AC 2008-2285: DEVELOPMENT OF AN UNDERGRADUATE COURSE IN MICROSTATION © AND GEOPAK © FOR CIVIL ENGINEERING STUDENTS

Gregory Nail, University of Tennessee-Martin

Assistant Professor, Engineering Department, The University of Tennessee at Martin, Martin, TN,(2002-present)

PhD, Texas A&M, 1991; MS, Texas A&M, 1986; BME, Auburn, 1984; PE Registration Civil and Mechanical (1998)

Development of an Undergraduate Course in Microstation © and GEOPAK © for Civil Engineering Students

Abstract

The paper is a report on the successful initial development of a one semester undergraduate course in Microstation © and GEOPAK©, for undergraduate Civil Engineering students. A brief summary of the academic institution is provided, describing the environment within which the engineering program exists. The Bachelor of Science in Engineering program is described in summary. Significantly more details are provided concerning the Civil Engineering specialty concentration. The rationale behind why the course development was undertaken is explained, focusing on the specific educational needs of the undergraduate Civil Engineering students. A summary of the capabilities of Microstation © and GEOPAK © is explored, relative to undergraduate versus graduate educational needs – as well as practical career considerations. An overview of the literature reveals that other, similar, courses have been developed. The background and preparation of the instructor is presented, including training and advance preparation of course materials. The workbook contents, accompanying computer files, and how it was selected is also described. The course content and method of delivery are discussed. A description of the scope of the course and how it relates to and supports other courses in the program is provided. Scheduling, exams, and grades, are also described. Special circumstances surrounding the initial offering of the course, including the results of a student survey, are presented. The course is described in terms of being in an ongoing process of development. Future direction of the course, and ideas for improvement, are discussed.

Background

The University of Tennessee at Martin (UTM), located in Martin, TN, reported a total fall 2008 enrollment of approximately 7200 (www.utm.edu). UTM offers baccalaureate degree programs in over 80 specialized fields, administered from five colleges. UTM is primarily an undergraduate institution. It is descended from the Hall-Moody Institute, originally founded in 1900 by Baptists local to the Martin, TN area. In 1927 the property was acquired by The University of Tennessee. After several name changes, the current name was adopted in 1967.

Engineering courses were first offered on the UTM campus in 1930. The Engineering Department was founded in 1946. A four year Bachelor of Science in Engineering Technology (BSET) program, begun in 1969, was discontinued in 1996 - the same year in which an ABET-accredited four year Bachelor of Science in Engineering (BSE) program was initiated. An extensive history of the BSE program has been compiled by Wheeler[13]. Another version has been authored by Henson[5].

Implemented on a semester basis, the BSE program consists of a total of 128 credit hours of course work. Four concentrations are available within the BSE program. They are Civil, Electrical, Industrial, and Mechanical Engineering, and correspond to the traditional areas of practice covered by these disciplines. Degree requirements include completion of a one semester industrial internship, a senior capstone design project, and passing the National Council of

Engineering Examiners (NCEES) Fundamentals of Engineering Exam (FE). The 128 semester credit hours derive from general education (50 hours), engineering core (51 hours), and engineering concentration (27 hours) requirements. The engineering concentration requirement is unique for each discipline. Thus, the courses that make up this requirement identify the discipline of the degree candidate.

Civil Discipline Concentration

The engineering core courses are listed in Table 1. Note the very first course in the list, ENGR 101 Engineering Graphics. Historically, this course was the place where manual drafting, or mechanical drawing, was introduced. AutoCAD © was first introduced in 1987, in the BSET program. It was incorporated into ENGR 101 from inception of the BSE program. Presently, AutoCAD © instruction constitutes essentially the entire course. All engineering students, regardless of discipline, are required to pass this course. Therefore, all civil discipline students are exposed to AutoCAD © through ENGR 101.

