The importance of practitioner/academic teams in advanced surveying technology classes

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ASEE ABSTRACT – 2015 CONFERENCE

A REPORT ON THE USE OF A PRACTIONER/ADACEMIC TEAM IN AN ADVANCED SURVEYING TECHNOLOGY CLASS

While technological advances have permeated most of society over the past decade and more, those advances have been especially rapid with surveying technology. University professors have the theoretical background needed to understand how newly developed technologies work, as well as their limitations and optimal uses. However, the nature of the changing academic calendar means that they may get hands-on work with the technology for one semester a year or even less frequently. This, coupled with the variety of other duties that a professor needs to attend to, means that few university professors get the daily practice with new surveying technology needed to master its use.

The true masters of this technology are the practitioners who work with it in their daily practices. Unfortunately, they are rarely proficient in the art of teaching and rarely are as familiar with how a given class fits into the overall educational structure of a well-planned curriculum.

One potential solution for this dilemma is to structure classes dealing with rapidly changing technology such that the class is under the direction of a university professor who is responsible for the course structure and assessment, yet has a practitioner to assist with instruction on using the technology.

This paper discusses the methods used in one class to pair up an industry practitioner with a university professor in an effort to deliver the best possible educational experience to the students in the class.

A REPORT ON THE USE OF A PRACTIONER/ADACEMIC TEAM IN AN ADVANCED SURVEYING TECHNOLOGY CLASS

East Tennessee State University's B.S. in Surveying and Mapping Science degree is an ABET accredited program that seeks to prepare students for licensure and subsequent practice as Professional Surveyors.[1] Each of the various professions have unique paths to licensure and the surveying profession is no different. Typically, the path to becoming a Professional Surveyor requires completion of educational requirements, plus a period of approved work experience under the supervision of a Professional Surveyor, plus successful completion of licensing exams.[2]

This path to licensure has created a sort of de facto partnership between education and industry in preparing students for licensure. The role of education has been to provide the theoretical background and educational breadth needed to gain entry to the profession and to understand how the profession fits into the larger societal framework. The role of industry has been to provide the depth needed to master the technology and specialized aspects of the profession.

A BRIEF REVIEW OF THE IMPACT OF TECHNOLOGY ON ENTRY LEVEL OPPORTUNITIES FOR SURVEYING GRADUATES

Historically, it wasn't much of a problem to get students and recent graduates the work experience needed for licensure, especially in robust economic times. When distances were commonly measured with steel tapes, the typical survey crew consisted of three or more people, one of which served as a crew chief and typically had a great deal of experience, another with intermediate experience who served as an instrument operator and head chainman, and the remainder with minimal experience who executed tasks as assigned by the first two. Surveying students and graduates were well suited to step into the lower roles and to advance quickly as they already had some exposure to surveying theory and basic equipment use.

In this era, data was collected and recorded by hand, maps were hand drafted and computations were only beginning to be done with electronic aids. Consequently, a surveying firm's investment in equipment was comparatively small and was dwarfed by the investment in labor. Entry level jobs were plentiful.

The advent of computerized drafting and electronic distance measuring technology in the 1970's increased the equipment costs for the typical surveying firm. And they allowed for increased productivity, with less labor needed. So, surveying firms began investing a higher percentage of their costs in electronic equipment and less on labor – especially less skilled entry level labor. By the 1990's the typical surveying firm was using total stations with electronic data collectors for field surveys and computers to perform calculations and to plot maps. Fewer technicians were needed in the office for drafting and computations and the typical field crew was now reduced to two people. Although there was less need for entry level labor on surveying field crews, an inexperienced and minimally proficient surveying student or recent graduate was still a valuable member of a surveying crew, so long as the other crew member was well experienced and skilled.

But the pace of change in surveying technology has increased rapidly in the last 20 years and is continuing to increase. GPS equipment is now prevalent and the cost is within reach of most surveying firms. And only one person is needed to operate it. The same is true for robotic total stations. Both of these have now been in widespread use for 20 years and especially in the last 10 years. Terrestrial scanners have been introduced in the past 10 years and are beginning to be widely used. They, too, only require a single operator. And of course drone technology is commercially available and only awaits FCC approval in the next year or so. It will likely be widely adopted by the surveying community within the next few years. Advances in wireless technology and miniaturization in computers has also had an impact on the surveying profession.

