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Maximizing Student Learning with the Use of Random Oral Questioning in the College Classroom

Hettie J. Buck
Florida Institute of Technology

Abstract: This research study investigated the effectiveness of random oral questioning during class lectures and discussions to promote consistent preparation, active participation and higher course achievement among undergraduate students. Treatment subjects were called upon by name to answer questions pertaining to assigned readings or the current topic of discussion. Control subjects were permitted to answer identical questions on a voluntary basis. The effect of random oral questioning across varying levels of self-regulated learning was also investigated, as was the effectiveness of the technique in reducing measured levels of student classroom communication apprehension. Treatment subjects obtained significantly higher levels of course achievement than did control subjects, indicating the benefits of the instructional method. The "simplicity" of random oral questioning may facilitate widespread implementation of the technique at the undergraduate level.

Educational theorists such as Bruner and Piaget have stressed the importance of student involvement in the learning process. This constructivist view of learning denies the notion that students can effectively acquire new knowledge simply by absorbing information provided by a teacher. Rote memorization or the regurgitation of facts does not exemplify learning or understanding (Pines and West, 1986). Rather, students should be active seekers and processors of information, not passive recipients (Schunk, 1986; Davis & Murrell, 1994) and communication through discussion needs to complement or replace the memorization of finished knowledge (Hauser, 1990). For meaningful learning to take place, students need to construct their own knowledge by assimilating and integrating new concepts. This constructivist approach to teaching "puts the student in the drivers seat" (Perkins, 1992) and stresses the importance of active student engagement.

Unfortunately, many undergraduate students are not actively engaged in the learning process (McKeachie, 1994; King, 1993). This lack of student engagement manifests itself when students fail to do assigned readings, are inattentive during lectures and fail to participate in class discussions. Disengagement in the form of nonpreparedness and off-task behaviors during class has a strong negative impact on student achievement (Nystrand & Gamoran, 1989).

Preparedness

Frequently, professors request that students complete assigned readings prior to a lecture or discussion. This request is based on the premise that "the quality of the classroom experience for

both instructors and students is impacted by the extent to which students prepare themselves to engage actively in the learning process" (McDougall & Cordeiro, 1992, p. 193). Current research indicates that in the absence of periodic verification, many students fail to complete assigned readings on a timely basis but rather choose to do the assigned reading just prior to an examination, if at all (Tuckman, 1994; McDougall & Cordeiro, 1992).

As stated previously, constructivist theory purports that knowledge is not transferred from one person to another but rather, knowledge is a state of understanding. As such, knowledge must be constructed by each individual learner through a process of trying to make sense of new information and relating this information to what the learner already knows (King, 1993). During classroom lectures most unprepared students are receiving information and memorizing it rather than actively analyzing, synthesizing and evaluating the subject matter. In addition, generalizations may be stated by the instructor that may not be apparent to the unprepared student or the instructor may provide solutions to problems before students have developed an answer or meaning for themselves (McKeachie, 1994). When students attend class unprepared and merely "take in" information dispensed by the teacher, there is nothing to insure this information will be internalized (King, 1993).

Participation

In addition to the need for timely preparedness, students also need to actively participate during the learning process by expressing their ideas. In other words, student engagement in the form of participation is also important for meaningful learning. Smith's 1975 descriptive study (as cited in Heckelman, 1985) reported that when students participated in classroom discussions their outcome measures were higher than when student participation was not present. Students need to find their own voices and verbally express their interpretation of course content (Morgenstern, 1992; Hauser, 1990).

Questions posed during a class lecture or discussion can provide a means for instructors to ascertain what students know and how well students can verbalize their understanding of course material. Research indicates that skilled questioning techniques can foster thoughtful and reflective learning leading to higher levels of academic achievement (Gall, 1984; Dean, 1986) yet, many college instructors rely heavily on the lecture method of instruction to present information. "The lecture is probably the oldest teaching method and still the method most widely used in American colleges and universities (McKeachie, 1994, p. 53). This "transmittal" mode of instruction may be necessary but not sufficient for optimal learning.

When instructors at the undergraduate level do incorporate questions into classroom lectures or discussions, they typically permit students to voluntarily respond to the questions. Under such circumstances a few students participate frequently, but a majority of students participate infrequently or not at all, which places many students in a passive role. In her 1992 ethnographic study, Morgenstern found that only a small core of students participated regularly in classroom discussions and as the term progressed, a "participation pattern" emerged. She found that the responses of four

to six students accounted for seventy to eighty percent of all student speech during the observed classes and that some students never said a word in class throughout the fifteen week semester. The instructional method of soliciting voluntary responses to posed questions may actually be reinforcing student nonpreparedness and nonparticipation, thus limiting active student engagement (McDougall & Cordeiro, 1992).