Engineering Core Courses		
Course Number	Title	Credit Hours
ENGR 101	Engineering Graphics	3
ENGR 121	Statics	3
ENGR 201	Engineering Methods	2
ENGR 220	Strength of Materials	3
ENGR 231	Electronics I	3
ENGR 232	Circuits I	4
ENGR 241	Dynamics	3
ENGR 301	Computer Aided Engineering/DesignTools	1
ENGR 310	Engineering Materials	3
ENGR 311	Probability and Statistics	3
ENGR 315	Engineering Analysis I	3
ENGR 317	Instrumentation and Experimental Methods	3
ENGR 340	Thermodynamics	3
ENGR 341	Fluid Mechanics	3
ENGR 380	Engineering Economy	3
ENGR 409	Project Management	2
ENGR 410	Senior Design I	1
ENGR 411	Senior Design II	3

Engineering Core Courses
Table 1

Beginning fall 2005 the ENGR 301 Computer Aided Engineering/Design Tools course replaced a previous sophomore level design course, ENGR 210. ENGR 301 was scheduled to meet once a week for three hours, and was intended to be a computer lab setting where discipline-specific software could be introduced. Initially, the civil and mechanical discipline were grouped together, with exposure to the I-DEAS © solid modeling and design package. From the outset, it was realized that I-DEAS © was perhaps not an optimal fit for civil discipline students – at least

not in the main. During the 2005-2006 academic year the decision was made to replaced the I-DEAS © exposure with GEOPAK ©, for the civil discipline students. However, implementation proved more complex than it appeared.

Software Selection

The primary reason for selecting GEOPAK © software for ENGR 301 is that the Design Division of Tennessee Department of Transportation[10] (TDOT) required all surveys, survey projects, and all other consultant projects to use, or be converted to, Microstation © or GEOPAK © as of January 31, 2006. Evidence of widespread acceptance of GEOPAK © and Microstation © can also be found in the literature. In 2002 Kissoff[6] states that *ODOT* [Ohio Department of Transportation] *evaluated the options that were available and chose GEOPAK as their preferred third party design software*. He goes on to state *Currently, 19 states as well as the Federal Highway Administration and the Army Corps of Engineers have adopted GEOPAK as their preferred design package*. In 1998 a joint study survey (of 27 states) by University of North Carolina Highway Safety Research Center[11] and the North Carolina Department of Transportation found that *…most DOTs report visualization capabilities closely linked to Microstation and Integraph hardware and related software*. More recently, in 2004, Newton[7] reports that *Microstation continues to be popular with the world's largest AEC firms – 47 of the 50 state transportation departments have standardized on Microstation, and a majority of the Engineering News-Record Top 150 Global Design Firms rely primarily on Microstation and other Bentley software for their projects.* Similar claims are made by Goldberg[3], who stated (2005) that *Microstation is the standard design platform used in 47 state DOTs and the U.S. DOT*. He also stated that GEOPAK © was being used by 43 state DOTs.

Summary Capabilities

Microstation © is a 2- and 3-D computer drafting and visualization software package. The basic approach to usage is the three-step process of identifying the tool, entering settings, and performing operations. It is a comprehensive CAD program with complete capabilities with regard to complexity of options. These include unlimited numbers of levels, multiple line attribute options, many snap modes, complete selection and manipulation tools, multiple viewing options, multiple text options, precise control over measuring options, and precise drawing tools. The software has all the expected capabilities of a CAD software, plus many advanced and highly specialized features. These additional features include ability to seamlessly interact with .dwg files, extensive printing options, sophisticated controls over units and scaling, raster image import and control options, and others. The above lists are representative but incomplete. Drawings are recorded in its own .dgn or *design file* format. The software subscription purchased by UTM, which was used in the ENGR 301 during fall 2007, was the Microstation V8 2004 Edition ©. For a more complete, although still abbreviated, description of this software, see Newton[7]. This software has since been upgraded again. Another article by Newton[8] describes the latest version.

GEOPAK © is a series of modules, or programs, which run as add-ons to Microstation ©. Modules include *GEOPAK Drainage* ©, *GEOPAK Landscape* ©, *GEOPAK Site* ©, *GEOPAK Water* ©, and others. The various modules are design software. They allow the user to generate

different aspects of site development and design. These include positioning and location of roadways, buildings, and detention ponds. Other capabilities include design and analysis of draining and storm sewer systems. The list given above is representative but incomplete. These various modules utilize an underlying .dgn file. The underlying theory or approach involves the three way assignment, or hierarchy, of elements, objects, and models. Elements from a .dgn file are assigned elevations, or slopes, and become identified as *site elements* in the GEOPAK Site © module, for example. A group of these site elements form a *site object*, such as a road or building. Groups of site objects form a *site model*. This entire process is begun when digitized elevation data is converted into a .tin file, from which GEOPAK © generates its own .gsf or *geopak site file*. The .dgn and .gsf files contain the drawing and elevation data, respectively, on which the various modules work to develop the intended designs, composed of collections of site objects, which form a site model. The other modules operate on the same principle.

