quiz Scores and Standard Deviation of All Participants in Phase 1

Version	Mean	Standard Deviation
Blanks	8.173	2.011
No Blanks	8.061	2.145

Table 2

Mean Quiz Scores and Standard Deviation of Participants Consistently Preferring Blanks in Phase 1

Version	Mean	Standard Deviation
Blanks	8.593	1.731
No Blanks	8.257	2.048

What was not anticipated was that the material in the *Foundations of Quantitative Reasoning* course, which was used in Phase 2, was significantly less conducive to using blanks in the lecture notes than the material in the *Math of Social Choice* course, which was used in Phase 1. As a result, during several of the weeks of the study in Phase 2, students in both sections of the course got the same class notes and no comparison of quiz scores could be made. *Table 3* shows the mean quiz scores and standard deviation of all participants in Phase 2 with and without blanks; *Table 4* shows the mean quiz scores and standard deviation of those participants consistently preferring the use of blanks in Phase 2. These comparisons are based on the scores from four 10-point quizzes.

Table 3

Mean Quiz Scores and Standard Deviation of *All Participants* in Phase 2

	Mean	Standard Deviation
Blanks	8.493	2.109
No Blanks	8.281	2.597

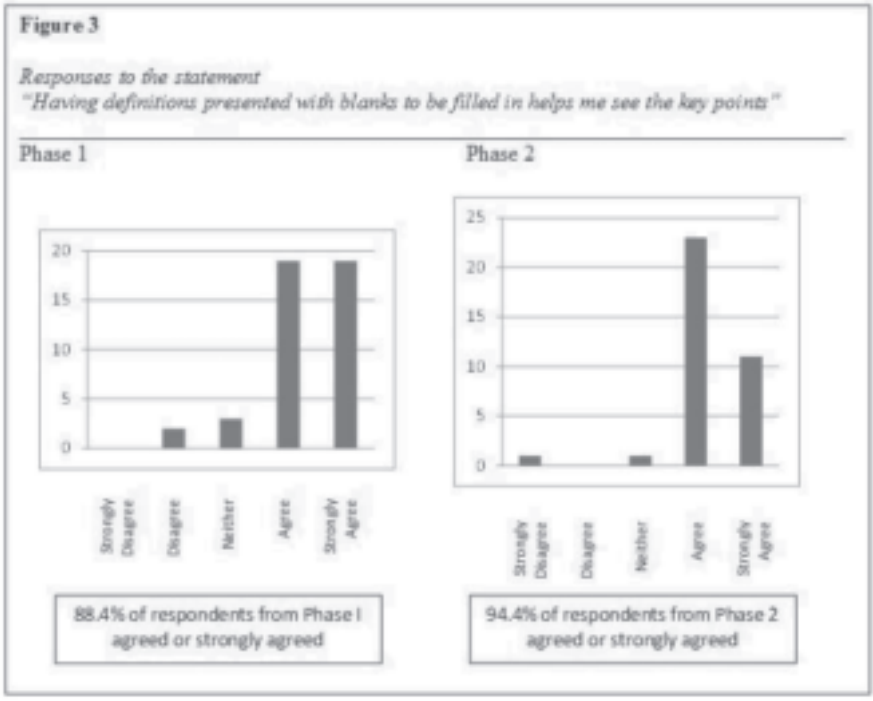
Table 4

Mean Quiz Scores and Standard Deviation of *Participants Consistently Preferring Blanks* in Phase 2

