

Case Study- and Project-Based Applications for Tablet PCs and Collaboration-Facilitating Software

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Introduction

Like most engineering curricula, traditional undergraduate civil engineering curricula usually comprise a blend of lectures, laboratories, and projects. Within this framework, Cognitive learning is usually confined to Bloom's levels I-III (Knowledge, Comprehension, and Analysis), although well facilitated learning will typically extend to Bloom's levels IV and V (Analysis and Synthesis), especially with well planned project work, directed discussions, and carefully targeted lab and class assignments. There is evidence that higher Affective learning can occur when activities are built around project-based, inquiry-based, and case-based learning.

Undergraduate focused engineering programs can commit faculty time and resources to the development of high quality learning activities in their classes. However, in research-focused institutes, faculty time and resources targeted to undergraduate learning must be shared with other portions of the institute mission, and faculty members who wish to foster higher level learning can be impaired by large classes, limited time, and less institutional support. Even so, the majority of engineering graduates are produced by institutes that feature division of resources and faculty among a broader array of activities. The biggest hurdle for such institutes may be with the faculty members' time and support for undergraduate learning-focused activities. Tablet PCs, along with the use of collaboration-facilitation software, have the potential to bridge the learning gap between the types of learning that typically occur in these two different settings.

This proposal is for the development of learning modules that have the potential to be adopted by faculty at institutes that are not undergraduate-focused. These learning modules will be developed around project-based and case study-based learning in the civil engineering subdiscipline of geotechnical engineering. The modules will thus be implemented in the following courses: CE336-SOIL MECHANICS (fall term) and CE436 FOUNDATION ENGINEERING (winter term). In addition to the innovative learning modules that will be explored herein, the project will also include development of more traditional learning activities facilitated by Tablet PCs, but emphasis will be on collaborative opportunities that will enhance higher Cognitive and Affective learning at both Rose-Hulman and at institutes that are not undergraduate-focused. Following is a summary of implementation and potential improvement for each of the courses:

CE336-SOIL MECHANICS

In this required junior-level course, learners explore the process of geotechnical subsurface investigation through a course-long project, typically for a proposed on-campus facility. The real subsurface investigation requires students to work in teams to design the subsurface investigation, weigh exploration options, interpret data collected by multiple teams, check colleagues' work, and devise suitable design solutions. The course is heavy in collaborative work and sharing of information. Learning activities include data collection in the field and in the laboratory. Planned learning activities making use of DyKnow capabilities and the ANGEL Course Management system can make these collaborative activities simpler. Some implementations should include:

- Collaborative creation of Excel- or MathCad-based tools for geotechnical design
- Collection of field and laboratory data directly into forms that facilitate simple sharing of the data in a common database accessible to all students.
- A subsurface investigation game in which teams race to develop and implement an effective subsurface investigation of a site.

- A “Rules of Thumb” tool that permits simple assessment of key team decisions in the design of subsurface investigations, assessment of data that is collected, and evaluation of designs that are the outcome of more complex design tools
- Learning activities that involve study of or investigation of real or hypothetical geotechnical failures using Leonards’ methodology for investigation of failures
- Some modules comprised of traditional lessons that demonstrate and reinforce applicability of the technology in that setting

The full extent of the role of DyKnow in facilitating the envisioned collaborative learning activities is uncertain at this time, but it appears certain that the Tablet PCs with DyKnow and ANGEL will simplify and accelerate these collaborative learning activities. Limitations that may be encountered could include

- The use project-dedicated Tablet PCs in a laboratory or field setting may be inappropriate. This may limit Tablet PC usage to demonstration or controlled trial configurations. Actual implementation may require use of student laptops.
- Use of the dedicated Tablet PC classroom space may not be appropriate if only some of the course meetings use the technology.

There are two sections of this course, with combined enrollment between 30 and 50 students.

CE436-FOUNDATION ENGINEERING

The enrollment in FOUNDATION ENGINEERING is usually on the order of 10-20 students. This civil engineering technical elective extends the students’ design knowledge in the field of geotechnical engineering. Modules developed for this course will be an extension of those developed for CE336:

- A “Rules of Thumb” tool that permits extends assessment of key decisions in the evaluation of designs that are the outcome of more complex design tools
- Collaborative creation of Excel- or MathCad-based tools for geotechnical design
- Learning activities that involve study of or investigation of real or hypothetical geotechnical failures using Leonards’ methodology for investigation of failures
- Some modules comprised of traditional lessons that demonstrate and reinforce applicability of the technology in that setting

Limitations may include usage of a Tablet PC classroom for a class of this size.

Assessment

Assessment of learning effectiveness will be managed with the assistance of the Institutional Research Planning and Assessment office (IRPA) here at Rose-Hulman. Because there are two sections of CE336, it would be practical to facilitate learning in one section using tablet-based methods while facilitating learning in the other section using techniques that do not depend on this technology. Multiple learning modules will assure that each section of the class uses tablet-based methods, alternating which section uses tablets and which does not when going from one module to another. CE436 is a technical elective course that meets as only one section, so this dimension of assessment will be less practical. However, 07-08 enrollees will be novice Tablet PC learners, while 08-09 enrollees will have experienced Tablet PC learning in CE336. Collection of data over this two year span could provide interesting insights into retained learning processes.

It is likely that different learning styles will favor tablet-based learning. It is assumed that correlation between learning styles and student learning will be a part of the assessment, along with other significant parameters identified with the assistance of IRPA. In fact, advice and guidance from IRPA in planning the learning activities and assessment will be central to measurement of the effectiveness of learning in this project.