Considering the above facts regarding acceptance of Microstation © and GEOPAK ©, and their many features, it was the opinion of the faculty concerned that these software would constitute excellent exposure for our undergraduate civil discipline students. It was concluded that our students would gain extremely valuable experience even through only summary, or abbreviated, exposure to the software. It was further concluded that these benefits could potentially support our students in career employment goals, or aspiration to pursue graduate study.

Literature Overview

The use of Microstation © and GEOPAK © is documented in the literature. This use includes both professional practice and educational. A few select examples of the software appearing in educational oriented papers follows.

Nicholas II et. al.[9], in a 2003 paper, report on the incorporation of Microstation © into an undergraduate Civil Engineering Technology program at Fairmont State College, West Virginia. This was done as part of a course which included exposure to various software, called Software Series in Civil Engineering Technology Independent Learning Experiment. Instruction was delivered in three modules; introduction, bridge design applications, and highway design applications. The introduction of Microstation © was suggested by Fairmont State College's Civil Engineering Industrial Advisory Committee. AutoCAD © instruction was already in existence within the curriculum, and was not eliminated with the addition of Microstation ©. The instructors developed their own course manual, consisting of a series of exercises. The exercises were oriented around the three modules. The course has received excellent reviews from students and employers, including the West Virginia Department of Transportation.

In another 2003 paper, Walters and Gao[12] describe a graduate-level construction engineering and management course, at Iowa State University, within which Microstation © is incorporated. It is used by students to apply or develop two and/or three dimensional drawings as the base to perform construction engineering data extraction, storage, and calculations. The course is divided into three components; basic computer graphics, applications in construction, and advanced technologies. Learning objectives are centered around exposure, understanding, and application of the various software packages. Microstation © appears in the applications in construction course component, and its ability to interact with AutoCAD © files is featured. Other

applications include management capabilities such as tracking changes, time sequences, and identifying incompatabilities.

Gomez-Rivas and Pincus[4] give an overview of a *Structural Analysis Design* Engineering Technology program at The University of Houston-Downtown. This 2002 paper describes the degree program as a whole, summarizing the various components. Microstation © appears as part of a junior level course in three-dimensional modeling, which includes other software packages.

Kissoff[5], in another 2002 paper, reports on the integration of GEOPAK © into a sophomore level *Civil Engineering Design and Graphics* class in the Construction Engineering Technology program at The University of Toledo. The author explains that, because of trends promoted by state departments of transportation, his program opted to integrate GEOPAK © into design classes. Specifically, GEOPAK © was integrated into a synchronized CAD laboratory which included highway geometric design, and site and utility layout. A semester long project was used as the vehicle with which the software was introduced to the students. The conversion from quarters to semesters was the original impetus for the expansion of the CAD laboratory course offering. The prerequisite is a freshman level course which incorporates Microstation © instruction. The author refers to the challenge of adequately exposing students to all of the capabilities of GEOPAK © within the available 33 contact hours. Interesting student survey results are presented, representing a composite sample spanning several semesters. Nearly 70% of the respondents reported having had no formal experience with Microstation © prior to enrollment. The author attributes this to the recent startup of the courses within the curriculum. 96% of the students strongly favored the semester long project. However, 30% indicated they were unsure of their proficiency with GEOPAK ©, and 35% answered with a *maybe* to the same question. Student comments clearly indicate some degree of frustration with the complexities and capabilities of GEOPAK ©. The author comments on these difficulties, making clear that exposure to GEOPAK © was achieved – not proficiency. Despite difficulties, the conclusions are very upbeat, so that the plans are to continue with GEOPAK © as implemented. The author emphasizes the point that the exposure was a significant and worthwhile accomplishment, even if proficiency was not achieved.

