Making surveying education relevant

This paper examines how selected surveying/geomatics programmes address the issue of making their courses relevant to industry needs, student characteristics and one particular trend within higher education

Garfield Young
Lecturer & Programme Director, Surveying & GIS Division, University of Technology, Jamaica

Martin J Smith
Associate Professor & Deputy Head of Department, Department of Civil Engineering, The University of Nottingham Nottingham, UK

Roger Murphy
Professor of Education, The University of Nottingham, Nottingham, UK

Surveying education has been 'playing' catch up with changes in the surveying/geomatics industry and some individuals are of the opinion that the lag is substantial and demands immediate attention. Not only has technology impacted the surveying industry but the modernisation brought on by information and computer technologies has considerably impacted educational methods used in surveying/geomatics programmes. This paper examines how selected surveying/geomatics programmes address the issue of making their courses relevant to industry needs, student characteristics and one particular trend within higher education. The discussion is based on empirical data from a research that involved fifteen surveying/geomatics programmes from thirteen countries. The study investigated curriculum architecture and pedagogical alternatives within the discipline and the impact these have on students' preparedness for work.

Responding to change in the geospatial industry

Though some specialised surveying operations such as cadastral surveying are still protected activities for surveyors in some countries, generally land measurement and representation are no longer seen as exclusively the domain of surveyors. The geospatial industry continues to become more and more commercialized and caters to a growing market. In some contexts this is perceived by the surveying community as a threat and in others as an opportunity. Though these perspectives need to be taken in context, there is a growing awareness within the international surveying community that changes in the geospatial industry should be viewed as an opportunity for surveyors. Surveyors are now expected to adapt their systems of measuring, computing and representing land features to ever changing technologies. Indeed, as it relates to this area of work and education the only constant is change (Enemark, 2005).

Some argue that surveyors should not limit their roles and functions to doing only the things they used to do using new methods and new tools. Contemporary surveyors are encouraged to embrace the new opportunities and use their expansive knowledge and skills to engage with or rather lead the way in the commercialized geospatial industry. Surely surveyors are best placed to provide not only reliable data and processed information, but with appropriate education and training they can also provide leadership, advice and guidance in the vast array of areas where spatial information is used.

Surveying/geomatics education

The scenario described above brings to focus questions about the systems used to educate individuals for the surveying profession. In a number of countries the training and education of surveyors have been historically rooted in a system of apprenticeship. Young men (primarily) with a proclivity for mathematics and the outdoors were seen as prime candidates

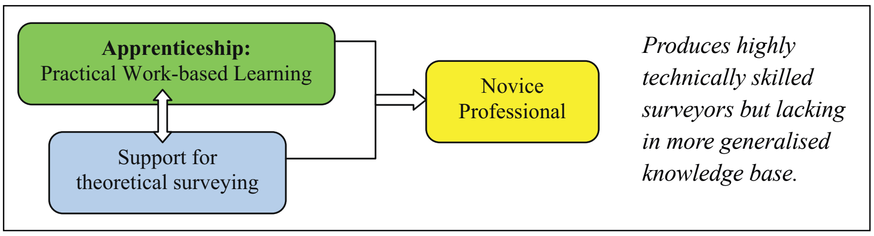

Fig 1: Apprenticeship Model

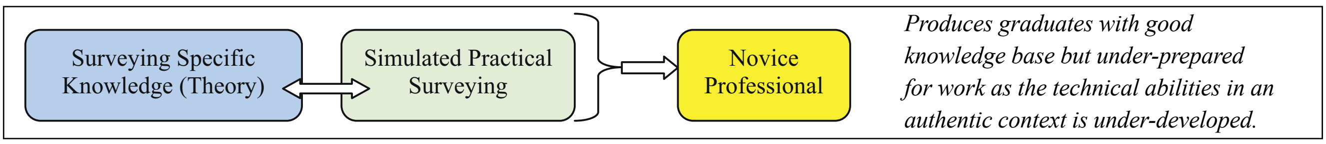

Fig 2: Traditional Education Model I

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for surveying apprenticeship. They would be trained under the supervision of a professional surveyor and through some supporting arrangement exposed to theoretical and computational aspects of the discipline. After a period of 'adequate' development in surveying knowledge and skills, the apprentice could follow a legally prescribed process to obtain a license to practice as a professional surveyor.