There is a continual need to improve the quality of student learning at the undergraduate level (McKeachie, 1994). "Because learning is a constructive process and instruction involves helping students integrate old and new knowledge appropriately, the optimal goal of any instructional strategy is to help students take more responsibility for their own learning and integration of knowledge" (Weinstein & Meyer, 1991, p. 25). This study investigated the effectiveness of random oral questioning in the college classroom. The technique can be employed during a class lecture or discussion whereby individual students are called upon by name, in random order, to answer questions pertaining to the assigned readings or the current topic of discussion (McDougall & Cordeiro, 1992). The technique of random oral questioning may be an efficient and effective instructional strategy to promote timely preparedness and active student participation, which may in turn enhance student learning and course achievement.

Self-Regulated Learning

This study also investigated the relationship between the instructional technique of random oral questioning and the construct of "self-regulated learning". Self-regulation can be broadly defined as one's ability to exercise control over one's actions (Tuckman, 1990). Research indicates that the self-regulation of cognition and behavior are important aspects of student learning and academic achievement (Pintrich & DeGroot, 1990; Corno, 1986; Schunk, 1986; Zimmerman & Martinez-Pons, 1988; Zimmerman, 1989; Lindner & Harris, 1992). When students lack the ability to self-regulate their learning, class preparedness and thus academic achievement may be negatively impacted. Although it was predicted that the treatment technique of random oral questioning would promote higher levels of achievement for all students, the technique could prove especially beneficial for students with low measures of self-regulated learning, indicating an ordinal aptitude treatment interaction.

It is also evident that motivational factors mediate the utilization of metacognitive strategies and effort management (Pintrich & DeGroot, 1990). Although measured differences in student motivation were not addressed in this study, the technique of random oral questioning could be an incentive for some students. Specifically, the "social pressure" of being called upon to orally answer questions could motivate students to more adequately prepare for class. Students would not want to appear unprepared or "foolish" in the presence of the instructor or their peers. Students could also be motivated to pay closer attention during lectures or discussions because the order of questioning is not prescribed. Thus, students would also be less likely to become "disengaged" during class lectures or discussions.

Classroom Communication Apprehension

In addition to the lack of self-regulated learning, a student's predisposition not to communicate during class discussions may also adversely impact his or her achievement. Accordingly, the construct of "classroom communication apprehension" was also incorporated into this study. This construct as defined by Neer (1987) refers to the avoidance of verbal participation in the classroom.

Accumulated research shows that students with high levels of classroom communication apprehension generally avoid class discussions or maintain a low interaction profile when they do participate (Neer, 1990). Studies also suggest that instructional techniques which emphasize voluntary student participation may hinder students with high levels of communication apprehension. Such students are unnecessarily "placed at a competitive disadvantage because they are too apprehensive to engage in the behaviors required to achieve success" (McCroskey & Andersen, 1976, p. 80).

Neer suggests that classroom communication apprehension can be mediated in part by instructor behaviors or instructional techniques. Random oral questioning may prove to be an effective technique to increase class participation especially for students with high levels of communication apprehension thus "mainstreaming" these students into class discussions. It was predicted that the instructional technique of random oral questioning would significantly reduce levels of classroom communication apprehension and enhance engagement by requiring routine participation on the part of all students during lectures and discussions.

Method

Population and Subjects

The target population or the population of interest for this study consisted of undergraduate students enrolled in four year academic programs at competitive colleges or universities in the United States. The accessible population consisted of approximately 1,800 undergraduate students enrolled at a technological university in east central Florida. The effective sample was comprised of 52 undergraduate students enrolled in two sections of an aviation chemistry course.

Instrumentation

The construct of self-regulated learning was measured using the Motivated Strategies for Learning Questionnaire (Pintrich, Smith, Garcia, & McKeachie, 1991). The Motivated Strategies for Learning Questionnaire (MSLQ) is a self report inventory designed to assess college student's motivational orientations and learning strategies. The instrument consists of 81 Likert type statements within 15 subscales. The subscales of the MSLQ are modular and were designed to be used jointly or independently to fit the needs of researchers or instructors (Pintrich et al., 1991). Three of these subscales were used in this study to collect information pertaining to metacognitive and effort management strategies. Internal reliability coefficients (Cronbach's alpha) for these three

subscales are reported as follows: Metacognitive Self-Regulation: alpha = .79, Time Management and Study Environment: alpha = .76, and Effort Regulation: alpha = .69 (Pintrich et al., 1991).

The Class Apprehension about Participation Scale (CAPS) was used to measure classroom communication apprehension. The instrument is a self rating scale and consists of 20 Likert type statements. The CAPS not only assesses generalized communication apprehension as established through its correlation with other communication apprehension instruments, it also functions as an instrument to assess "classroom-specific" communication apprehension (Neer, 1987). Reliability of the CAPS was evaluated using Cronbach's alpha. The internal consistency was found to be .94 and the CAPS is considered to be a highly reliable measure of classroom communication apprehension (Neer, 1987).

