

AC 2010-69: ENGINEERS OF THE ROUND TABLE: UTILIZING A DISCUSSION FORUM TO ENHANCE STUDENT LEARNING IN GEOTECHNICAL ENGINEERING

Tanya Kunberger, Florida Gulf Coast University

Dr. TANYA KUNBERGER is an Assistant Professor in the Department of Environmental and Civil Engineering in the U.A. Whitaker School of Engineering at Florida Gulf Coast University. Dr. Kunberger received her B.C.E. and certificate in Geochemistry from the Georgia Institute of Technology and her M.S. and Ph.D. in Civil Engineering with a minor in Soil Science from North Carolina State University. Her area of specialization is geotechnical and geo-environmental engineering.

Robert O'Neill, Florida Gulf Coast University

Dr. ROBERT (Bob) O'NEILL is Chair of the Department of Environmental and Civil Engineering in the U.A. Whitaker School of Engineering. Dr. O'Neill received his B.S. from the United States Military Academy at West Point in 1975, M.S. in Structural and Geotechnical Engineering from Stanford University in 1984, and a Ph.D. in Structural Engineering from Kansas State University in 1993. Before joining FGCU in August of 2006, he was a Professor of Civil Engineering at Roger Williams University in Rhode Island. Prior to his tenure at Roger Williams University, he served as a member of the senior faculty in the Department of Civil and Mechanical Engineering at West Point. Dr. O'Neill is a retired US Army Corps of Engineers Lieutenant Colonel. His area of specialization is structural engineering. He is a member of the American Society of Civil Engineering (ASCE) where he is an active member of the Committee for Faculty Development and an ExCEED Mentor. Dr. O'Neill is a civil engineering program evaluator for the Accreditation Board for Engineering and Technology (ABET).

Engineers of the Round Table: Utilizing a Discussion Forum to Enhance Student Learning in Geotechnical Engineering

Abstract

Analysis and design are often critical components of most senior level courses, particularly those that follow introductory courses. Emphasis tends to be placed on the calculations necessary to ensure proper design and/or analysis can be performed, and that results conform to established standards of the given topic. This paper considers the concept that students should be able not only to analyze or design particular components or systems, but also be able to analyze, evaluate, and comment upon work that has been accomplished by others in the field. The belief is that it is important to focus on the students' ability to synthesize information, to be able to critically evaluate research that has been done by others in the various areas of engineering, and to relate the analysis and design that students are performing in the classroom to a larger picture of what is occurring in engineering.

This paper discusses the incorporation of discussion forums (roundtable discussions) into a senior level geotechnical engineering course. The class is the second in a two course sequence in geotechnical engineering, and required for all civil engineering majors. Roundtable discussions occurred on a weekly basis and focused on a technical paper related to current class topics. Prior to coming to class, students were expected to have read the paper, as well as considered the discussion questions provided to them by the instructor. A portion of these discussion questions were specific to the paper itself, while others were more general in nature and the same for all roundtable papers. Many of the paper specific questions were designed to focus discussion on the important points, while the more general questions were open-ended and allow for flexibility in the direction of discussion. Students were asked to participate in full class discussions and smaller group discussions, as well as online wiki (collaborative website which allows for community editing to develop a cohesive, interactive, and constantly evolving source of information) discussions outside of class. Every paper did not utilize every discussion technique, but rather techniques were varied with the intent of maximizing student interest, participation, and, ultimately, learning.

The idea of developing the skill to critique others' work, comment on strengths in a paper or proposed hypothesis, in a particular research program or a given case study, assists in addressing ABET outcomes g (an ability to communicate effectively), i (a recognition of the need for, and an ability to engage in life-long learning), and j (a knowledge of contemporary issues). This synthesis and evaluation also requires mastery of a higher level of the cognitive domain as identified in Bloom's taxonomy. Evaluation and assessment was conducted through the use of pre and post minute papers, student surveys and self evaluation of ABET outcomes, assessment of relevant course learning objectives as well as class instructor and visiting professor observations.

Educational Environment

Civil Engineering students at Florida Gulf Coast University take a two course sequence in Geotechnical Engineering. The first course is a junior level course offered in the spring semester and focused on an introduction to basic principles of soil mechanics. Emphasis in the first course is on the development of a firm foundation of key concepts. Learning is reinforced through homework, projects, and exams, heavily augmented with in class and laboratory activities. The second is a senior level course offered in the fall semester and focused on retaining walls, slope stability, and shallow and deep foundations. Emphasis is on the application of key concepts to the analysis and design of geotechnical concepts. Individual and larger group projects, as well as the use of finite element software reinforce learning.