In a number of countries such as Britain, the military has also played an important role in the training and education of persons in surveying. Civil societies have benefitted from military trained surveyors who have worked, for example, in the primary surveys of numerous countries that were overseas territories of the former British Empire. Some of the earliest local surveyors in many of these former British colonies were apprenticed to European surveyors employed to the Directorate of Overseas Surveys (MacDonald, 1996). In Britain and other contexts, university graduates with academic degrees in fields such a geography and mathematics were also recruited to fill senior surveying positions within the civil service. With this latter group in-house training within the surveying establishment were provided since they had limited or no exposure to surveying knowledge and skills after graduation.

Formal surveying education in most of the countries looked at in the study, started in technical institutions such as the polytechnics in England and some Caribbean and African countries. These technical institutions provided vocational training offering certification to sub-degree levels (a few also offered Bachelor's degrees). They trained individuals who could follow on to become licensed surveyors. Many of these polytechnic institutions were upgraded to universities and many former sub-degree surveying courses upgraded to degree courses. Within this framework of development, surveying curricula maintained a strong focus on measurement and mapping. However, university requirements brought about a broadening of education for students in degree programmes. In many cases this meant a reduction in the concentration of specialised surveying education and an increase in general education. However, this had to be balanced with demands from professional accrediting bodies to maintain certain specialised content if the courses were to maintain a strong surveying flavour. In spite of this trend, it was found that in all 15 programmes studied, the specialised core elements remain the major components of the surveying curricula.

An important difference in the educational approaches of the past and present was identified. The apprenticeship system had a primary focus on building practical competences through a process of scaffolding. This was supported by short, sometimes informally arranged sessions to teach relevant theoretical concepts. Most of the university-based courses in the study had a system that was the opposite of this educational model. They are primarily concerned with covering theoretical concepts along with simulated practical exercises that reinforce the theoretical concepts. Where work-related experience was included as part of the study, it was given secondary consideration relative to the more theoretical focus. ***Figures 1 & 2*** illustrate the two models of surveying education described above.

Work-based skills development is the aspect that differentiates *Traditional Model I* from *Traditional Model II*. In those curricula that did not include work-based experiences, this was a decision based more on resource constraints rather than on philosophical reasons. Programme leaders generally expressed that because surveying education is profession-oriented, students would benefit from industry exposure during their studies. The ability to incorporate industry experience in surveying education, though not always a viable option for universities, is generally viewed as a learning activity that enhances students' readiness for work.

The models illustrate colour-coded boxes that highlight aspects of the educational models that seek to develop: disciplinary knowledge and skills (blue); work-based learning (dark green); practical skills (light green); and professional competences (yellow). The upper levels indicate primary emphasis in the curriculum and the lower level secondary emphasis.

The study found that a contemporary model of education (***Figure 4***) is emerging based on how the surveying community perceives the modern context of the discipline. This educational model seeks to incorporate the