Instructor and Qualifications

Implementation of GEOPAK © into ENGR 301 required, of course, an instructor, software, and computer lab. The software could be purchased through an education subscription agreement from Bentley Systems, Inc.. Adequate computer laboratory facilities existed. Hiring a qualified instructor proved prohibitively expensive. This might not have been the case for a larger engineering program, or one with more financial resources. But for the UT Martin program this constituted an obstacle. It was preferred to employ existing personnel, ideally, existing faculty. However, none of the existing faculty at that time had adequate skill with GEOPAK © to attempt instruction.

Thus, a contradictory situation existed. Hiring an outside, specialized, instructor was deemed too expensive. At the same time, our own faculty were unable to offer the instruction. This seemingly unimportant management detail is pointed out because of a suspicion of the author.

The author suspects that this same situation likely exists elsewhere (other small or medium-sized engineering programs) – perhaps more often than not. No formal data or evidence is offered for this speculation, but it is offered as a point to consider.

This obstacle was overcome when an existing faculty member agreed to take on the GEOPAK © software instruction, as a profession development goal. This is how the author became the instructor of the course. An additional factor contributing to this arrangement was the availability of the GEOPAK © software to the faculty for his own purposes. Specifically, in exchange for taking on the responsibility to learn and teach GEOPAK ©, the faculty would be able to use it to produce technical work suitable for publication or presentation. Finally, Bentley Systems, Inc. offers professors or instructors undertaking such an endeavor free training at certain facilities. Thus, the motivation for the author's effort to become trained in GEOPAK © was established. At the same time, the mechanism whereby training could be obtained was also established.

Civil Discipline Courses (total 27 hours required)		Credit Hours
Required Courses (18 Credit Hours)		
GEOL 121	Engineering Geology	3
ENGR 350	Elementary Surveying	3
ENGR 351	Basic Structural Analysis	4
ENGR 450	Reinforced Concrete Design	4
ENGR 451	Geotechnical Engineering	4
Elective Courses (9 Credit Hours Required)		
ENGR 352	Transportation Engineering	3
ENGR 353	Hydraulics and Hydrology	3
ENGR 370	Vibrations	4
ENGR 452	Steel Design	3
ENGR 453	Pavement Design and Analysis	4

Civil Discipline Courses
Table 2

Finally, the instructor's background is significant in this regard. The author does not hold a civil discipline degree. Instead, he holds mechanical discipline degrees with specialization in fluid mechanics – followed by eleven years of career experience with computational hydraulics. During the author's computational hydraulics experience he took additional graduate level course work (civil discipline) with emphasis on hydraulics and sediment transport. Professional registration was obtained by virtue of having passed both civil and mechanical discipline proficiency exams. This is pointed out to demonstrate that functional operation and instruction in this software package does not require discipline-specific background – at least not for exposure at the undergraduate level.

Civil Discipline Course Sequence

The Table 2 shows the available civil discipline courses. The upper portion of the table lists required courses. The lower part of the table lists electives. Many of these courses offer potential

for various computer aids or software packages to be introduced or incorporated. Although GEOPAK © has not been named or designated as the software package to be integrated throughout the curriculum, it is being positioned for that possibility. For example, the site design capabilities are central to transportation projects (ENGR 352). The drainage and geospatial capabilities lend themselves to support hydraulics or hydrology analysis (ENGR 353).

Training and Preparation

As outlined above, the instructor did not have sufficient skills with GEOPAK © at the time he accepted responsibility for teaching the course. The subscription agreement available with Bentley Systems, Inc. made training available to the instructor with free tuition. After assessing the capabilities of GEOPAK ©, the skills of the instructor, and background of the students it was decided that the course would be most beneficial if it were more evenly divided between Microstation © and GEOPAK ©. This conclusion was reached because of the fact that GEOPAK © is essentially an add-on to Microstation ©. Therefore, proficiency with Microstation © is required in order to utilize it. *Bentley Institute*, the training arm of Bentley Systems, Inc., offers many training course for Microstation © and GEOPAK ©. As part of the subscription agreement, the instructor was entitled to free tuition at these training courses. It became clear to the author that Microstation © proficiency was needed first. Therefore, the instructor enrolled in and sat for the *Essential Microstation* four day training course, June 12-15, 2007, at a facility in Chicago, Illinois. This course is targeted to first time users of the software. As a follow-up the instructor reviewed the training manual, and proceeded to rework every exercise in it during the remainder of summer 2007. Simultaneously, in anticipation of the fall 2007 ENGR 301 course, a set of notes and test questions were developed. Training in GEOPAK © was taken by the instructor in an on-line format, starting with the beginning of fall semester 2007. The *GEOPAK Site I* course was begun as classes started for fall 2007. It is a course targeted for first time users, with some Microstation © experience. This on-line course was completed December 23, 2007.

