

## **Application of the ExCEED Approach in the Classroom**

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### **Abstract**

The American Society of Civil Engineers (ASCE), the United States Military Academy (USMA) and the National Science Foundation (NSF) have joined forces to improve the quality of teaching of instructors and professors in Civil Engineering departments across the country. In an effort to attract, retain and graduate civil engineering students, USMA, ASCE and NSF have been offering a week long faculty development program since the summer of 1999 called "Excellence in Civil Engineering Education (ExCEED)." This teaching methodology emphasizes six main points: (1) the preparation of a list of objectives; (2) the use of board notes and colored chalk; (3) the pursuit of class interaction between students and professors, (4) the use of physical models, (5) the use of variety of teaching techniques and (6) the pursuit of collaborative learning. This approach was implemented in the author's fall and spring classes and at the end of each semester, the students were surveyed about the author's effectiveness in his ExCEED approach to teaching. The results of the student surveys indicated that lower division students ranked the usefulness of detailed list of class objectives, the highest. Also, the ranking of the list of objectives increased subsequent semesters for the same course. With regard to collaborative learning, the group quizzes were ranked generally higher by the lower division students. The ranking of individual quizzes were ranked the lowest. It was observed that the group quizzes generated collaborative learning, feedback about their understanding of the topic and lively team discussions, which was evident in the survey.

### **Introduction**

The American Society of Civil Engineers (ASCE), the United States Military Academy (USMA) and the National Science Foundation (NSF) have joined forces to improve the teaching skills of Civil Engineering faculty across the country. The model for teaching and learning promoted by this workshop emphasizes orientation, the use of detailed list of class learning objectives, provide information, stimulation of critical thinking about the subject, the use of physical models, the creation of opportunities to apply the knowledge, the assessment of student performance with constructive feedback, and the creation of opportunities for self-assessment. The main reason for initiating the effort to improve teaching is that 41% of students switch their initially chosen major in engineering with 98% of these students citing poor teaching as the contributing factor<sup>1</sup>. This problem is being evaluated through research with the GRASP program.<sup>2</sup>

The ExCEED workshop is a week long intensive faculty development program. The participants are divided into teams of four with each group assigned a head and assistant mentor. The workshop includes formal presentations of teaching techniques, and class demonstrations using the technique by the workshop faculty. An important aspect of the workshop is that the participants are given the opportunity to apply the techniques in the form of a 30 minute and 50 minute lecture during which the participant is video-taped. In addition the group mentors provided constructive feedback of the lecture. In an effort to attract, retain and graduate civil engineering students, USMA, ASCE and NSF have been offering the week long short courses during the summers of 1999, 2000 and 2001. These short courses are titled "Excellence in Civil Engineering Education (ExCEED)." About 24 professors are selected from across the country to attend each session.

This teaching approach emphasizes six main points: (1) the preparation of a detailed list of class objectives for each class time, (2) the use of board notes and colored chalk, (3) the pursuit of class interaction between students and professors, (4) the use of physical models to illustrate topics to be covered in class, (5) the use of a variety of teaching techniques to reach most of the students and (6) the pursuit of collaborative group learning. Some of these methodologies were utilized in the author's civil and geological engineering courses. At the end of the semester an opinion survey was distributed the students asking them to rank the usefulness of the more detailed list of class objectives and group quizzes.

### **Objective**

The main objective of this study was to determine the reaction of the students with respect to the partial implementation of the lessons learned at the Summer 2000 ExCEED workshop. The group quizzes and detailed class objectives were selected for evaluation due to the fact that they are easier to carry out in the classroom environment. The group quizzes were intended to increase group and collaborative learning and indirectly, to increase the interaction among students and the instructor. This approach served as an opportunity to pose critical thinking through higher level questions to be solved in a collaborative way.

