

Student Submitted Quiz Questions as Method to Increase Understanding of Material and Initiate Studying

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Abstract

Students in an upper division Software Engineering class were given the assignment of submitting one candidate multiple choice question each week. A question was required to also include a reference to the day of lecture or page of the textbook, and the rationale to support the correct answer. These questions served as the basis for eight quizzes, a mid-term and a final test. The students were advised that they could share the questions with each other. For each ten question quiz, eight or nine of the student submitted questions were selected.

A questionnaire was distributed in conjunction with the first and last quizzes and the following results were observed:

1. Students shared their questions with each other.
2. Writing quiz questions help students understand the material and initiate studying.
3. The students' view of this mechanism improved between the first and last quizzes.
4. Students altered their study habits between the first and last quizzes to incorporate more emphasis on the shared questions.

Introduction

Kaner [1] reported that he handed out a pool of questions from which students were encouraged to study for mid-term and final exams. He suggested that handing out questions had three significant advantages, these included:

1. It allowed students to think more about the answers and prepare their answers more carefully.
2. It encouraged students to review and discuss the material together. This he believed provided better and longer-term retention of the material
3. It helped remove language barriers from non-native English speaking students and allowed him to use much more complex questions.

This concept was extended to an upper division Software Engineering course, Object Oriented Analysis and Design. Each student in this class was asked to submit a multiple-choice question each week. The questions were required to include a reference to the day

of lecture or page of the textbook and the rationale to support the correct answer. This was a novel concept for the students as none reported that they had ever done this before. At the end of the semester, a couple of students commented very positively about this technique on the class/instructor evaluation survey. Comments from these students indicated that they believed that researching and developing test questions helped them understand the material better and initiated earlier studying.

These comments were the seed for an experiment to attempt to quantify any benefits from this weekly assignment, specifically whether having students write quiz questions is perceived to improve their understanding of material and initiate earlier studying.

Procedure

During the fall semester of 2004, students in an upper division Software Engineering class, Software Quality, were given the assignment of submitting multiple-choice questions each. There were 29 students in this class. The questions were required to include a reference to the day of lecture or page of the textbook and the rationale to support the correct answer. The students who completed this task earned two points per week out of a possible total of 500 points for the semester.

The students were encouraged to study together and share their questions with each other. Sharing of questions was promoted by providing an email distribution list and a shared network disk for the class.

These questions served as the basis for eight quizzes, a mid-term and a final test. For each quiz, eight or nine of the student submitted questions were selected. The student quiz questions were selected based on coverage of material and quality of the question. All selected student questions were transformed by at least reordering the choices and in most cases adding additional distracting answers. A few of the students made use of the distracting answers as an opportunity to exercise their humor and creativeness. For instance, "One of Ivar Jacobson's contributions to Software Engineering was eating crackers with pickled fish during the requirements phase." In addition to student submitted questions, the instructor added one or two questions to each quiz. The instructor's questions were not shared with the class. The instructor submitted questions insured coverage of all material. The mid-term and final examines were 30 percent multiple choice and 70 percent essay and short answer. The essay and short answer were composed by the instructor and were not shared with the students.

During the first and last quizzes of the semester, a questionnaire was distributed to quantify the students' impressions of writing quiz questions. The questionnaires were voluntary. To help insure anonymity, the students were instructed to place the completed questionnaires in folder at the far side of the classroom from where the instructor and the quizzes were collected. Questionnaires were not used for all eight quizzes due to time constraints. The content of the questionnaire can be found in Appendix A.

It was hypothesized that students would report that:

1. They shared their quiz questions with each other,
2. They made use of shared quiz questions for studying,
3. Writing a quiz question helped them understand the material, and
4. Writing a quiz question helped them start studying the material earlier,

Results

Below are the results, organized by quiz question.

