An Independent Learning Experiment: Software Series in Civil Engineering Technology at Fairmont State College

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Abstract

The author offered a series of one- and two-credit special topics software courses for students in the Civil Engineering Technology Program at Fairmont State College. To date the courses offered have concentrated on software for hydraulics and hydrology, and construction management and estimating. Courses offered in the hydraulics and hydrology area were TR-55®, Haestad Methods®, and KYPipe®. Courses offered in the construction management and estimating area included Timberline® Precision Estimating and Primavera® P3 Project Management Software. These courses were offered in addition to program requirements and were not applicable as elective credits toward graduation; in other words, students signed up simply to gain a better understanding of the various software programs. Students were given a syllabus with expectations defined. For some courses, the students simply completed problem sets and submitted those for grade while in other courses one or more projects were also assigned. The author met with students biweekly to evaluate progress, answer questions, and provide direction. Informal assessment of success is included.

Introduction and Background

Students may be enrolled in either an Associate of Science or Bachelor of Science degree program in Civil Engineering Technology Program at Fairmont State College (FSC). The program is arranged as a 2+2 program whereby the first two years of instruction in the baccalaureate degree comprise the associate degree. The AS degree is concerned primarily with providing instruction in the areas of English; mathematics; sciences; economics; construction materials, methods, estimating; plane and construction surveying; graphics; statics and strength of materials; and introductory courses in environmental engineering technology and structures. The balance of the baccalaureate program attempts to provide a generally well-rounded curriculum to prepare graduates to be immediate contributors to the civil engineering team upon graduation. Specifically, the baccalaureate degree is a traditional program consisting of a broad-based curriculum designed to offer students instruction in several broadly-defined, parallel tracks, namely:
Track 1: Surveying, Graphics & Transportation
Courses include instruction in plane surveying, construction surveying, land surveying, route surveying, highway design and transportation. Additionally, students receive instruction in CAD and Civil Engineering CAD.

Track 2: Construction
Courses include light construction, construction materials and methods, economics, construction estimating, and construction management.

Track 3: Hydraulics and Hydrology
Courses include instruction in fluid mechanics, hydraulics, pipe networks, pumps, hydrology, and urban watershed design.

Track 4: Environmental
Courses include instruction in chemistry, geology, introductory environmental engineering technology, and water and wastewater systems. Students desiring an additional environmental emphasis may select from safety and environmental components of industry, environmental hazard control, hazardous waste technology, and air pollution technology.

Track 5: Geotechnical
Courses include instruction in soil mechanics, environmental geotechnics, advanced soil mechanics and foundation design.

Track 6: Structures
Courses include instruction in statics, strength of materials, dynamics, steel design, concrete design, wood design, and advanced structural analysis.

One goal at FSC is to introduce students to the types of software commonly employed in industry in each of the six tracks listed above. Students receive instruction in basic productivity software (MSOffice® 97 Professional Edition®, i.e., Word³, Excel⁴, PowerPoint⁵) and a programming language through required courses. Additionally, exposure to AutoCad⁶, SurvCADD⁷ and Eagle Point⁸ is provided through two introductory CAD courses and subsequent use in higher level courses, thus addressing computer use in Track 1. Various other discipline specific software experiences are provided throughout the program in each track.

Certainly, the author recognizes the importance of providing software experiences in various technical courses to enhance the overall technical and computer prowess of the graduate as outlined by TAC of ABET⁹. However, from informal discussions with other faculty and his own experiences, the author recognizes some of the inherent difficulties of introducing software into traditional lecture courses. Students, and maybe even some faculty from time to time, need to be reminded that software is not an end-all but simply a tool, much as a slide rule or
calculator, that assists us in the performance of our work. As such, software must
not be taught at the expense of fundamental concepts or in lieu of basic analysis
and design procedures. Yet, the author’s observation about software is that it can
take on a life of its own - students can get bogged down in the computer
assignments, and faculty get bogged down addressing hardware and software
questions at the expense of the fundamental concepts of the course. Still, it
remains the author’s parallel desire to furnish cogent computer/video experiences
expected by the MTV- or X-Generation\textsuperscript{10} while stealthily conveying the
fundamentals necessary to evaluate and solve real problems and meanwhile,
discern bad output – hence, the impetus for undertaking this experiment.