### **Methodology**

#### **Group Quizzes**

Group quizzes consisted of 1 or two questions administered at the beginning or end of the 50 minutes classes to be completed within 5 to 10 minutes. Students were given an average of 5 to 10 quizzes per semester. In one class, Foundation Design, the quizzes were administered mainly during lab time and these quizzes were longer and more complex. Usually, the questions were selected from topics that the author noted to be difficult for students to grasp in previous semester exams and/or projects. The students were asked to divide into groups of two or three to solve the problem. Many times these quizzes were open book and open notes. Each group submitted one quiz for grading. In some occasions, some students preferred to work independently. The result of the quiz also served as a good indicator of their understanding of the topic. In several occasions, these group quizzes provided the author with quick, direct feedback

that alerted me the shortcomings of the class. Therefore, it was used to clarify some of the weak points encountered in the class.

One of the quizzes asked the students determine the hydraulic gradient in a permeability test setup. Most students are able to use Darcy's equation by heart, but a geometric deviation from the typical permeameter illustrated in textbooks or in class become confusing to apply the equation if they do not understand the concept very well. If the student has a good grasp of the concept, however, he or she will answer it correctly, no matter how the permeameter setup or field problem is arranged.

Questionnaires were handed out along with the final exam. The students were told that these questionnaires are not part of an evaluation, but to solicit their opinion about the group quizzes and detailed course objectives. The questionnaire was titled "ASCE ExCEED TEACHING TECHNIQUES EVALUATION." Six statements were listed related to group quizzes which were as follows:

1. It allowed me to teach or explain to members of my group.
2. I was able to learn from my group members.
3. It helped me to get feedback from my group members about my understanding of the subject.
4. All group members participated to solve the quiz.
5. I was given group quizzes in other classes at NMSU.
6. I prefer to take individual quizzes.

The above statements were designed to be answered by choosing one answer from five choices. These answers were very similar to the terms used in class evaluation by our department. These choices ranged from strongly agree, agree, no opinion, disagree and strongly disagree. The objective of the six statements that were used in the survey was to determine if there was interaction and collaborative learning among team members. Question one was used to determine if the student contributed in the team effort by teaching or explaining to his or her team members. Question 2 was used to determine if he or she was able to benefit from this interactive and collaborative learning. Question 3 asked if the students got feedback from their group, which either reinforced his/her understanding of the topic or clarified his/her misunderstanding. Question 4 was used to determine if the group members participated actively or they were passive observers leaving the thinking and solution of the problem to certain individuals. Question 5 was used to determine if this type of quizzes were administered in other courses at NMSU campus. The last question was used to determine if the students preferred to take the conventional, individual quizzes.

Initially, the students appeared to have difficulty in pairing with another or forming a group with another student to solve the problem. After the second quiz, however, the students formed groups without any difficulty. Many upper level students in the senior level class, where the quizzes were longer, distributed the work among their members. These groups generally finished their quizzes very fast and many times they helped other groups to solve the assignment. The ultimate goal of the group quizzes were to make the students interact, learn, and provide feedback about their understanding of the topic.

## **Class Objectives**

Class objectives of the day were listed on the board before the class began in two classes, Foundation Engineering and Geohydrology. These courses are senior level courses and most of the students are in their last year or semester. On the other hand, most of the students are freshmen and sophomore in Geology for Engineers. In this class, the class objectives were provided chapter by chapter and given out after an exam or when a lesson was completed. The words used in the class objectives were: explain, describe, calculate, design, define, etc. as suggested by professors at the ExCEED workshop. In the class objectives questionnaire, there were five statements which were as follows:

1. The class objectives before class allowed me to focus on the given topics.
2. The list of objectives helped me to prepare for the exams.
3. The exams were in accordance with the list of objectives.
4. Instructor should continue listing class objectives.
5. The syllabus is a sufficient list of course objectives.