As is often the case, the recent economic recession saw many surveying firms downsize, merge or cease operations entirely. The surviving firms often have fewer employees than before. This is nothing new and has been experienced several times over the years. Recessions come, companies downsize, business picks up and companies expand. That seems to be happening again. However, what is different this time is that surveying firms are investing in new surveying technology – expensive technology – that can be operated by one person working alone. Many surveying firms are now sending out one person in a truck equipped with wireless technology, a laptop, and either GPS equipment or a robotic total station and that person now does what took three or more people to do 35 years ago. Consequently fewer surveying firms are willing to hire an entry level person and train them. Previously, that person could be performing useful tasks while they learned on the job. Now, they are merely learning on company time, while producing minimal benefits for the company until they establish their proficiency with the new technologies.

So, technology has changed the nature of the education/industry partnership in developing students for professional licensure and practice. Industry's role is still intact. However, the economics of the new surveying technology mandate that the entry level employee be able to operate the technology, often with little or no supervision. Knowledge of basic theory and a broad education is no longer enough to get a student that entry level job. An in-depth proficiency in working with rapidly changing technology is also necessary.

THE CHALLENGES OF ADDING IN-DEPTH TRAINING WITH CHANGING TECHNOLOGY TO A BROAD EDUCATIONAL PROGRAM OF STUDY

Getting surveying students proficient with modern surveying technology raises a couple of challenges. One challenge is in finding enough equipment for the students to work with. Not only is this equipment expensive, but because of the rapid changes in technology, it becomes obsolete quickly and has a short replacement cycle, even if it is fully functional. And if the goal is to get these students proficient in operating the equipment, it isn't enough to have one piece for them to be exposed to in a show and tell environment. There needs to be enough pieces of equipment so that students can have substantial time actually operating it. So educational institutions not only need to have multiple pieces of expensive equipment, but they also have to cycle through it more rapidly than private sector firms do, in an effort to ensure that students are operating current state of the art equipment.

Finding the time for instruction with the new technology is also more of a challenge than might be apparent at first glance. One might think that time needed for instruction on the new technology can be found by discontinuing time spent on old technology. However, some obsolete technology remains useful for teaching basic theory. For instance, steel taping is largely obsolete, yet it is quite useful for demonstrating concepts about systematic errors that can be easily observed. So, in order to find the time for instruction with current technologies, it is necessary to carefully consider the ramifications of dropping instruction in other areas.

Finally, finding personnel who are skilled enough in operating the new technology to be able to teach its efficient operation to students is more of a challenge than might be thought.

Tenured and tenure-track professors have the theoretical background needed to understand how newly developed technologies work, as well as their limitations and optimal uses. However, the nature of the changing academic calendar means that they may get hands-on work with the technology for one semester a year or even less frequently. This, coupled with the variety of other duties that a professor needs to attend to, means that few tenured or tenure-track professors get the daily practice with new surveying technology needed to master its use.

The practitioners who work with this technology in their daily practices, and the vendors of the equipment, are the ones who have mastered its use and are best suited to instruct students on its use. Unfortunately, they are rarely proficient in the art of teaching and rarely are as familiar with how a given class fits into the overall educational structure of a well-planned curriculum. Hence, bringing in practitioners as adjuncts to teach a specific class works well with the hands-on part of the class, but not as well with the theoretical part of the class.

The Automated Surveying and Mapping (SURV 4550)[3] class is a required senior level class in the B.S. in Surveying and Mapping Science curriculum. This is one of three required classes in the curriculum that emphasizes work with surveying equipment commonly found in current surveying practice.[4] SURV 4550 has four prerequisite classes and can be thought of as the culmination of those prerequisite classes where similar technologies are taught, but at a more basic level. In SURV 4550 the students are exposed to the most advanced versions of those technologies that the university has at its disposal. Class projects are designed to require students to use these technologies in a manner that is similar to what can be expected in current surveying practice and to deliver a final product that is similar to what is delivered in current surveying practice. A major goal for this class is to turn out students who are exposed to enough modern surveying technology to be able to work alone as a one man survey crew within a few months of being hired by a surveying firm. This should enable them be a productive addition to the firm shortly after being hired.

Although the students in SURV 4550 have already been exposed to the equipment and technology used in this class, that exposure is quite limited. They received few repetitions in the prior classes and they were only exposed to basic commands and capabilities. Students entering the class haven't been exposed to 80% or more of the commands and capabilities of the software and hardware this technology is capable of. And this remaining 80% is the most powerful part of the technology and the part that is most likely to change with new technological developments. The professors who taught the prerequisite classes are familiar enough with the basic capabilities and commands to be able to teach it. But staying current with the annual changes and full capabilities of this technology simply can't be done on a part time basis.