Software Series in Civil Engineering Technology: An Independent Learning
Experiment (SSCETILE)

The project described in this paper, the Software Series in Civil Engineering
Technology: An Independent Learning Experiment (SSCETILE) at Fairmont
State College, is an attempt to investigate an alternative approach to software use
in the CET program at FSC. This strategy was developed as an alternative to the
two software instruction methods the author received when he was a student,
namely, 1) using classroom time for software instruction, or 2) disseminating
software with little or no instruction. It is an admission that neither method is
ideal, and recognizes both the “computer bog” phenomena and the “panicked
student” syndrome as undesirable outcomes. In truth, the project described in
this paper is a result of the author’s frustrations in incorporating specialized
software instruction into various courses. For some courses such as soil
mechanics and foundation design, the author has employed relatively simple
programs without significant difficulty. However, in certain other courses, the
author discovered that software instructional time placed a significant drain on
time that would otherwise be spent on engineering fundamentals or analysis and
design methods.

Since Track 1 above has significant software instruction already, the author went
about developing an alternative methodology to provide software instruction for
Tracks 2 and 3. Groups of one- and two-credit special topic software courses to
match Tracks 2 and 3 described above were developed by the author and offered
for credit during the Fall 1998 semester. To date, courses offered in the software
seminar series have focused on hydraulics and hydrology; and construction
estimating, scheduling and management as described in the following sections.

These courses were in addition to program requirements and were not applicable
as elective credits toward graduation; in other words, students signed up simply
to gain a better understanding of the various software programs. Students were
given a syllabus with expectations defined. For some courses, the students
simply completed problem sets and submitted those for grade while in other
courses one or more projects were also assigned. The author met with students
biweekly to evaluate progress, answer questions, and provide direction.

The software courses have appropriate co-requisites or pre-requisites such that students take these courses concurrently or subsequent to lecture courses in the respective subject areas. Thus, the software courses serve as enhancements to the lecture courses.

**Construction Track Enhancements**

Software courses offered in the construction management and estimating area include Timberline® Precision Estimating and Primavera® P3 Project Management Software.

**Timberline**
The Timberline® software course provides an introduction to computer estimating. The course text is the Timberline Precision Estimating Standard Edition Student Workbook11. Initially, students read, review, and work tutorials in the workbook. In addition, students are expected to complete two projects provided by the instructor. Some of the topics covered in the manual and required in the projects include: setting up an estimate and performing quick takeoffs and item takeoffs; working with estimate totals; specifying takeoff quantities and assembly takeoffs; manipulating estimates and creating reports; developing formulas; setting up items and assemblies; developing material classes and bill of materials (BOM); and setting up subcontractors and price codes. Construction Estimating, a sophomore level course, is a co-requisite or pre-requisite for the Timberline® software course.

**Primavera**
Primavera12 P3® Project Planner 2.0 software provides students with a computer tool for project management and scheduling. Primavera P3® provides scheduling and resource leveling capabilities that includes backward resource leveling and various options to calculate float and lag. For the Primavera® course, students work tutorials and complete two projects. Construction Management, an upper division course, is a co-requisite or pre-requisite for the Timberline® software course. For each project, students are required to set up a project schedule with resource requirements, and determine the critical path.

**Hydraulics Track Enhancements**

Software courses offered in the hydraulics and hydrology areas are TR-55®, Haestad Methods®, and KYPIPE®. The co-requisite lecture course for each of these software courses is Hydraulics and Hydrology, a junior level course.

**TR-55**
Soil Conservation Service Technical Release 55 (TR-55)13 provides procedures to
calculate storm water runoff volumes, peak discharges, hydrographs, and storage volume requirements for detention ponds in small urban watersheds. Students review the TR-55 manual and examples. Upon completion, a potential development property is provided for analysis. Both present and future conditions with sub-area zoning are analyzed. In addition, this project requires the student to utilize the storage volume requirements found with TR-55 to design a small detention pond, locating and sizing principal and emergency spillways.