Student course achievement was measured using instructor designed examinations. Parallel make-up exams were administered as needed to students who missed an examination. All exam items were reviewed for content validity by experts in the field of aviation chemistry. Split-half reliability coefficients for instructor designed examinations ranged from .84 to .90.

Procedures

To insure an adequate length of intervention, this study took place over a full academic semester (approximately 15 weeks). Treatment and control sections covered the same course content and all materials, such as textbooks and handouts, were identical. All assignments and student assessments were also identical.

Intact sections were randomly assigned to either a treatment or control condition. The treatment section was taught using the instructional technique of random oral questioning. This method entails posing questions during a lecture or discussion and randomly calling on a specific student by name, to respond. Random order was established by providing the instructor with a computer generated random list of student names. A class seating chart for the treatment section was developed to facilitate the questioning process. The control section was taught using the conventional instructional method of permitting students to voluntarily respond to posed questions.

To control for unwanted variance in implementation, all questions posed during class lectures and discussions were prepared in advance and were identical for the treatment and control groups. These questions were based on the assigned reading material or the current topic of discussion . The design and delivery of the questions incorporated the findings of prior research (Redfield & Rousseau, 1981; Gall, 1984; Kaplan & Kies, 1994). Specifically, questions were developed at the various levels of Bloom's taxonomy for each course topic with the predominant use of higher level cognitive questions.

A detailed syllabus was given to students during their first class meeting. The syllabus described course policies and requirements including specific due dates for all assigned reading. One of the most common causes of nonpreparedness among undergraduate students is that students don't know

exactly what is expected of them (McKeachie, 1994). In addition to the written syllabus, all students were informed verbally that they were expected to complete required reading prior to the lecture or discussion for which the reading had been assigned. Students in the treatment group were also told they would be called upon at random during lectures or discussions to orally answer questions about the assigned readings. Students in the control group were not given these instructions.

All students completed three subscales of the Motivated Strategies for Learning Questionnaire (MSLQ), the Class Apprehension about Participation Scale (CAPS), and a demographic form. The CAPS was readministered during the last week of classes. Examinations were given during regularly scheduled class meetings with the exception of the final examination which was given during final exam week.

Numerous classroom observations were conducted to verify proper implementation. The treatment and control sections were frequently observed to insure the same questions were being asked of both groups. The number of questions posed to students during each class meeting was also documented.

Results

Group means and standard deviations for the Motivated Strategies for Learning Questionnaire (MSLQ) and the Class Apprehension about Participation Scale (CAPS Pretest and CAPS Posttest) are presented in Table 1.

Table 1
Descriptive Statistics for Measures of MSLQCAPS Pretest and CAPS Posttest

	Treatment Group		
	MSLQ	CAPS Pretest	CAPS Posttest
Mean	114.20	48.95	45.26
SD	21.74	18.37	15.96

	Control Group		
	MSLQ	CAPS Pretest	CAPS Posttest
Mean	108.06	52.03	50.78
SD	16.94	18.99	15.16

Possible scores on the MSLQ range from a low of 24 to a high of 168. Higher scores on this instrument are favorable as they indicate higher levels of self-regulated learning. Possible scores on

the CAPS range from a low of 20 to a high of 100. On this instrument, low scores are preferable as they indicate less reluctance to participate during classroom discussions. Group means and standard deviations for examination scores are presented in Table 2.

Table 2
Descriptive Statistics for Student Achievement

	Treatment Group			
	Exam 1	Exam 2	Exam 3	Final Exam
Mean	81.60	89.40	70.79	78.47
SD	13.33	7.36	17.35	11.13
	Control Group			
	Exam 1	Exam 2	Exam 3	Final Exam
Mean	67.56	70.79	58.59	71.34
SD	16.67	18.70	15.10	12.45

Hierarchical multiple regression was used to test the effect of group membership (treatment or control) on student course achievement. Regression analysis revealed that a significant proportion of the variance in student course achievement was explained by group membership [$F(1, 50) = 8.4$, $p < .05$]. The regression coefficient for the dummy coded variable of group membership indicated the treatment group surpassed the control group in course achievement.

Step two of the analysis tested the effect of self-regulated learning, as measured by student MSLQ scores, on the variance in student course achievement scores. This was done by entering student MSLQ scores into the regression equation and calculating the semipartial correlation coefficients. The semipartial correlation coefficient indicates the proportion of variance in the dependent variable uniquely accounted for by a given independent variable, beyond the variance accounted for by the other independent variables in the equation (Cohen & Cohen, 1983). A test of the semipartial correlation coefficient revealed that MSLQ scores contributed significantly to the variance in student course achievement beyond the variance explained by group membership [$F(2, 49) = 3.8$, $p < .05$].