The training materials obtained from the Essential Microstation course consisted of a 350 page manual[2] with accompanying computer files. The approach taken in the training manual involves presenting the student with a series of relatively short exercises. Most of these exercises consist of reading up a prepared .dgn file in Microstation © and performing certain operations on it. These files and exercises were prepared so that they promote student exposure to only one, or a few, operations or features at one time. In this way the student learns about the features of the software sequentially, rather than all at once. The manual is broken down into 28 chapters, several of which contain short or medium length design problems. Each chapter is oriented towards illustrating one capability, or a group of similar capabilities. One obvious advantage of this approach is that of being able to stop at a convenient point, and restart again when able. The instructor for the Essential Microstation course led the students by performing the very same exercises, using the same files, on projected screen visible to the class. During and after each exercise he was available to assist with any difficulties in executing the steps. This method of delivery resulted in continual progress, so that almost every exercise in the manual was eventually completed.

Training materials for the Site I online course were similar in layout and design to those from the Essential Microstation classroom training course. The Site I training manual[1] was viewable

online, and could be printed out. Knowing this material would likely be used to instruct ENGR 301 students, the author printed out the entire manual in this way. The 110 page Site I manual contains eight chapters, with each one much more summarized and less detailed, but longer in length. Since the manual contains exercises with the site, drainage, and sewer modules, it is clearly designed for student overview or summary exposure. The material is presented in a similar way to the Essential Microstation manual – in that the student is exposed to only a few operations at a time, using prepared files.

Upon request, Bentley Institute granted permission to reproduce training materials, from both the classroom and online courses, for purposes of supporting our ENGR 301 course – provided none were sold for profit. This proved extremely helpful, and paved the way for reasonable results with our first offering of ENGR 301 with Microstation © and GEOPAK ©.

Course Content

The goal of the instructor, initially at least, was to deliver a course split evenly between Microstation © and GEOPAK © exposure for the students. This goal was not realized during fall 2007. However, it remains a primary objective, to be reached during subsequent editions of the course. The results of fall 2007 were that a total of eleven lab sessions were held. Nine and one-half of these featured Microstation © instruction, followed by one and one-half sessions with GEOPAK ©. Tables 3 and 4 summarize the results of actual material covered during fall 2007. The chapter numbers refer to those in the earlier referenced training manual for Microstation © or GEOPAK ©. Table 3 reports coverage by date and chapter. Table 4 reports coverage by topic.

Lab	Date	Recorded Activity
1	Aug 28	Microstation © Intro and Chap 1 (sections 1-10)
2	Sep 4	Finish Chap 1
3	Sep 11	Chaps 2-3
4	Sep 18	Chaps 4-6, assign 1st Design Problem from Chap 7
5	Oct 2	Chaps 8-10
6	Oct 9	Mid-Term and Chap 11
7	Oct 16	Chap 12 and 13 through page 13-183
8	Oct 30	Finished Chap 13, 14-15, assign problem from Chap 16
9	Nov 6	Chaps 17-19
10	Nov 27	Chaps 22-23, begin GEOPAK © Chap 2 through page 8
11	Dec 4	Redo Chap2, Chap 3 Excerpt, Chap 4A Excerpt

Fall 2007 Course Content for ENGR 301
Table 3

Both mid-term and final examinations were administered. The mid-term was administered at the beginning of the October 9 lab (no. 6). The final exam was administered on December 12, a full 8 days following the last lab session, no. 11 (December 4). Both tests were aimed at promoting

student learning and retention of the various names and nomenclature associated with the features and capabilities of the software. The exams consisted of multiple choice, fill in the blank, and recall questions. Also, a screen capture of the open software interface, with all major tool boxes clearly visible was presented to the students. This image had leader lines from all major features back to a blank label, to be filled in by the examinee. This addition was designed to test student familiarity with the graphic user interface, and the various names of the most commonly used tool bars and features.