**Haestad**

Haestad® Methods, Inc. provides a general purpose applications package for hydraulics engineering in its “Computer Applications in Hydraulic Engineering.” Students purchase this product which includes an academic version of the industry software on CD-ROM. The program includes four programs, namely, Flowmaster®, StormCAD®, CulvertMaster®, and WaterCAD®. Students work tutorials provided in the Haestad book, followed by about 40 problems at the end of the chapters. Problems assigned in Flowmaster® include basic hydraulics, flow characteristics, energy, friction losses, pressure and open channel flow. Problems assigned in StormCAD® include hydrologic principles, hydrology, and storm sewer design. Problems assigned in CulvertMaster® include culvert hydraulics, outlet and inlet control. Problems assigned in WaterCAD® include pressure systems, energy losses, pumps, control valves, and pipe networks.

**KYPIPE**

The 25-pipe free version of KYPIPE Total Modeling Package® (available via the Internet) is utilized for pipe network modeling. The KYPIPE “hydraulic engine” utilizes KYCAD for hydraulic model development and modification. Also, the KYDATA module provides data management abilities. Other modules for graphics evaluation and management are KYGEMS and KYGUM. KYQUAL provides constituent concentration capabilities for evaluating chlorine residuals. KYCAL allows for calibration of the model given field pressure and flow measurements. Students are required to access and modify the examples provided with the software, followed by solution of problems and a project provided by the instructor.

**Preliminary Observations & Lessons Learned**

The first trial for these software courses is not yet completed at this writing, nor have official student evaluations been performed. A second iteration of these courses is scheduled for the Spring 1999 semester. Some as yet preliminary, and quite general, observations will be presented in bullet form representing both the students’ and author’s perspectives.

- Students take these courses concurrently or subsequent to lecture and
laboratory courses in the respective subject areas. The courses serve as enhancements to the lecture and laboratory.

- The author observes that students are eager to sign up for these courses.
- Students are rewarded with specific software course designations on the official college transcript, which they view as an effective marketing tool when applying for employment.
- Additionally, some students participating in these courses informally indicate that this type of self-paced learning is preferred over conventional methods of instruction.
- All courses should have weekly meetings. Initially, some of the courses involved biweekly meetings; however, the author has come to believe that weekly meetings are conducive to continuity.

Summary

The author offered a series of one- and two-credit special topics software courses for students in the Civil Engineering Technology Program at Fairmont State College. To date the courses offered have concentrated on software for hydraulics and hydrology, and construction management and estimating. Courses offered in the hydraulics and hydrology area were TR-55®, Haestad Methods®, and KYPIPE®. Courses offered in the construction management and estimating area included Timberline® Precision Estimating and Primavera® P3 Project Management Software. These courses were in addition to program requirements and were not applicable as elective credits toward graduation; in other words, students signed up simply to gain a better understanding of the various software programs. Students were given a syllabus with expectations defined. For some courses, the students simply completed problem sets and submitted those for grade while in other courses one or more projects were also assigned. The author met with students biweekly to evaluate progress, answer questions, and provide direction. Not surprisingly, it would appear from initial observations that many of these X-Generation students preferred this type of self-paced learning over conventional methods of instruction.

Bibliography:

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Tony Brizendine is Coordinator of the Department of Civil Engineering Technology and Director of the College Honors Program at Fairmont State College. He holds an AAS in Civil Engineering from Wytheville Community College, a BSCET from Bluefield State College, an MSCE from Virginia Tech, and a Ph.D. in Civil Engineering from West Virginia University. He is a registered professional engineer in Virginia and West Virginia, and a licensed professional surveyor in West Virginia.

Brizendine is a Past-President of the West Virginia Section of ASCE; currently serves as WV Treasurer and FSC ASCE student advisor since 1991. He serves as Chair of the Committee on Technology Curricula and Accreditation (CTC&A) for ASCE, and is a member of the Technology Accreditation Commission of the Accreditation Board for Engineering and Technology. Among numerous honors and awards, he is the 1995 West Virginia Young Civil Engineer of the Year; 1993 West Virginia Great Teachers Program; 1997 FSC Outstanding Advisor; and 1997 FSC Outstanding Faculty Achievement Award.