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VARIATIONS OF THE GROUP QUIZ THAT PROMOTE COLLABORATIVE LEARNING

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Abstract - In this paper, we demonstrate how variations of the in-class group quiz can resolve two difficulties often reported by instructors as they contemplate the use of collaborative learning techniques in lecture classes. The two difficulties we refer to are (1) encouraging student acceptance of active learning and (2) making the transition from lecturer to facilitator. In this paper, we show how these two difficulties can be resolved by converting familiar, in-class, individual quizzes to group quizzes. In addition, we show how group quizzes can play additional roles in the collaborative learning process such as assisting in the development of instructional materials that enhance learning, coaching students in the development of learning skills, promoting interaction among students, and reducing students' anxiety with quizzes. Finally, we present statistical data that defends the use of group quizzes in the grading process.

Introduction

After students and teachers have had years of engagement in a teaching/learning interaction where teachers lecture and students listen, both parties can develop a level of comfort with this teaching/learning modality that may make it difficult for them to adjust to the new roles that they must play in an active learning environment. This paper is written for instructors who are looking for suggestions that may help them take the first step in the use of collaborative learning techniques in the engineering and technology classroom. We discuss how something as familiar as the in-class quiz can be transformed into an effective tool that can facilitate the acceptance of collaborative methods by both the teacher and the student. This is accomplished by giving group quizzes in addition to, or in place of, quizzes taken on an individual basis. According to Jones and Brickner¹ after a three-year study of using group quizzes, group activities in the form of group quizzes benefit all students. The value of cooperative learning methods in promoting learning, retention, and motivation are by now well known²⁻⁵.

In this paper, rather than promoting cooperative learning, we address several concerns commonly reported by instructors as they contemplate the incorporation of collaborative learning activities in their classes.

1. What can I do to encourage students to work together and instead of preferring simply sit back and listen?

2. How do I write appropriate materials that facilitate learning in groups without taking a crash course in dealing with groups?
3. How do I regain control of the class after relinquishing it to the students for their group work?
4. How can grades be assigned meaningfully if some students receive higher grades on group assignments than they would earn individually?

These questions are sometimes enough to prevent a busy faculty member for making the leap to collaborative learning. We provide answers to these questions based on six semesters of using group quizzes in a required sophomore level course in analog electronics in an electrical engineering program.

Using Group Quizzes to Encourage Students to Work Collaboratively

A simple way to encourage students to work together is to take a graded activity that students find stressful and make it a collaborative activity. The in-class quiz is an excellent candidate. If the level of difficulty is set at an appropriate level, even good students will see some benefit in collaborative learning. Furthermore, group quizzes can be used to promote discussion and peer teaching by structuring them so that students are given a minute or two to discuss the quiz before attempting a solution. This can be done in several variations--hence the title, "Variations on the Group Quiz . . ."

Group quizzes provide an easy transition into collaborative learning for two reasons. First, instructors are already used to giving individual quizzes, and only a little extra effort and planning are needed to turn them into collaborative learning events. Second, students are already familiar with taking quizzes, and group quizzes are seen as an improvement over individual quizzes, as we will show in our discussion on student satisfaction.

Group quizzes can be used to facilitate group discussion by giving students a few minutes to discuss various aspects of the quiz before they begin to solve the problem. This can be accomplished by setting aside an amount of time, say two minutes, for group discussion only. This will give students a chance to review the material and plan their strategies. We do not allow any writing or calculating during this period to prevent

groups from starting a solution too soon. The following are several variations on the group quiz that we find effective in promoting collaborative learning.

Variation 1: Promoting Discussion of Basic Principles

Figure 1 illustrates the instructions that are given to promote discussion of basic principles. Discussion time allows students to review the fundamental principles, improve learning, and reduce anxiety.

Instructions: This is a ten-minute group quiz. For the first two minutes, before you read the quiz, **discuss the basic principles that pertain to (name a principle)**. No writing or calculating is allowed during this period. Use this time to discuss the basic principles that you will need to solve the quiz. Do not begin writing until you are instructed to do so.

Figure 1. Promoting Discussion of Basic Principles.