Lab	Topic
1	menus, tools, tool boxes, tool settings, key-in, status bar
2	view windows, elements, snapping, closing files, seed files, settings
3	views and view controls, element placement, AccuDraw, snaps, undo
4	polygons and ellipses, snaps, manipulating elements
5	units, AccuDraw, measurements, attributes, references
6	(mid-term exam), levels
7	fences, element selection, text attributes, text styles, text tools
8	text placement tools, editing text, modifying elements, cells
9	grouping elements, references, models
10	patterning, dimensions, digital terrain modeling, tin files
11	digital terrain modeling, tin files, site modeling, building, roadway

Fall 2007 ENGR 301 Coverage by Topic
Table 4

Student Survey Results

Students were asked to complete three evaluations during the course. A simple evaluation was administered at mid-term. It is part of the Engineering Department's ongoing commitment to maintain ABET accreditation, and is composed entirely of comments from students. It has no numerical scoring. The second evaluation was a standard instrument administered to all courses taught by untenured faculty at UTM. It was developed for a traditional lecture course. Therefore, the author developed the third survey independently. It was aimed specifically to the fall 2007 edition of ENGR 301. Partial results and accompanying discussion follow.

A total of 21 students, the entire course enrollment, responded to the author's survey. This group was 86% male and under age 24. It was 90% single and roughly evenly divided between urban (48%) and rural (43%) backgrounds. Table 5 contains a list of selected survey questions and the corresponding student responses.

Note the response to the first two questions. At first glance these results seem to be at odds. While only 14% of the respondents ranked the manual as *excellent*, a clear majority (76%) recommended keeping it. This can be explained by the author's anecdotal observation that students tend to be dissatisfied, at least to some degree, with any text. Overall, the author

interprets this as a reasonably strong endorsement of the manual, especially when considering it is the very first edition of the course.

1. Question: Make a recommendation regarding the training manual.	
recommend continue using it	(76%)
recommend search for possible alternatives	(24%)
recommend replacing it	(0%)
2. Question: Rate the Bentley Microstation training manual overall?	
excellent	(14%)
good	(57%)
acceptable	(24%)
poor	(5%)
unacceptable	(0%)
3. Question: Make a recommendation regarding the prepared files with the manual?	
They helped me learn a great deal	(14%)
They helped me learn some	(76%)
Indifferent	(10%)
The files do not help	(0%)
The files are an obstacle to learning	(0%)
4. Question: Rate the GEOPAK materials (handouts and files) overall?	
excellent	(19%)
good	(48%)
acceptable	(24%)
poor	(10%)
unacceptable	(0%)
5. Question: Make a recommendation regarding self-paced assignments.	
prefer entirely self-paced assignments	(38%)
prefer part self-paced and part as a group following instructor	(57%)
prefer no self-paced assignments	(5%)
6. Question: Make a recommendation regarding the pace of the course.	
It was too fast	(10%)
It was just right	(76%)
It was too slow	(14%)
7. Question: Overall this course has been	
a good course	(62%)
indifferent	(33%)
a waste of time	(5%)

Selected Questions and Responses from Author's Survey
Table 5

The lack of negative responses to question three is encouraging. However, the small number (14%) of responses at the other end of the scale seems to indicate some room for improvement. The author was somewhat surprised by this result, and has paid close attention to it. Two students (not in the 14%) wrote comments regarding the files. One student wrote, *If there was*

something I needed to do with the file, but forgot how, I had to search the manual for specific commands. The other comment was, *Some of the drawings seemed like they were already completed all we had to do is change a few things.* The prepared files were, as the last comment implies, basically finished drawings – or almost finished. Perhaps this illustrates student desire to take on longer, more involved, exercises?

The lack of more positive responses to question four can be at least partially explained by the way in which the instructor presented the material. Portions, or excerpts, of the Site I manual were photocopied and distributed to the class. The students did not receive the entire manual. Therefore, this might not represent a true student assessment of the materials.