The Concept of and Rationale behind Round Table Discussions

The first course in the two course sequence provides broad coverage of critical geotechnical engineering concepts – e.g. soil properties, compaction, consolidation, flow of water, etc. In addition, the course has a heavy lab component which typically exposes students to ten different laboratory sessions on the previously discussed topics. Because of this, the second course needed a different direction. Furthermore, the inherent nature of design, which does not conform well to discrete homework problems and the time limited nature of testing suggested a new approach was necessary. This led to the development of a course which is heavily project based. While this serves well for the mechanistic aspects of the learning outcomes (e.g. the ability to analyze and design a gravity retaining wall for external stability and the ability to analyze the impact of water on slope stability), as developed, it did not address aspects of learning outcomes that were less quantitative to the desired level. While it is clearly possible to integrate design and analysis calculations with communication, synthesis, and evaluation the roundtable discussion presents them separately for two main reasons: 1) separation allowed for the inclusion of activities performed by others either at a level more complex than covered in this undergraduate course, or on a topic not fully addressed in the course, and 2) the division allows for the ability to incorporate recent issues, critical new developments, or minor course variations without significant course revisions.

Implementation

Round table activities were incorporated into the 2009 fall semester of Geotechnical Engineering on a weekly basis with each session running approximately 45 minutes. Twenty-eight individuals were enrolled in the course, all of them senior level students who had successfully completed the first course of the geotechnical engineering sequence. While the majority of the round table discussions were centered on either journal articles or conference proceedings that the entire group was required to read, individual article presentations and laboratory activity discussions were also included. Over the course of the semester ten round table activities occurred. Half of these were the entire class reading the same journal article or conference proceeding, two were students discussing articles they read on a topic of their choice, two were wiki activities centered around three separate articles, and one was a discussion focused on

triaxial laboratory testing. Each discussion was centered on a topic that correlated to the current lesson topics of the course. Unless otherwise stated, the discussions began with a brief introduction by the instructor, followed by small group discussions (between 5 and 7 individuals to a group) for about 30 minutes and culminating with a full class discussion for the remaining time. The following sections provide brief descriptions of each of these various activities.

Journal Article Discussions

Journal articles were selected from refereed journals whose focus is in the area of geotechnical, geoenvironmental, and/or geological engineering. Both historical and recent articles were used, and authorship was never repeated. An example of an historical article utilized was Mitchell, Vivatrat and Lambe's 1977 article on the "Foundation Performance of Tower of Pisa."¹ The article addresses the authors' analysis of the bearing capacity and settlement of the Leaning Tower of Pisa and was discussed in conjunction with course lessons on settlement analysis. One of the interesting aspects of using this article was the fact that the students had watched a NOVA video² as well as performed settlement analysis on the Leaning Tower of Pisa in the first Geotechnical Engineering course. The two main discussion points for the article were as follows:

1. Considering the analysis in the article was performed over 30 years ago, what are the similarities and differences to the process introduced in class today.
2. How does the analysis in the article compare to the calculations you performed in the previous class and how does it relate to the video you viewed?

Additional journal article discussions were based on Leshchinsky's March 2009 article entitled "On Global Equilibrium in Design of Geosynthetic Reinforced Walls,"³ in the Journal of Geotechnical and Geoenvironmental Engineering and a 2006 article in Soils and Foundations entitled "Examination of Slope Hazard Assessment by Using Case Studies of Earthquake and Rainfall Induced Landslides,"⁴ by Mizuhashi et. al.

Conference Proceeding Discussions

A subtle but meaningful means of supporting a message of life-long learning is illustrating to students a personal pursuit of learning by the instructor. This was accomplished by utilizing a paper by one of the keynote speakers from the 2009 International Foundation Congress and Equipment Expo (IFCEE). Dan Brown presented the "Management of Risk in Deep Foundations with Design-Build"⁵, which was also written as an article in the conference proceedings. Since the instructor was at the presentation, a more personal introduction to the article and author was presented in class. Another key aspect that differentiated this article from others was that it was from the point of view of the practitioner, rather than an academic and researcher. The introduction to design-build and a clearer picture of the economic side of engineering were also key points that this article was able to bring to light.