Step three of the analysis investigated the possibility of an aptitude treatment interaction (ATI) by examining the interaction between the aptitude of self-regulated learning and the treatment condition of random oral questioning. The interaction term which was carried by the product of the two previously entered variables was entered into the equation and the semipartial correlation

coefficients were again tested for significance. No significant interaction was found, indicating that an aptitude treatment interaction was not present. The results of these regressions are presented in Table 3.

Table 3
Membership, MSLQ and Interaction Term on Student Course Achievement

IV Added	df	Cum.R^2	I	F
Group Membership	1,50	0.144	0.144	8.43*
MSLQ Scores	2,49	0.206	0.062	3.82*
Interaction Term	3,48	0.207	0.001	0.05

Note. I = Increment in R^2
*$p < .05$.

Repeated measures t tests revealed no significant reduction in classroom communication apprehension for the treatment section t (19) = 1.81, $p > .05$, nor the control section t (31) = 0.44, $p > .05$.

Conclusions and Recommendations

Discussion of Results

This study sought to determine the effectiveness of random oral questioning in the college classroom. It was predicted that the instructional technique of random oral questioning would significantly increase student course achievement. Regression analysis of group membership (treatment or control) and course achievement produced a significant F value (see Table 3). The aviation chemistry treatment section surpassed the control section on all in-class examinations and the final examination. Calculated effect sizes for each of the four examinations ranged from .57 to .99 with an overall effect size of .75. Such effect sizes indicate the practical significance of using random oral questioning in the college classroom in addition to the already demonstrated statistical significance of the instructional technique.

These findings are in agreement with McDougall and Cordeiro (1992, 1993). Although their studies investigated student *expectation* of random oral questioning rather than the actual implementation of the technique, they reported that the experimental group means were significantly higher than the control group means across numerous replicated experiments.

It was also predicted that there would be a significant interaction between the treatment condition of random oral questioning and the aptitude of self-regulated learning as measured by student MSLQ scores. The aptitude of self-regulated learning did explain a significant amount of the

variance in student course achievement beyond that explained by group membership, but there was not a significant interaction. In other words, even though the treatment condition of random oral questioning proved highly effective in increasing student course achievement, the treatment was not differentially or selectively effective for students across varying levels of self-regulated learning. When the interaction term is found to be non-significant, it is assumed the regression is homogeneous across groups. This implies that the instructional technique of random oral questioning can significantly increase course achievement regardless of a student's level of self-regulated learning.

In addition to measured differences in student achievement, classroom observations revealed a striking difference between the treatment and control groups regarding preparedness. Students in the treatment section were consistently willing and able to respond to the instructor's questions. On several occasions every question posed during a given class meeting was answered correctly by the individual student who was called upon to respond. On the contrary, students in the control group were unprepared and very reluctant to respond to posed questions. The instructor often needed to provide answers to the posed questions himself as no student was willing to respond.

An additional analysis investigated the effectiveness of random oral questioning in reducing levels of student classroom communication apprehension. It was predicted that the technique of random oral questioning would significantly decrease student posttest CAPS scores after controlling for pretest CAPS scores. A comparison of pretest and posttest CAPS scores, as presented in Table 1, indicates that students in both sections showed reduced levels of classroom communication apprehension although this reduction was not found to be statistically significant. The reduction of classroom communication apprehension is a positive outcome but because the reduction applies to students in both sections this result can not be ascribed to the treatment condition of random oral questioning.

Limitations

It is believed that prior academic achievement posed the greatest threat to the internal validity of this study since differences in current course achievement could be attributable to differences in prior achievement (pre-existing differences) rather than the treatment condition. Data on prior academic achievement were analyzed and no significant difference between the treatment and control sections was found. (The analysis was based on students with an available GPA at the beginning of the academic semester, $t\,(42) = 1.83, p > .05$).

It is unlikely that the attitude of subjects in this study posed a threat to the internal validity. The written syllabus outlining course policies and requirements was exactly the same for the treatment and control groups. In addition, the questioning techniques used in each section were probably considered a "regular" part of class instruction rather than a manipulated condition.

Summary and Recommendations

The instructional technique of random oral questioning has been shown to be beneficial for students. When instruction was conducted using the technique, students were more actively engaged in their learning process than were students in a control section where the technique was not used. This higher engagement was accompanied by higher course achievement. Assuredly, replication of this study could enhance the generalizability of the findings.

An important goal of education is to enable each student to synthesize and apply his or her existing knowledge to new learning situations. For students, the real value of random oral questioning may be found in the enhanced retention and application of learned material. Future studies might investigate the technique's effect on long term retention and application of covered material especially for academic courses offered in a progressive sequence. The comparative utility of random oral questioning versus more common strategies such as pop quizzes to increase student preparedness, engagement and course achievement might also be investigated.

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