The author posed question five because of his observation of some students occasionally appearing to become bored – while others were frustrated. This divide shows up in the survey result. Although a majority (57%) expressed preference for the mixed approach, a large minority (38%) evidently felt that they did not need assistance from the instructor. Overall, the author interprets this result as an endorsement of the mixed approach. This approach does allow those who prefer self-paced assignments to do them, even if not all the time. Like the 38% above, the author developed a definite preference for allowing the students to work on their own. This arrangement was impractical, however, when the assignment or exercise did not have a definitive stopping point which allowed something unique to be displayed on the screen. The author has experienced significant student plagiarism in other settings. Therefore, he is reluctant to embark on self-paced work that is not able to be in some way verified or validated as original.

The author did not anticipate the responses received to question six. The author's opinion is that the course was entirely too slow, although it went somewhat faster as the semester progressed. Perhaps this is indicative of the fact that, despite having prior CAD experience, new software is always challenging.

The author included question seven, worded accordingly, partly to illustrate the difficulties that can be encountered when working with young undergraduate students. At the outset, the author informed the class of the benefits of becoming exposed to this software, its acceptance among state departments of transportation, and some of the other facts pointed out above. As the survey results show, a vast majority of students (95%) understood the connection between their chosen field of endeavor and this particular software. Clearly, the 33% response originates from students who, for whatever reason, did not find the course particularly exciting or interesting - but who understood it had value unrelated to any problems encountered. The single student, depicted by the 5%, who responded negatively to this question represents a challenge faced by all instructors in similar situations. The author interprets the small number of negative responses to mean that the vast majority of students understood the inherent value of exposure to the software – regardless of other factors influencing their experience with the ENGR 301 course.

The standard evaluation given to all courses at UTM consists of a list of 26 questions with numerical response options, for each question, ranging from one (poorest) to five (best). The overall result of this evaluation for ENGR 301 was 4.406. This value is unrealistically high when compared to similar courses. The author is truly humbled by this report, and does not believe it in any way represents any actual measure of his effectiveness, or the superiority of the course.

The author believes this can only be explained in terms having to do with the level of student maturity, and their desire to see the course succeed in the long run. It reflects a good working relationship between the instructor and students, as well as the result of a clear majority of students in the course with a long range, mature view of the situation. As a class they delivered such an unrealistically high evaluation as an affirmation regarding future potential of the course.

A number of students wrote comments in the sections reserved for them on the author's survey. Two students wrote comments that, in the author's opinion, seem to capture the overall impression received when reviewing the survey results. One student observed, *Dr. Nail was very patient with the class, and did a good job overcoming the problems that inevitably occur the first time a class is taught*. Aside from being a personal compliment, this statement expresses exactly the situation as it unfolded, during the semester. Some relatively minor difficulties occurred, but nothing that prevented the overall progression of the material. Another sums up the course by stating, *For this course being a new course, it turned out ok*. The author understands this as it is written. The student did not say the course was excellent, or one of the best. On the other hand, the student did not think it was poor. It was *ok*. The author takes encouragement from this thought, now turning attention towards diligently trying to improve the course.

Closure

Initial development of an undergraduate course in Microstation © and GEOPAK © has been successful. The course is not finished. Many improvements need to be made. However, it has been established and has received reasonable reviews from students. The author considers this an accomplishment, especially when considering his inexperience with the software and that this was the initial course offering.

Extensive student evaluation of the course seems to indicate that, despite difficulties experienced, the initial offering was a success.

Given that the course materials and presentation, for the most part, were successful, the author intends to focus first on balancing the course content more evenly between Microstation © and GEOPAK ©. Achieving this goal will simultaneously cause coverage of the material to run at a faster pace, addressing some of the apparent shortcomings as expressed by students.

A second, longer range goal, is to develop some course materials. Specifically, the sort of materials desired are those that facilitate both group and self-paced assignments – which are relatively immune to plagiarism. This effort will include examination of available manuals or texts. However, the existing materials are clearly adequate. It is concluded that there is no need to replace or upgrade the course materials immediately.

This endeavor illustrates that it is possible, with a good deal of work and determination, for a faculty to successfully develop an undergraduate course in Microstation © and GEOPAK ©, even if that faculty has no background in either.

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