Minutes studied for quiz

The results for minutes studied for the quiz, from question one, are summarized in Table 1. There was a noted drop in the number of minutes studied from the first quiz to the last quiz, means of 55.36 to 29.64 minutes, respectively. It was surprising, at least to the instructor, that ten students studied more than an hour for the first quiz and one student studied six hours; whereas, only three students studied more than an hour for the eighth quiz.

Table 1: Time studied

Time studied in minutes	Mean	standard deviation	Min	Max	Did not study
Quiz 1 (N = 28)	55.36	82.67	0	360	3
Quiz 8 (N = 28)	29.64	36.69	0	180	6
Difference 1 to 8	-25.72				+3

Sharing quiz questions

The results from question two indicated that there was a marked increase in the percentage of students who shared their quiz questions with others, means of 39.29% to 64.29%, between quiz one and quiz eight (see Table 2). The results from question three indicated that there was also a large increase in the percentage of students who used the shared questions for studying, means of 55.14% to 78.57%, between quiz one and quiz eight. Most students used the classes' shared disk as a means for sharing their questions versus email.

Table 2: Sharing questions with others

Question Sharing (in percent)	Shared with Others	Used Others	Shared via email	Shared via disk
Quiz 1 (N = 28)	39.29	57.14	7.14	50.00
Quiz 8 (N = 28)	64.29	78.57	3.57	75.00
Difference 1 to 8	+25.00	+21.43	- 3.67	+25.00

Study Material Source

In question four, the students reported the percentage of their total study time that was spent studying from shared questions and from their notes and book. The percentage of time spent studying from shared quiz questions increased dramatically from 19.75 to 48.82 percent between quiz one and eight. This trend was reversed for the time spent studying from notes and the book, mean of 69.54 and 29.75 percent respectively for quiz one and eight.

Table 3: Percentage of time studying from Shared Questions or Book and Notes

Study Material (in percent)	Shared Questions		Notes and Book		Did not study
	mean	Sd	Mean	sd	
Quiz 1 (N = 28)	19.75	27.07	69.54	35.86	3
Quiz 8 (N = 28)	48.82	28.39	29.75	28.39	6
Difference 1 to 8	- 29.07		- 40.24		+3

Time spent developing question

In question six, the students reported how many minutes they spent developing a quiz question. The mean minutes spent for each of the quizzes was virtually the same, 13.19 and 13.74 minutes for quiz one and eight, respectively.

Table 4: Time spent developing quiz question

Time in minutes	Mean	standard deviation	min	max	Did not write a question
Quiz 1 (N = 28)	13.19	6.05	5	30	2
Quiz 8 (N = 28)	13.74	6.51	5	30	9
Difference 1 to 8	+0.55				+6

Writing question helped understand material

For question seven, the students rated the degree to which writing a quiz question helped them understand the material. A rating of '5' was "a very significant factor" and a rating of '1' was "none at all". The mean rating for both quizzes was positive at 3.56 and 3.92 for quiz one and eight, respectively. These mean ratings fall between "some", '3', and "significant factor", '4'.

Table 5: Quiz question helped understand material

Help Understand Material Rating *	Mean	Standard deviation	Min	Max	Did not write a question
Quiz 1 (N = 28)	3.56	0.57	3	5	2
Quiz 8 (N = 28)	3.92	0.71	3	5	9
Difference 1 to 8	+0.36				+6

* 1 = none at all; 2 = very little; 3 = some; 4 = significant factor; 5 = a very significant factor

Writing question helped initiate studying

For question eight, the students rated the degree to which writing a quiz question helped them start studying the material. A rating of ‘5’ was “a very significant factor” and a rating of ‘1’ was “none at all”. The mean rating for both quizzes was positive at 3.15 and 3.97 for quiz one and eight, respectively. These mean ratings fall between “some”, ‘3’, and “significant factor”, ‘4’.