Independent Article Discussions

As part of a semester long project in the course, students were required to read a number of articles on a topic of their choice related to geotechnical, geoenvironmental or geological engineering. In an effort to generate an exchange of ideas, one round table was devoted to a discussion of these articles. Students were required to come to the session prepared to talk briefly about an article they had read related to their semester project. They were required to present title, author, and location of the article, as well as a brief summary and a couple of sentences about how this article in particular would assist with the completion of their semester project. Listening to classmates discuss articles on different topics illustrated the breadth of the field of geotechnical engineering, while talks along similar lines as the students' potentially provided additional sources of information. In addition to their oral discussions, students were required to provide written summaries of these articles to the instructor.

These discussions involved the entire class for the entire period, rather than having time devoted to small group activities. Each student was given between 2 and 3 minutes to present their particular summary and discussion. Papers in this category all had undergone peer review prior to publication and ranged from historical to recent and included journal articles and conference proceedings.

Laboratory Discussions

When the course topics entered into strength and bearing capacity of soils, the round table session for that week was a discussion of laboratory shear testing. Students were required to read typical testing procedures for a variety of triaxial testing methods (e.g. consolidated drained, consolidated undrained, unconfined compression) and the instructor conducted a demonstration of setup and testing for both the direct shear and triaxial shear tests. The discussion was more of a question / answer session with regards to setup, testing, and the comparison among the various tests.

Wiki Discussions

In an effort to vary the delivery mechanism of the round table discussions, one of the final activities was that of a round table wiki. For this activity the students were divided into three groups (approximately 9 students per group). Each group was provided a paper (all of which were in the 2009 IFCEE conference proceedings) related to a different deep foundation case study. Students were required to read the article and contribute to the development of a wiki which contained the following sections: 1) an orientation which provided a brief overview of the article, 2) a summary which gave more in depth detail about the article, 3) an important points section, 4) a questions raised section in which they were asked to ask and / or answer questions either factual or opinionated, and 5) a relation to class portion. The intent was that this smaller group could create a synopsis that not only discussed the article, but also evolved into a broader topic based discussion. Once the three wikis were complete, students were asked to review one

of the wikis created by a different group. In this way they gained exposure to key points of the other articles as well as the associated discussions without having to read the article itself.

Results and Lessons Learned

This section will briefly discuss feedback obtained from student responses as well as faculty thoughts, results of the assessment of student learning outcomes, and the relation of these sessions to ABET outcomes g (an ability to communicate effectively), i (a recognition of the need for, and an ability to engage in life-long learning) and j (a knowledge of contemporary issues).

Student Feedback

The overall response to the inclusion of round table discussions was a positive one. When asked in an anonymous survey at the conclusion of the course if they felt the roundtable activity was a valuable one, some of the responses were as follows:

- “Yes! The discussions were great and the articles were insightful. They gave exposure to real world problems and solutions.”
- “Yes, it improved my technical reading and writing skills greatly.”
- “Yes, very beneficial. It opened my eyes to the research community in engineering.”
- “For the most part, I thought this was a constructive exercise. In many classes we deal with our isolated design problems and are not truly exposed to real world effects.”

Along with the question of the value of the activity, students were asked to provide thoughts on how the round table sessions could be improved. Some of the feedback included thoughts such as the following:

- “Shorter articles. Even the less technical exposed new things about what a geotechnical engineer does.”
- “Maybe use local articles, [so] we can relate.”
- “I think that it was a good use of time; however, I think that maybe having people write a small summary for some of the articles was more beneficial than just reading and talking about it in class. I think it would sink in more if a summary was written, then talking about material.”
- “Improvements could be a broader question base or a better explanation before the first one.”

Probably the most telling quote, at least from the instructor’s viewpoint, was:

- “it was interesting when I could understand the articles. Some were too technical and I couldn’t grasp it all, but I learned.”

Instructor Thoughts

This was the first major attempt by the instructor to include discussion activities in a course. Having virtually no experience with leading this type of forum, the round table sessions became a learning opportunity for all involved. The first session was an eye-opening experience for everyone. Many of the students had left the reading of the article to immediately prior to class, or at best to the night before, not realizing that comprehension might require multiple readings. Virtually none had previously read a technical engineering journal article. In retrospect, the article itself was also one that was more technical and required a greater degree of background knowledge than most undergraduate students possess.

All of these factors combined resulted in the second round table becoming a repeat of the first, using the same article and reducing the number of discussion questions so that each smaller group focused on a single question and brought the results of that question back to the entire group. This process of having smaller groups focus on a particular point, discussing it during class, and then reporting back to the larger group provided a different dynamic in the culminating discussion than when all of the smaller groups discussed the same questions. Because individuals had not previously discussed all of the points, they were more attentive during the larger group session, and the larger group session functioned more as an article summary. In sessions where each smaller group focused on the same questions, the culminating group session tended to focus upon a couple of key points in the article, rather than the article as a whole.