Variation 2: Promoting Discussion of Strategies and Procedures

Another variation on the group quiz is shown in Figure 2. In this variation, students are allowed to read the quiz prior to the group discussion. Discussion time is given so that students can plan their strategies under less pressure.

Instructions: This is a ten-minute group quiz. First read the problem. Then for the two minutes, **discuss possible approaches to solving the problem**. No writing or calculating is allowed during this period. Use this time to discuss possible strategies. Do not begin writing until you are instructed to do so.

Figure 2. Promoting Discussion of Strategies and Procedures.

Variation 3: Using Group Discussion as a Prelude to Individual Work

Instructions: This is a ten-minute individual quiz. Before reading the problem, spend two minutes **discussing the basic principles that pertain to (name the basic concept)** with your group. No writing is allowed during this period. Do not begin writing until you are instructed to do so.

Figure 3. The Individual Quiz as a Group Learning Event

Quizzes taken on an individual basis, which we give approximately 25% of the time for individual accountability, can

be converted into a collaborative learning event without turning them into group quizzes. Figure 3 illustrates this use of the individual quiz in a group context.

Additional Features of Our Group Quizzes

The group quiz is made an effective collaborative learning event by incorporating the following guidelines.

1. During the discussion period that begins each quiz, do not allow students to write. This will force students into a brainstorming process. If students are allowed to write, they often begin to try to solve the problem immediately rather than engage in the brainstorming process.
2. When the quiz is being solved, allow only one person to write. All others in the group should contribute to the group effort through active participation. Otherwise, some groups will choose to work individually and submit the "best" paper, and the synergism of the group is not attained.
3. Sign errors and omission units should lead to larger deductions than on individual quizzes. This will encourage students to participate actively instead of leaving the work to the best student in the group.
4. Quizzes should test basic principles or basic procedures rather than memorization. In our class, students are promised that they will not be expected to recall long procedures. The objectives are to reduce quiz anxiety and to encourage students to focus on the basic principles.
5. Students should be given any information that would be difficult to recall under the stress of a quiz.

Additional Benefits of the Group Quiz

The introduction of collaborative group quizzes into the lecture class benefits students in ways other than active learning. They provide an excellent means for promoting student interaction, they present a convenient mechanism for conveying meta-learning instructional materials to students, and they help reduce students' anxiety with in-class quizzes. A brief description follows.

1. Students can exchange phone numbers and E-mail addresses in as part of an organized classroom activity, eliminating any reluctance on the part of a student to make contact with other students.
2. Groups can be arranged for added value. In our class, we arrange groups using the following process. We first invite students to select their own groups based on personal acquaintances. We then form pools of students based on their availability outside of class for collaborating, i.e., those that can meet in the morning, in the afternoon, and in the

evening. Students in each pool then form groups of three. This improves the chances that the groups can meet outside of class for other learning activities.

3. Taking quizzes in groups helps to remove some of the anxiety associated with individual quizzes, particularly when time to review is allowed.
4. Group discussion helps weaker students see what successful students know and how they think. This prevents students from living in an academic vacuum. Unlike sports and music, where learners can observe the performance of an expert, students cannot observe the workings of the mind of successful problem solvers.
5. The instructor can easily regain control of the class after a group or individual quiz since the time limit provides a natural transition.

Developing Instructional Materials Within the Group Quiz Structure

Group quizzes and individual quiz provides an excellent structure for writing additional instructional materials. These materials can include instruction that helps students improve their critical thinking skills, problem solving skills, and learning skills.

Embedding a Cognitive Lesson in a Quiz

Figure 4 demonstrates how a quiz can be expanded to include a **cognitive** lesson. In this application, the quiz is designed to teach a particular cognitive lesson.

Cognitive lesson: In your last homework assignment, you learned a procedure for determining the voltage gain of an amplifier, given the value of the transconductance of the transistor. In this quiz, you are asked to use the basic principle instead of the procedure in solving a more general problem to demonstrate how an understanding of general principles can help you solve problems more effectively.