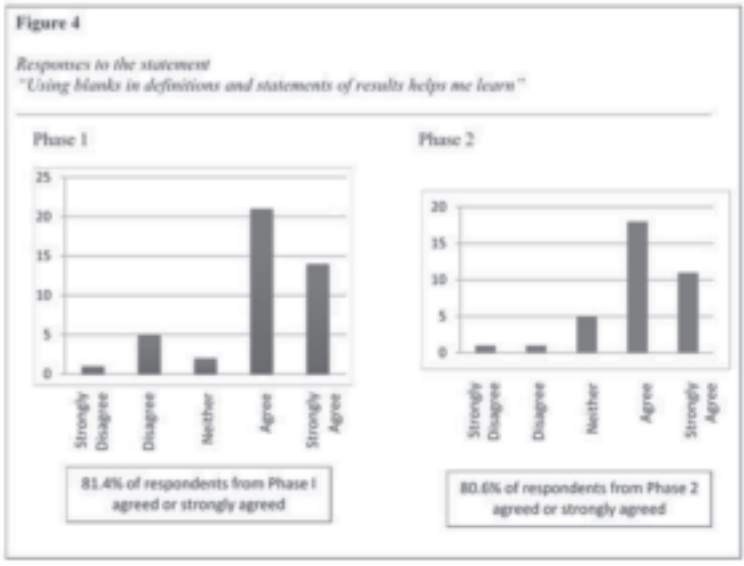
	Mean	Standard Deviation
Blanks	9.320	2.096
No Blanks	8.769	2.471

Results – Student Perceptions

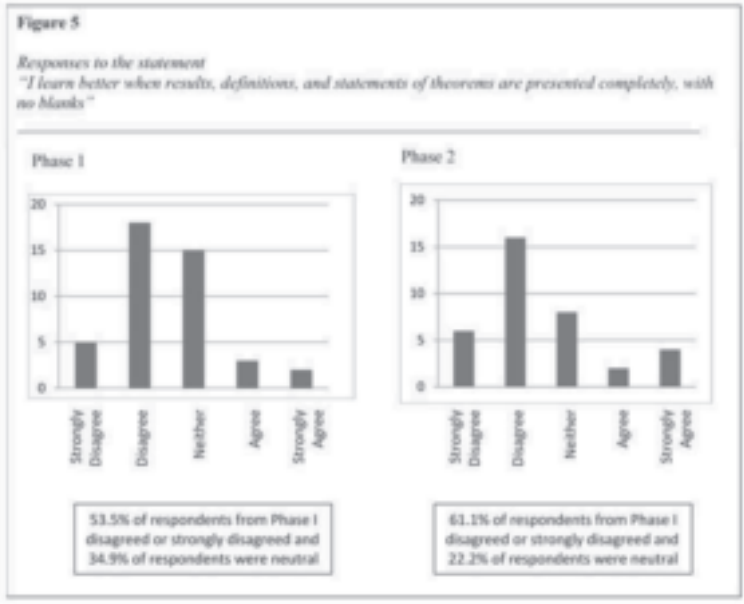
The questionnaire consisting of fourteen Likert scale statements and three short answer questions was conducted near the end of both semesters to measure students' perceptions of their learning. The Likert items included both positively and negatively phrased statements. Three of the statements included were "Having definitions presented with blanks to be filled in helps me see the key points", "I learn better when results, definitions, and statements of theorems are presented completely, with no blanks," and "Using blanks in definitions and statements of results helps me learn." Graphs giving the breakdown of responses to these three statements are given in *Figures 3, 4*, and *5*.



Overall, 91.1% of all respondents agreed or strongly agreed with the statement "Having definitions presented with blanks to be filled in helps me see the key points."



Overall, 81.0% of all respondents agreed or strongly agreed with the statement "Using blanks in definitions and statements of results helps me learn."



Overall, 57.0% of all respondents disagreed or strongly disagreed with the statement "I learn better when results, definitions, and statements of theorems are presented completely, with no blanks" and 29.1% were neutral.