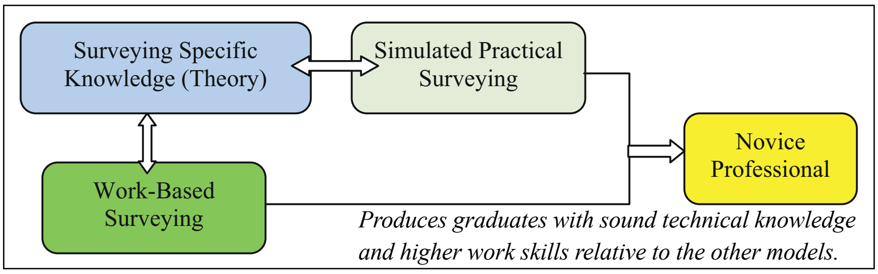

Fig 3: Traditional Education Model II

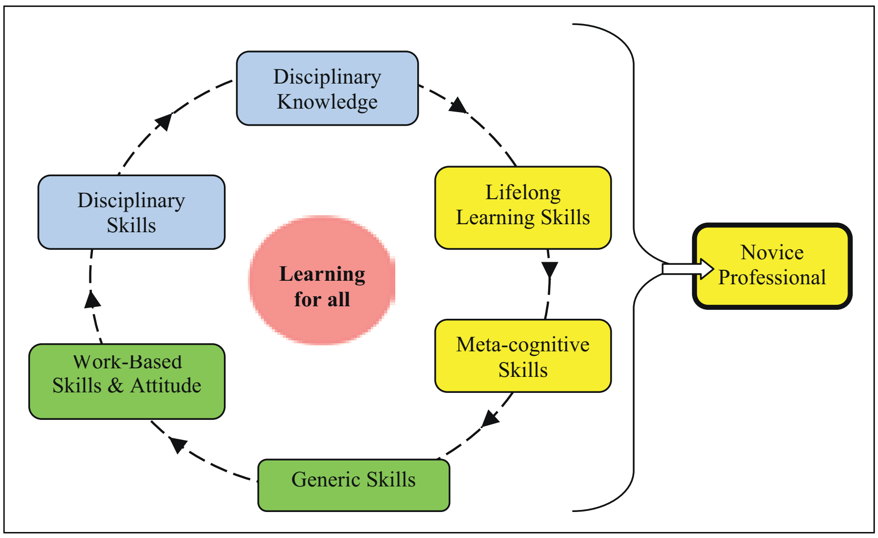

Fig 4: Contemporary Model of Surveying Education

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corpus of traditional surveying knowledge with knowledge of wider geomatics areas. Additionally, the model seeks to convey other aspects of learning that are more related to developing in students the skills to function in a dynamic world where interests and methods are in constant flux. Learning for the entire community of learners (not only the students) is at the centre of this model. With this model the disciplinary knowledge and skills may take on a generalist geomatics approach or it may offer narrow specialisations in areas such as Measurement Science, GIS, Remote Sensing, Photogrammetry, etc. Generic skills are those that are typically assumed to be developed during the normal course of knowledge growth and skills development. However, higher education programmes are now expected to explicitly incorporate systems that can develop generic transferable skills in students. Some examples of generic skills are: time management, teamwork, critical thinking and adaptability. These may be developed through increased group activities, learner-directed learning and meta-cognitive activities such as those that encourage reflection and critical thinking. Allowing students to choose surveying methods in the execution of multiple tasks and to justify their choices in the context of economy and accuracy and other specifications has been identified as one way of building critical thinking skills in surveying students.

Relevance of educational methods

Considering students' expectations and their changed characteristics

Student Expectations

Students' motivation for accessing higher education courses is primarily associated with career aspirations. Surveying students expect their university education to prepare them for work in the surveying industry and also to help in their preparation for professional certification. This fact has been overwhelmingly acknowledged by surveying students, programme leaders, academics and representatives of professional accrediting bodies interviewed in the study. The degree to which universities prepare students for the profession is a product of a number of factors. The knowledge content of the course is one of the more obvious factors as well as the degree to which students are able to apply theoretical concepts to practical situations. However, the link between pedagogical approaches and learning is less frequently acknowledged. Certain approaches are better at promoting certain types of learning than do others. If, for example, students are expected to have a holistic appreciation of a particular surveying method, they should be able to engage with the theoretical concepts, the skills required for applying theory to practice, and the affective aspects of negotiating the problem in a relevant context. In other words, concepts are not taught as abstract ideas that are joined with related concepts and activities after graduation. Rather, the learning of theoretical concepts occurs in a setting where related activities are linked. This kind of learning arrangement is described by Kolb (1995) as experiential learning. In this context students are able to make meanings of the teaching and learning experiences.

The study found that sometimes experiential learning is hindered by lack of resources. For example, where three-dimensional laser scanning is presented in theory but the expensive equipment is not available for demonstration and hands-on applications to real surveying situations. Two universities in the study have demonstrated how 'virtual' experiences can be employed as an effective alternative. This refers to the use of multimedia, animation, video conferencing and other live links that allow students to at least see how concepts can be applied in real situations.

Student Characteristics

Educational literature has identified changes in the characteristics of individuals who access higher education. It speaks of the emergence of students with characteristics vastly different from past realties. Students born in the late 1980s and onward have been referred to as *Net Generation Learners* (NGL) by Oblinger & Oblinger (2005) and as *New Millennium Learners* by Pedró (2006). These descriptors define the first generation of children to grow up surrounded by

Surveying Education

There is the continuing need to raise the next generation of professionals that is not only educated and competent but also agile and able to respond responsibly to the growing demands from humanity. Humanity is facing a series of challenges ranging from adequate food and shelter; environmental degradation, natural disasters and climate change; growing income chasm and economic crises. The profession cannot just measure but also need to manage, to mitigate, to meaningfully deploy its sciences and technologies, its knowledge and practices for the betterment of humanity so that the profession remains relevant. Against this backdrop, surveying educators have the unenviable task of educating and shaping our next generation of professionals.

However, there is always a gap between education and practise. This gap can be better addressed when the educators and the practitioners within the profession turn to each other for input and guidance particularly over things such as curriculum. The teaching institutions and the industry have to engage and work with each other to address this gap. This is happening and this gap also appears to be lessening with time as industry steps up to provide appropriate practical exposure, as new technologies that are being deployed is also being introduced to teaching institutions at faster and faster rates.