## **Results**

The results of the survey were analyzed class by class and for each semester. The course of Geology for Engineers was surveyed for two consecutive semesters. On the other hand Foundation Design was surveyed only one semester. The Geohydrology survey was not included in this study due to the low number of students and graduate student enrollment. The results were ranked as 4 points for strongly agree, 3 points for agree, 2 points no opinion, 1 point disagree and 0 for strongly disagree.

## **Group Quizzes**

With respect to question 1 for group quizzes, 18% of the surveyed students strongly agreed. Seventy percent agreed and only less than 10 percent had no opinion. The ranking of the responses to questions 1, 2, 3, and 4 were equal to 3 and greater. This indicates that most of the students agreed or strongly agreed with these questions (Figure 1 and 2). Another observation from Figure 1 is that during the second semester of administration of the group quizzes in the Spring 2001, the response ranking to questions 1, 2, and 3 showed an improvement. This might have been the result of better management and experience as a result of the previous semester in handling of the quizzes with respect to organization, proctoring and confidence. In general, the response of the survey by students taking lower division courses indicate that the administration of group quizzes are favored and slightly improved during the following semester, even though the responses that fall under no opinion and disagree increased also.

Question 4, which asks if all members of the group participated in the solution or brainstorming of the problem, remained very much the same in the Fall of 2000 and Spring of 2001. When we compare the ranking by students taking the upper division course and the lower division courses with respect to question 4, students taking the lower division course rate the group quiz higher than the students taking the upper division course. Both groups of students taking lower division

and upper division course ranked questions 1, 2, 3, and 4 as either agree or strongly agree. Regarding to question 6, the students taking the upper division course favored much less taking lower division course to take the individual and conventional quizzes (Figure 2). Both groups of students had opinions in the zone of disagree and strongly disagree with few having no opinion. This trend might be developing as a result of ABET requirement of collaborative and team work in upper level courses as part of capstone design courses.