In the short answer portion of the questionnaire, students were asked the following: "Please compare and contrast the two ways definitions and results are presented in the Class Notes. Which do you prefer? Is one more beneficial to your learning?" An example was included with this question, showing a definition given in both the Blanks and No Blanks forms. Following is a sampling of the responses to this question:

> "I prefer the notes and definitions with blanks. It is helpful to have the blanks because I have to understand it to fill it in. And it helps me pay more attention."
>
> "With blanks helps me realize what words I need to focus on and study."
>
> "The box with no blanks is overwhelming. The one with blanks helps me break down and understand the paragraph."
>
> "I prefer the one with blanks because the no blank one all blends in but the blank ones answers stand out."
>
> "I like the one with blanks because it helps me learn better. A big long paragraph is boring."
>
> "I have to understand the definition / read all of it thoroughly (with blanks) vs. no blanks when I might skim it / not look at as closely because it's given to me."
>
> "The blanks would help because I remember the information that I write down. It is rather beneficial instead of just reading along."

Students in this study clearly preferred having definitions and statements of results presented with blanks in place of key words as we did

in class. Their general perception was that using blanks for prior knowledge and generalizations helped them see key points and aided their learning.

Statistical Analysis of the Data

In Phase 2, four quizzes had background material that lends itself to using blank-enhanced instructor notes. In none of the four quizzes were there statistically significant differences in the quiz scores between the two sections. The Wilcoxon-Mann-Whitney (WMW) nonparametric test was used to test for differences between the sections. Observed significance levels for the tests ranged from about 0.600 to 0.400: nothing approached statistical significance. In three of the four cases the section using the blank-enhanced instructor notes had a higher mean score. The differences in means were on the order of 0.50 points with an associated standard deviation of about 1.6 points. One question about the results of this study that can be profitably asked about was the ability of this study's parameters to detect such a difference. The disappointing news is that the section sizes make a small difference like this difficult to detect: with 36 observations the study has a probability of about 12% of detecting a difference of this magnitude. If the number of students were increased to 100 observations evenly divided among the two conditions, the power only increases to about 28% (in both cases this is assuming the conventional 5% α level is used).

This study's authors were looking at fairly small changes in student scores, and so student preferences were relevant. When the responses to SPTL questions about the blank-enhanced notes were examined, two these were noted: the two sections are homogeneous in their distribution across the Likert items *and* there is a substantial preference for the blank-enhanced notes in both sections. The Pearson χ^2 values for homogeneous responses are 2.45 (0.485), 5.54 (0.236) and 8.1 (0.087). Only one approaches statistical significance at the usual 5% level. If the distribution of the student responses is compared to a random selection (i.e., indifference to the answer) model, we find that the students are not selecting responses at random among the set. Instead, the relative frequencies are shifted in every case towards preferring the blank-enhanced instructor notes.

The results in Phase 1 are qualitatively the same. In this course there was much more material that lent itself to the experimental intervention. Results from seven quizzes were available. Again, the two sections were generally not statistically significantly different. In one case

the result of the WMW test was statistically significant in the "wrong" tail: the test scores were modestly higher for the section that did *not* use the blank-enhanced notes. Once again, we can ask about the ability of this study to detect differences of this magnitude (roughly 1 point with a standard deviation of about 2.4 points). We found that the study has slightly more than a 20% chance of detecting this with the study size of 40 students. The power increases to 46% if the number of students increases to 100 divided equally among the two conditions.

As previously reported, we were looking at small changes in quiz scores with no real evidence that the experimental condition is harmful. Consequently, student opinion can be used to decide the utility of the blank-enhanced notes in the classroom. As in Phase 2, the three item responses appear to be homogeneous in the two sections. The chi-square test statistic values (the observed significance level is given in parentheses) are 6.05 (0.109), 5.75 (0.281), and 8.03 (0.091). When the class values are pooled, we once again find the distribution of responses is not random: the students are expressing a preference in each item favoring the blank-enhanced notes.

Conclusions

The benefits of guided lecture notes have been shown in numerous studies in various disciplines. While the data from this study do not indicate that using blank-enhanced guided notes improves student learning versus guided notes with complete definitions and results, neither do the data suggest that any harm is being done. This being the case, we can profitably consider the student's own opinions on the matter. For this, the data quite clearly states that the students in this study preferred the blank-enhanced guided lecture notes over guided lecture notes without blanks; their perception was the blanks helped them identify key words and concepts and aided their learning. More research is needed across disciplines.

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