FIG Commission 2 (Professional Education) within its current four-year work plan is also addressing this challenge and this gap. Within the Commission, we are encouraging research, discussions and debates, for instance, on means to improve the delivery of surveying education, on components within a surveying curriculum that will keep the next generation of professionals relevant. Together with FIG Commission 1 (Professional Practice) in particular, and FIG's other eight Commissions, we are considering and identifying what is and what it takes to bring forth the next generation of surveying professionals that is not only well educated and competent but also agile and able, professionals armed with sciences and technologies, knowledge and best practices, responsibly extending the usefulness of surveying for the benefit of society, environment and economy, next door to everywhere.

Surveying curriculum and programmes that are keeping abreast with current realities and challenges of the time, as well as the demands on and the needs of the profession are addressing this issue better and better.

CheeHai TEO
President, FIG

Prof. Dr. Steven Frank
Chair, FIG Commission 2 (Professional Education)

digital media, with most of their activities dealing with peer-to-peer communication and knowledge management mediated by these technologies (Pedro, 2006). These students are considered to be particularly adept with computers, creative with technology, highly skilled at multitasking, find interactivity engaging, and have a preference for experiential, hands-on learning. How true are these descriptions of modern surveying students? How do we engage this breed of students?

Observations of teaching and learning activities within Surveying/Geomatics courses strongly suggested that contemporary surveying students bear many features of the NGL. For example, in lectures students were observed connecting with friends via online social networking tools, surfing the internet to look up new concepts being presented and using their personal computers to read the notes from the lecture and to augment them. Computer technology seemed indispensible to the surveying students. There was some evidence that pedagogical approaches were informed by a desire to engage these student characteristics. The technology in many cases was integrally linked to the study programme. This was evident within the classroom setting as well as in laboratories and in field exercises. Surveying students in several contexts were clearly oriented to the technology as part of their education as well as tools useful for instruction.

While the use of technology within surveying education programmes appears to have growing support within universities, a bigger challenge appears to be finding effective ways of conveying to students competencies for lifelong learning. While surveying students need to be supported in their learning, they also need to be encouraged to be actively engaged in seeking the knowledge and skills that will support ongoing learning. This is important because many things that surveying students learn in today's classrooms may be obsolete by the time they graduate. Thus, surveying students must be encouraged and supported in developing critical thinking skills, the skills to be able to deconstruct a problem and follow unpredictable paths to finding materials and tools to aid them in coming to decisions related to authentic surveying problems. Whether this is done through case study learning, group-based learning, project-based learning, problem-based learning, or other methods, the critical thing is that the education needs to be oriented towards learning and not teaching. Within this modern educational paradigm, all stakeholders in the educational framework are learners (as illustrated in Figure 4).

Conclusion

Our study gives consideration to the nature of the systems used to train and educate individuals for the modern surveying profession. How relevant are they to the modern context? Who are the individuals who typically access surveying courses or rather to whom do surveying courses appeal? The answers to these questions are fundamental to the development of surveying/geomatics education programmes. These are issues of relevance. Relevance of practice to societal needs, relevance of education to practice and relevance of educational methods to students needs and to industry needs. Exploring these issues involves: (1) an understanding of the nature of the profession in its modern context and also foresight into the likely path it will take in the near future; (2) an understanding of the characteristics of modern day school leavers and higher education students; and (3) an understanding of the teaching and learning strategies employed by a responsive and responsible higher education sector.

There is no doubt that the geospatial industry has changed. It has become far more commercialized than it was a few decades ago. Increasingly non-surveying organizations are making inroads into the geospatial market, grasping the opportunities that this modern context offers. The modus operandi of surveyors has also changed (more so in some countries than others). We can foresee that those countries that are lagging in the technologies will eventually see wide-scale modernization of the surveying processes. We believe that two things are crucial for moving forward for the community of surveyors and surveying educators: (1) surveyors need not only to adapt their operations to the changing technologies but also tap into new opportunities that their skills-set clearly makes them ideal for; and (2) universities and other educational institutions that offer surveying courses need to orient the education towards learning for all in a community of learners involving all stakeholders. The curriculum structure and pedagogical approaches employed must begin to manifest a degree of flexibility that allows for changes to ensure relevance. If our educational efforts were to have a focus on learning rather than teaching, then we would be more inclined to try new methods and to adjust methods depending on our evaluation of students' needs and the needs of industry. As a surveying community we can only respond to contemporary demands if our orientations and our educational programmes are relevant to the times.

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