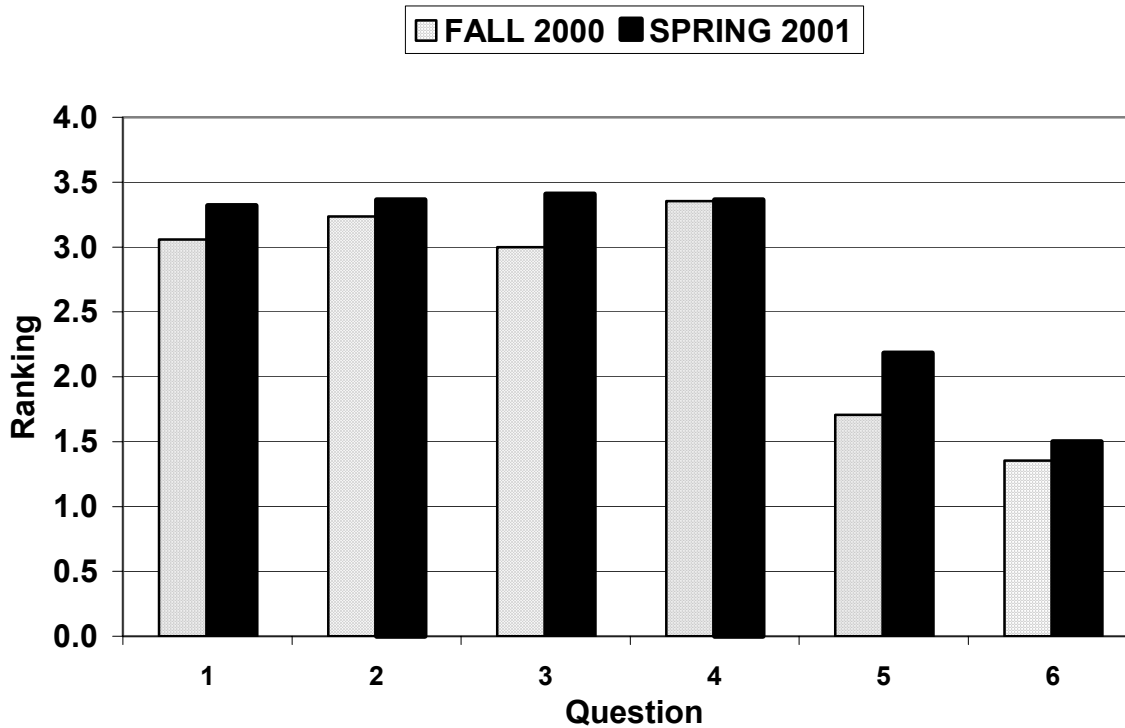


Figure 1. Ranking of group quizzes administered to students in Geology for Engineers during two consecutive semesters.

By comparison of the results of the survey between the upper and lower division courses, the response is very similar for questions 1, 2, 3 and 4. The disfavor for taking conventional quizzes further increases among students taking upper level courses (Figure 2). The net effect of strongly agree and agree do not change. The percentage of students without opinion remained less than 10 percent. When students were asked about taking individual quizzes, more than 65% disagreed and strongly disagreed.

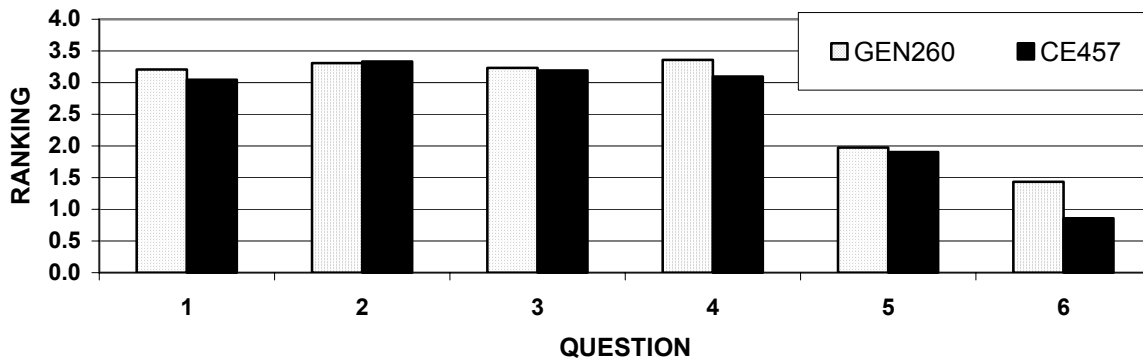


Figure 2. Comparison of the ranking of group quizzes administered to students taking lower and upper division courses.

### List of Objectives

With respect to the list of class objectives in the lower division course of Geology for Engineers, about 12% strongly agreed, 82% agreed and 8% disagreed with respect to question 1. More than 80% of the students agreed and strongly agreed to be given a more extensive list of class objectives. The ranking improved for every question the following semester compared to the previous semester. The author believes this improvement could also be the result of previous experience in providing detailed list of class objectives (Figure 3). On the other hand, students taking the upper division course of Foundation Design did not consider important the detailed list of class objectives. All of the questions answered by upper level students fall in the range of no opinion. This attitude might be the result of a developed habit of organization and experience gained through trial and maturity as an undergraduate student (Figure 4).

