

Various Assignments Employed in a Geotechnical Engineering Laboratory

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Abstract

ABET states that graduates of an engineering program can design an engineering experiment to meet a need, conduct the experiment, analyze and interpret the results, as well as organize and deliver effective communications¹. These objectives were used to design assignments in an introductory geotechnical laboratory course at The Citadel. In one assignment, students were asked to design a laboratory experiment to satisfy an objective and document the design in a written proposal. In another assignment, they were asked to develop a soil testing program and communicate their findings to an outside client in the form of a business letter. This paper describes various assignments employed in a geotechnical engineering laboratory.

Keywords

Laboratory, Pedagogy, Active Learning, Critical Thinking.

Background Information and Literature Review

Laboratory courses are often characterized by a lack of students' interest, and disparity between them and real life scenarios^{2,3}. Students typically perform a set of instructions without understanding the reasoning behind them³ and not enough attention is given to technical writing^{3,4}. The most commonly employed style of laboratory instruction is one in which students follow specific procedures to collect data and then experience a predetermined outcome that is already known⁵. There is no attention given to the planning of the investigation or to interpreting the results⁵. The obtained results are then used for comparison against a theoretical value^{5,6}. In the traditional laboratory setting, not enough time is spent on deep processing of information^{5,7,8}. Alternatively, inquiry- and discovery-based activities not only teach the scientific process but also increase student engagement and understanding^{9,10,11}. Moreover, inquiry-based laboratories are used to explore and apply concepts and are inductive as students start with making observations and collecting data to generate concepts^{9,10}.

One way to increase student's motivation is to design technical writing deliverables to introduce and reinforce skills, techniques, and work habits for writing effectively and efficiently in an engineering context¹². Nearly every engineering project requires that technical deliverables be prepared and submitted to one or more entities, and nearly every engineer is responsible to some degree for preparation of such deliverables. Technical writing may consume the majority of the labor hours of a practicing engineer.

Writing Assignments Used in a Laboratory Course

Various assignments were employed to enhance the laboratory course and promote the development of critical thinking skills. For the first laboratory report, a real world application

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assignment was developed which required students to communicate with a client in the community. The following is a memo from a client to the students: “On behalf of Built Right, I am writing to inform you that Geotechnical Student Consultants has been awarded the contract for geotechnical services in support of commercial land development at the future Ashley River Plaza in North Charleston, SC. Built Right is in the process of evaluating the borrow soil that will be excavated from the detention pond area. We need to determine if the soil is suitable as (1) structural fill under the proposed parking lots and building foundations, (2) general fill, or (3) liner material for the detention pond. We have obtained a sample of the borrow soil and have shipped the sample to you. We request that you perform the appropriate tests to classify the soil and evaluate the potential use of the soil for the applications described above. Please send us the report containing your findings and recommendations on or prior to 2/27/2017.”

Students in teams of four developed a testing program to perform several experiments on the soil sample. They evaluated the resulting grain size distribution curves and the Atterberg limits in accordance to the provided specifications. They also classified soils in accordance with United Soil Classification System. Moreover, they used the criterion specified by the client to assess the potential use of the soil for the applications described.

A writing workshop was conducted to assist students with the process of determining purpose(s) for writing; identifying all report requirements; organizing the document; defining the problem and stating all objectives; linking conclusions to the stated objectives; using figures and tables to illustrate key points; and analyzing the draft critically. Students were asked to write a first draft of the business letter prior to the writing workshop session. During the workshop, students were provided with feedback on their first draft of the letter.

The purpose of the second assignment was to introduce students to a research problem, examine the literature, design and perform an experiment, collect and interpret data, engage in critical discussion about the experimental design, write a proposal and a mock Conference Paper.

Students were asked to determine a quantitative relationship between the void ratio and hydraulic conductivity for sand. They were tasked to design an experiment and document the design in a three-page proposal. In addition, the proposal could not resemble a laboratory manual with a set of instructions. Instead, it was required to include the purpose for writing; the problem being solved; the specific laboratory tests that will be conducted; the important equipment that will be used and how the equipment will be configured; how the tests will be set up and conducted; how many tests will be conducted; how they will ensure that the tests will yield high-quality, reliable data; and a detailed plan for how they will analyze the data to obtain an appropriate model. Once the proposals were submitted and accepted, students in teams of five conducted the experiment using the available materials in the laboratory.

Lastly, students were asked to write a mock conference paper to describe their work in the proceedings of an ASCE Geo-Institute Conference. The Conference Paper needed to be a maximum of four pages long, with a minimum of three-cited references in a similar format to those being published in the proceedings for the Conference. The paper had to also meet all of the submission requirements specified in the Author’s guide for the Conference.

Conclusion

To maximize student learning and foster development of critical thinking skills, various writing assignments were employed in a Geotechnical Engineering laboratory course at The Citadel. These techniques engaged and motivated students to learn the fundamental concepts of Geotechnical Engineering. Future quantitative and qualitative assessments will be needed to verify the impact of various assignments on student performance. The assignments used in this study can clearly enhance and support traditional methods of instruction typically used in laboratory courses.

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