Figure 4: Embedding a Cognitive Lesson in a Group Quiz

Embedding a Meta-Learning Lesson in a Quiz

Figure 5 illustrates how a meta-learning lesson can be embedded in a quiz. Meta-learning lessons present students with information that will help them understand the learning process. The lesson embedded in Figure 5 demonstrates that homework problems are not unique entities to be learned and that a homework problem can be inverted by interchanging the known and the unknown.

Meta-learning lesson: The inverted problem is one in which the roles of the known and unknown are reversed. In the homework problem, the voltage gain A_{vi} was determined for a linear amplifier with circuit analysis techniques for a given transconductance. In this quiz, $|A_{vi}|$ is given and the transconductance is unknown. This is not a new problem--it is an **inverted problem**.

Figure 5: Embedding a Meta-Learning Lesson in a Group Quiz.

Concerns About Grade Inflation

Some instructors question use of group quizzes in determining course grades since the contribution of the individual is not easily determined. Our thoughts on this subject are summarized here.

1. Data taken from seven semesters of using group quizzes in a single course is shown in Table 1, which shows a comparison of semester averages for group quizzes, individual quizzes, and individual homework assignments. Table 1 also shows the semester exam averages. A total of 145 students comprised the study. In some semesters, group quizzes or individual quizzes were not given, or homework was not collected.
2. In our class, we also give individual quizzes approximately 30% of the time. Thus in a class that meets 30 times a semester, we may give 16 group quizzes and eight individual quizzes. An analysis of the grades of 145 students in seven semesters of the course shows that the class average on group quizzes is 6.9 points out of 10, and the class average on individual quizzes is 6.3 points out of 10, a reasonably small difference given the collaborative nature of group quizzes. Using different weights for the group quizzes and individual quizzes can easily reduce the effect of the collaborative action on final grades.
3. The correlation between group quizzes and semester exam averages is $r=0.38$ ($p < .001$) for 106 students. The correlation between individual quizzes and semester exam averages is $r=0.53$ ($p < .001$) for 122 students. Thus both group quizzes and individual quizzes demonstrate correlation coefficients with semester exam averages that are significantly different from zero. While it is a quite reasonable that the correlation coefficient is higher for individual quizzes, it is surprising and pleasing that the correlation coefficient for group quizzes is significantly different from zero.
4. We checked the correlation between homework scores and semester exam averages and obtained a value of $r=0.53$ ($p < .001$) for 106 students. Thus while group quizzes have a lower correlation ($r=0.38$, $p < .001$) with semester exam averages when compared with individual quizzes ($r=0.53$,

Table 1. Data From Seven Semesters of Using Group Quizzes.

		Averages (out of 10)			
Term	n	Group Quiz	Individual Quiz	Individual Homework	Exams
Spring '94	33	6.4	6.2	5.7	74.6
Fall '94	16		5.8	4.7	71.5
Spring '95	23			4.5	70.9
Fall '95	21	6.7	6.5	4.6	72.8
Spring '96	10	8.5	6.8	7.5	75.8
Fall '96	22	7.2	6.6		78.0
Spring '97	20	6.8	5.9		71.2
Composite	145	6.9	6.3	5.2	73.5

$p < .001$) and individual homework assignments ($r=0.53$, $p < .001$), the correlation for group quizzes with semester exam averages is not significantly different from the correlation values for individual quizzes and homework.

Table 2. Correlation with Exam Scores

	Correlation
Group quizzes	$r = 0.38$ $p < .001$ $n = 106$
Individual quizzes	$r = 0.53$ $p < .001$ $n = 122$
Individual homework	$r = 0.53$ $p < .001$ $n = 103$

- Incorporating group quiz scores in the determination of an individual's course grade is not unlike using homework scores. Students often collaborate on homework outside of class, and it is difficult to determine how much a student's homework paper represents individual work.
- At the end of the semester in our class, students rate each other's contributions to the productivity of the group. This rating is recorded in the grade book as equal to a quiz. While this may have little effect on final grades, this gives students a feeling of empowerment in their ability to reward or penalize students for their level of contribution to the group's efforts.