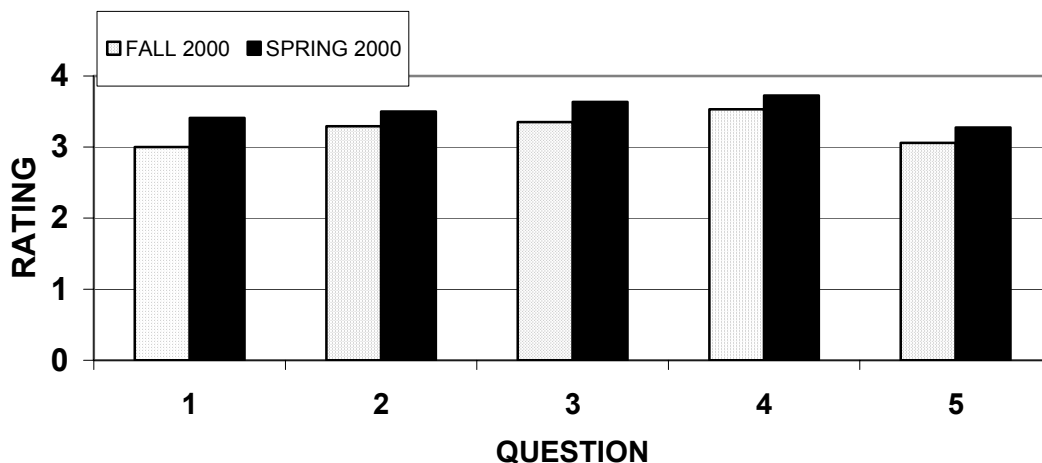


Figure 3. Ranking of the detailed list of class objectives by students taking lower division courses.

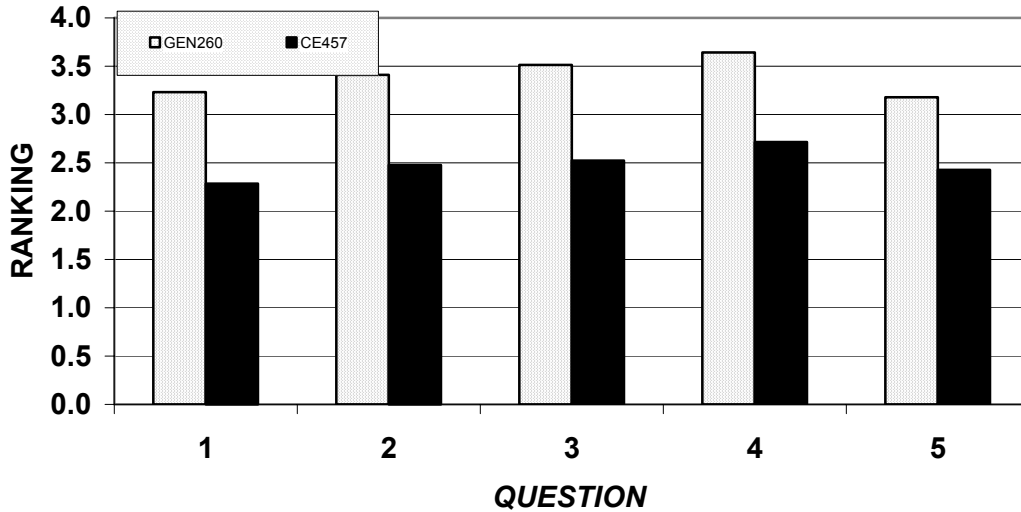


Figure 4. Comparison of ranking of the usefulness of detailed list of class objectives by students taking lower and upper division courses.

### Conclusion

The detailed list of class objectives appears to be very important for students taking lower division classes (freshmen and sophomore). It also appears that the upper level students (seniors and juniors) have developed study and organizational habits that work for them, therefore, the detailed list of course objectives is not as important for them. On the other hand, the group quizzes were ranked high by students taking lower and upper division courses. The group quiz is an excellent mean to pose critical questions or problems that force the students to exchange ideas and brainstorm. The nervousness and blank stares are absent when they are asked to work in small groups.

### References

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2. McShannon J. and P. Hynes. Gaining Retention and Achievement for Students (GRASP), a Faculty Development Program and a Method for Data Collection for ABET 2000. *In Proceedings of the 2001 American Society for Engineering Education, Annual Conference and Exposition.*

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Dr. Lozano currently serves as an Assistant Professor of Civil and Geological Engineering at New Mexico State University. His research interests include digital image processing of remotely sensed images and geotechnical properties of fine-grained soils with respect to swelling and permeability in interaction with waste products.