Table 6: Quiz question helped initiate studying

Help Initiate Studying Rating *	Mean	Standard deviation	min	max	Did not write a question or study
Quiz 1 (N = 28)	3.15	1.22	1	5	2
Quiz 8 (N = 28)	3.97	0.85	3	5	9
Difference 1 to 8	0.82				+6

* 1 = none at all; 2 = very little; 3 = some; 4 = significant factor; 5 = a very significant factor

Minutes Studied by Material Source

The number of minutes spent studying from shared questions and from notes and the book was derived from the product of total minutes studied (question one) and either the percentage of time studying from shared quiz questions (question 4a) or the percentage of time studying from notes and the book (question 4b). Students changed their primary study emphasis from their notes and the book to a balance between studying from the shared questions and from notes and the book between quiz one and eight (see Table 7).

Table 7: Minutes studied from Shared Questions or Book and Notes

Study Material (in percent)	Shared Questions		Notes and Book		Did not study
	Mean	Sd	mean	sd	
Quiz 1 (N = 28)	8.48	12.23	47.18	74.78	3
Quiz 8 (N = 28)	18.39	22.92	11.26	15.30	6
Difference 1 to 8	+9.91		-35.92		+3

Conclusions

Although none of the results were statistically significant, they are all in the direction that indicated that this process was perceived as positive in the students' eyes.

The result support all four of the hypotheses.

1. Students shared their quiz questions with each other, was supported by the results in Table 2.
2. Students made use of shared quiz questions for studying, was supported by the results in Table 3 and Table 7.
3. Writing a quiz question helped them understand the material, was supported by the results in Table 5.
4. Writing a quiz question helped students start studying the material earlier, was supported by the results in Table 6.

In addition to the formal hypotheses, the students' view of this mechanism improved between the first and last quizzes. This was indicated by the results in Table 5 and Table 6. Also, students altered their study habits between the first and last quizzes to favor studying from the shared quiz questions, see Table 3 and Table 7.

Interestingly, there was also evidence of the typical "end of the semester time crunch" that is common to Software Engineering and Computer Science programs. This was indicated by several results, including:

1. Time spent studying drop by nearly 50 percents between quiz one and quiz eight, see Table 1.
2. The number of students who reported that they did not study doubled from three to six, see Table 1.
3. The number of students who did not turn in quiz questions increased from two to nine. The students may not have thought that the two points earned by turning in a quiz question was worth the time, see Table 4.

Results not quantified but observed by the author was the amount of time spent executing this technique. The author perceived that it took much longer to organize, review and select student submitted quiz questions than it would have taken to write the quizzes from scratch. There was also a significant amount of time spent determining which students submitted quiz questions and keeping track of their earned points. Tracking questions, organizing questions, and writing quizzes would be a perfect task for a teaching assistant.

The students also seemed to enjoy adding humor to the questions and where possible as much of this humor was incorporated into the quizzes. The author perceived this as improving the normal gloomy test-taking environment.

In summary, the results were positive enough to support the use of this technique again.

References

1. Kaner, C. (2003), "Assessment in the Software Testing Course." *Workshop on the Teaching of Software Testing*.

Appendix A: The questionnaire

1. _____ How many minutes did you study for this week's quiz?
2. Did you participate in sharing quiz questions with other students in the class? **Circle those that apply.**
 - A. Shared my question with others
 - B. Reviewed other student's questions
3. Which mechanism did you use to obtain quiz questions from other students? **Select all that apply.**
 - A: email
 - B: ClassList shared drive
 - C: other (please specify) _____
4. What percentage of your time was spent studying from the other students' quiz questions _____ % vs. normal reviewing notes and the book _____%?
5. YES or NO Did you turn in a quiz question? If you answered NO to this question you are done.
6. _____ How many minutes did you spend developing a quiz question?
7. _____ On a scale of 1 to 5, did developing a quiz question help in understanding the material?
Where:
 - 1 = none at all
 - 2 = very little
 - 3 = some
 - 4 = significant factor
 - 5 = a very significant factor
8. _____ On a scale of 1 to 5, did developing a quiz question help you start studying the material?
Where:
 - 1 = none at all
 - 2 = very little
 - 3 = some
 - 4 = significant factor
 - 5 = a very significant factor