ABET Outcomes

Three of the ABET outcomes addressed by the round table discussions included outcomes g (an ability to communicate effectively), i (a recognition of the need for, and an ability to engage in life-long learning) and j (a knowledge of contemporary issues). Students were asked to evaluate the contribution of the course in general to their ability to accomplish each of these outcomes, with the options being a large, moderate, small, or no contribution. Table 1 summarizes the results for each of these outcomes and is based on a 96% (27/28 students) response rate.

Table 1: Student evaluation of course contribution to ABET Outcomes

ABET Outcome	Large Contribution	Moderate Contribution	Small Contribution
g (communication)	81%	19%	0%
i (life-long learning)	67%	22%	11%
j (contemporary issues)	67%	33%	0%

Note: No students evaluated the course having “no contribution” to these ABET outcomes

Student Learning Outcomes

One of the specific learning outcomes of the course is that students will be able to “discuss various contemporary issues in geotechnical engineering.” At the conclusion of the course, students were asked to self evaluate their own ability to accomplish the learning objective, as

well as the course coverage of the learning outcome. Table 2 summarizes student responses to this particular learning objective.

Table 2: Student evaluation of individual learning and course coverage of course objective “discuss various contemporary issues in geotechnical engineering”

Student Self Evaluation*				Student Evaluation of Course Coverage*			
Excellent	Satisfact.	Marginal	Unsatisfact.	Excellent	Satisfact.	Marginal	Unsatisfact.
59%	37%	4%	0%	71%	29%	0%	0%

*Response rate of 96% of total class (27/28 students)

Assessment of student ability of the same course objective was conducted by the instructor and based on student performance on all round table submissions over the course of the semester. Overall, a great majority of the students performed better than satisfactory on all round table activities, and all but one of the students performed at the satisfactory level or better. The combination of the student evaluations and course assessment suggests that the course was successful with regards to discussing various contemporary issues in geotechnical engineering.

Round table submissions included pre and post minute papers, article summaries, wiki contributions, and discussion forum contributions. The process that was employed with pre and post minute papers consisted of students being given two 5x7 index cards at the beginning of the discussion. They were then asked to take 2-3 minutes to write a three to five sentence summary of the article on one side of one of the index card and the three most important points of the article on the other side. After the discussion (in both small and larger groups) the students were asked to repeat the process on the second index card.

Future Offerings

Based on results of this initial trial, the following modifications will be incorporated into future semesters with respect to round table discussions:

1. The necessity to read the article early and potentially multiple times will be stressed prior to the first round table session.
2. Article selection will start with less rigorous articles for the first few sessions to help facilitate development of the discussion process prior to introducing what may be highly technical topics.
3. Article topics will follow the presentation of the associated concepts in class. It was initially thought that the articles could serve as an introduction and instill potential excitement in topics, however student feedback suggests that article comprehension levels are higher when read after topic coverage.
4. Articles from practitioners, articles covering topics students have a high familiarity with, and case studies will be included. An attempt will be made to find articles which could allow for “debate” type sessions to occur, based on student requests of this nature.
5. Example wikis will be provided to assure students are comfortable with the concept of wiki development. The instructor’s assumption that all participants were familiar with

contributing to a wiki was sorely inaccurate and obtained less than desirable effectiveness.

Conclusions

Round table discussions were integrated into a senior level geotechnical engineering design course in order to enhance students' ability to analyze and critique others' work, evaluate work completed by others in the particular field, and relate the analysis and design they are performing into the engineering profession as a whole. This synthesis and evaluation also requires mastery of a higher level of the cognitive domain as identified in Bloom's taxonomy⁶. These round table discussions also addressed ABET outcomes g (an ability to communicate effectively), i (a recognition of the need for, and an ability to engage in life-long learning), and j (a knowledge of contemporary issues). Sessions were held on a weekly basis for approximately 45 minutes each session. While some complications were encountered, overall the experience was a positive one for both the students and the instructor and satisfactorily addressed the desired learning outcomes. Students' self-assessment of learning objective accomplishment as well as their feedback concerning the value of the round table discussions were both positive. The instructor's assessment of the students' ability to accomplish the course objectives was also positive. Based on the initial offering round table sessions, incorporating modifications from lessons learned, will be included in future offerings of the course.

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