A DIFFERENT SOLUTION FOR GETTING PRACTITIONERS INTO THE CLASSROOM TO ASSIST WITH IN-DEPTH INSTRUCTION

One solution for the problem of finding someone skilled in the operation of this technology is to hire practitioners as adjunct instructors. This solves the problem of finding a proficient operator to give the instruction. However, it can be difficult to get a skilled operator to take enough time away from their practices to cover an entire course at an adjunct's pay rate.

Another solution is to use the Professor of Professional Practice designation (or something comparable) to add someone with the necessary proficiency on a long term basis. This allows them the time to develop teaching skills, and it normally avoids the requirements for a terminal degree, which few surveyors possess. Institutions that allow for this option are well suited to solving the issue of getting an instructor who is proficient in operating current surveying technology. However, unless the duties of this person are limited so that they have time to practice and stay current with the technology, they will likely need to be replaced as their proficiency decays due to the fact that they are devoting so much time to teaching instead of to their professional practices.

East Tennessee State University has not made the Professor of Professional Practice option available yet, so a different solution needed to be sought. That solution was to keep control of the class under the direct supervision and control of a tenured or tenure-track professor but bring in a practicing professional to assist as a lab instructor, much like graduate students are used in related undergraduate programs. SURV 4550 was the class where this solution was tried. It was tried for the first time in 2013 and again in 2014.

The lab instructor position is not set up as a university employee. Instead it is set up as a contract with a consulting surveying firm. This allows for payments that exceed the university rates for adjuncts. No individual is hired to fulfill this position and, like any contractor, the firm has the option of selecting any of its qualified employees to fulfill the duties of the lab instructor. Those duties are contractually limited to being present with the students while they perform their lab assignments and to giving them instruction and guidance on the safe, efficient and most effective ways to use the technology to solve the lab assignments. The tenured or tenure-track professor in charge of the class retains the responsibility to create and grade the lab assignments

SURV 4550 is a three credit course that is structured with a single one hour lecture and a single six hour lab. This is the only required course in the curriculum that uses a single six hour lab and one reason for doing this is to enable a surveying professional to assist with the lab without the need to be away from their practice for more than one day.

Although we don't yet have enough data to be able to report quantifiable conclusions we are quite pleased with the way the SURV 4550 class worked out in the two times that we used this partnership. The projects that were turned in by the students in these two years exceeded those of prior years, both in quality, and in the degree of usage of current technology.

The only data we have available to assess the effectiveness of this partnership is in the form of course evaluations from the students in 2010 and in 2014. In 2010, the course was taught solely by a tenured professor. In 2014 the same tenured professor taught the course with a practicing surveyor to assist with the labs. Unfortunately, the university changed course evaluation systems between 2010 and 2014 and the result was that fewer student evaluations were submitted in 2014 than previously. Fifteen student responses were submitted in 2010. Five responses were submitted in 2014.

Three questions were identical in 2010 and in 2014 and are useful for comparing the student's perceptions in 2010 against their perceptions in 2014. The students were asked to strongly agree, agree, disagree, or strongly disagree with a series of statements. Four points were assigned for strongly agreeing, three points for agreeing, etc….

Those statements and the mean results are:

Question	2010 result	2014 result
- The instructor was knowledgeable and current in the course content	3.1	4.0
- The instructor's presentation and demonstrations were clear	2.6	3.8
- I increased my knowledge and skills in the subject of this class	3.5	4.0

Although the data is sparse, it does show an improvement in student perception as to what they thought the practicing surveyor was adding to the class.

CONCLUSION

The Professor of Professional Practice or a similar arrangement is one solution for getting a qualified operator of current surveying technology to teach the use of this technology to students. However, the experience of the SURV 4550 class at East Tennessee State University in 2013 and 2014 leads us to believe that has shown that a partnership between tenured or tenure track professors and contract lab instructors also shows promise for instructing students on the use of current and rapidly changing surveying technology.

This partnership concept has only been used in two classes, so it is too soon to draw firm conclusions as to its effectiveness. More data is needed and more opportunity is needed for unforeseen issues to develop. But the early indications are promising enough that we expect to continue using this arrangement in future classes where instruction on the most current and most rapidly changing technology is involved.

Bibliography / End Notes

1. See the list of Program Educational Objectives and Student Outcomes listed in the Curriculum tab at http://applieddesign.etsu.edu/surveying/. All of the Program Educational Objectives and some of the Students Outcomes are directly related to the goal of preparing students for licensure or subsequent professional practice.

2. See http://ncees.org/licensure/.

3. See http://catalog.etsu.edu/preview_program.php?catoid=11&poid=3694&returnto=527 and click on SURV 4550 – Automated Surveying and Mapping to see the university catalog description of the SURV 4550 course.

4. The other two courses are dedicated to two specific types of surveying technology, GPS technology, and photogrammetric equipment and software.