Student Satisfaction With Group Quizzes

During the most recent semester, a survey of student attitudes toward group quizzes was conducted. The results confirmed our common sense expectation that group quizzes would be accepted as a favorable alternative to individual quizzes. The following table presents the results of our assessment of student attitudes. The items were scores on a 5-4-3-2-1 basis, where 5 = strongly agree, 4 = agree, 3 = neutral, 2 = disagree, and 1 = strongly disagree.

The information in Table 3 demonstrates a favorable student attitude toward group quizzes. The interpretations of each assessment item are included in the table (column 4). The overall results of the evaluation indicate that quizzes are stressful (#1), students prefer group quizzes over individual quizzes (#4), and they liked the discussion period that preceded the individual quiz (#4) and the group quiz (#5). Students also agreed that the discussion period improved quiz performance (#7), that group quizzes helped that get to know other students (#9) and made the course more interesting (#11), that group quizzes were a good use of class time (#12), and that at group quizzes helped them learn (#14).

Concluding Remarks

Any teaching intervention has its positive features and its negative features, its advantage and its disadvantages. Our use of group quizzes to promote collaborative, active learning in a lecture setting has taken this into consideration, and we have found that the positives greatly overwhelm the negatives. Furthermore, we have kept records of student performance over a period of seven semesters in the same course with the same instructor, and the data as presented in this paper help to confirm our positive impressions of our experiment with using group

Table 3. Student Attitudes Toward Group Quizzes.

	Item	Average	Interpretation
1.	Taking quizzes during the lecture period is stressful.	4.0	Students agreed that quizzes are stressful.
2.	Knowing that a quiz would be given each class period motivated me to stay on schedule with the homework assignments.	3.9	Students agree that quizzes motivated them to solve homework problems.
3.	I would rather be required to submit all the homework assignments each period than be given a quiz each period.	2.6	Students preferred to take quizzes than submit homework.
4.	I would rather take group quizzes than individual quizzes.	3.4	Students leaned mildly toward group quizzes over individual quizzes.
5.	Giving students a minute or two to discuss the principles associated with a quiz was a positive factor in taking individual quizzes.	4.0	Students liked the discussion period preceding an individual quiz.
6.	Giving students a minute or two to discuss the principles associated with a quiz was a positive factor in taking group quizzes.	3.9	Students liked the discussion period in a group quiz.
7.	Giving students time to discuss the principles before taking a quiz improved my performance on quizzes.	3.8	Students agreed that discussion improved performance on quizzes.
8.	Instead of giving a group time to discuss the principles associated with a quiz, it would be better to give students extra time to solve the quiz problem.	2.8	Students liked spending some quiz time to discuss rather than more time to solve the quiz problem.
9.	Working in groups helped me get to know other students in the class.	4.1	Students agreed that working in groups helped them to get to know other students.
10.	I have had few engineering classes in which group quizzes were given on a frequent basis.	3.2	Students were fairly neutral on this item.
11.	Working in groups on quizzes made the course more interesting.	3.8	Students agreed that group quizzes made the course more interesting.
12.	Using part of the class period for group quizzes is a good use of class time.	3.6	Students mildly agreed that giving group quizzes was a good use of class time.
13.	I did more than my fair share of the work on group quizzes in my group.	2.8	Students mildly disagreed that they did more than their fair share of work on group quizzes.
14.	Taking group quizzes is an effective way of increasing student learning.	3.7	Students agreed that taking group quizzes helped them learn.
15.	Group quizzes should be given in other classes to help students learn the material.	3.5	Students mildly agreed that group quizzes should be used in other classes.

16.	Students working in a group quiz should be allowed to solve the quiz independently and select the best one to submit.	3.1	Students were neutral on this item.
17.	Quizzes helped me focus on what I need to learn.	4.0	Students agreed that quizzes helped them focus on what to learn.

quizzes. Group quizzes provide a natural transition from individual effort to collaborative effort because both teacher and students are already familiar with in-class quizzes, and they can serve several purposes in the learning process. Using group quizzes requires only a modification of a familiar event is required instead of a new effort. A statistical assessment of grades earned by students demonstrates that group quizzes correlate positively with exam scores and are not very different from individual quizzes and homework in their relationship with semester exam averages. We recommend their use as a means for an instructor to easily introduce collaborative learning in the lecture class.

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