FUTURE-PROOF EDUCATION

IN

SURVEYING?

DR. BRUCE R. HARVEY

33rd Survey Congress – Association of Surveyors PNG - Madang

Future-proof education in Surveying?

Dr. Bruce R. Harvey
School of Geomatic Engineering
University of New South Wales

Abstract

How can University teachers prepare graduates to be the new generation of surveyors if traditional surveying is changing so rapidly? One approach is to foster general skills in students' education as well as specific technical skills. Another approach is to practise life long learning. This paper discusses these approaches.

1. Introduction

The conference theme "Surveying - The New Generation" is particularly relevant for universities. Good university teachers have always thought about educating students in a way that considers they will be working for many years after graduation and will use changing technology for new applications. Changes, new technology, and information 'overload' are dilemmas that have concerned many people and courses are frequently reviewed and improved.

This paper will try to avoid educational jargon and will use examples from Surveying. Firstly it will mention some of the current problems facing surveyors and university teachers. Then it will review some educational material on general skills education which is proposed as one way to produce future-proof education. Next it discusses how surveyors can train new recruits and maintain their own abilities. Finally it will make some recommendations and conclusions for 'New Generation' Surveyors.

2. The current scene

This section lists and describes of some of the current problems and challenges for surveying education.

Firstly consider the view from the surveying profession. A recent FIG working committee reported (FIG, 1996) that the environment in which surveyors work, is changing due to technology and management developments. They suggest this is a threat and a challenge, and universities need to consider: lifelong learning instead of just vocational training, management skills instead of just specialist skills, quality management instead of quality control, and project orientation instead of subject based education. These comments could be extended to other post secondary education and to 'on the job' and in-house training.

Next consider the advice of university educators. They say teachers have to consider the balances between: teaching technical skills and management; training and education; surface learning and deep learning. Using simple descriptions, surface learning as shown in figure 1 includes things like students remembering a lot of information, and deep learning includes students understanding concepts and being able to analyse and solve problems. A recent OECD Review of Tertiary Education in Australia said 'the changing employment market is not leading to a greater demand for narrowly trained specialists but for graduates who can think for themselves, communicate, empathise and work with others, invent solutions and create new possibilities'.

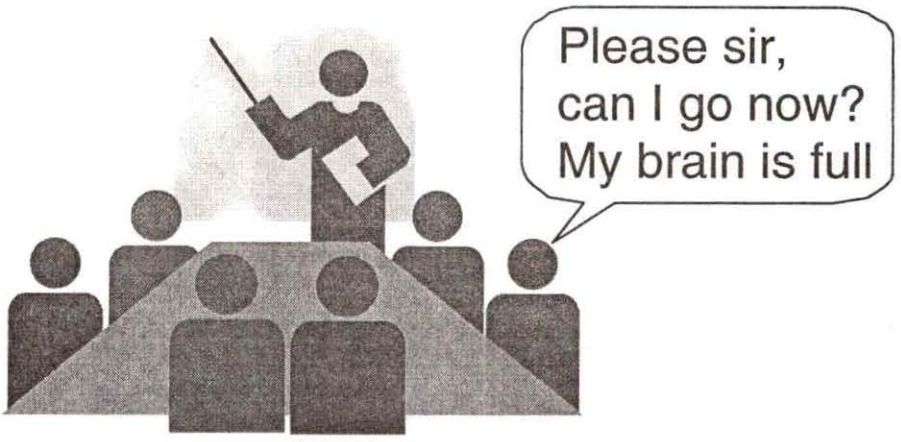

Figure 1. Surface learning is just 'filling students up' with information.

The third group to consider are employers. The type of graduates employers want varies considerably and seems to depend on the size of the organisation. According to anonymous feedback, some surveyors say they want graduates with technical skills and experience who can do productive work that earns income as soon as possible. However other employers say, "the type of graduate we are looking for has a broad education. We are looking for people who are not just good technically ..." P. Dougas (Georg, 1998). Some employers of graduates mention the following as important qualities: the ability to apply knowledge and skills in the workplace, communication skills, practical skills, capacity to learn new skills and procedures.

To meet the requirements of employers some universities, when designing or improving a course, ask employers questions like the following. Do you want to employ surveyors who can just use the instruments, do the calculations and plans or do you want more? Do you want them to think, be creative, and perhaps find better methods? What abilities and skills do you want fresh graduates to have? Then universities usually publicise the knowledge, skills and understanding that a student is expected to have upon completion of their course (e.g. Harvey & Trinder, 1995).

A key topic for this congress is change, it affects the profession, employers and universities. Considering the changing world of traditional surveying, Clark (1996) investigated the world of nature, in particular the evolution of limpets, and drew some conclusions for surveyors. If surveyors specialise more and more or have only one type of client or funds provider, then they may survive for ages but suddenly become

extinct because when conditions change they can not do anything else or find any other income. He advises that "Clinging to your present niche when the environment is changing guarantees extinction".

Another challenge is that new technologies, new survey equipment or new techniques, often mean work can be done faster so perhaps fewer surveyors are needed. This may eventually put surveyors out of work. Some senior surveyors say their companies and staff are doing surveys faster but are not making more profit or having more leisure time. Instead they are charging clients less for each survey and are now having to do more surveys to cover expenses.

To prepare for these changes people have tried to predict which technical skills may be useful in the future, not always with success. For example, in the past some people predicted computer use would be an important skill for graduates, but now computers are becoming easier to use and the skills are more easily and quickly learnt. The same could be said for surveying instruments. Think about what you learned when you were a student, which parts are still applicable, which are not? Even when technology changes with new equipment and new software versions, having learnt and used an old technology or old version of software, gives you skills and confidence that can help with new methods, versions or equipment. Software changes all the time so students should be able to choose the most suitable tool rather than being trained in detail in one software. Perhaps graduates have to be able to teach themselves how to use new versions.

So far this paper has considered the needs of the profession, universities and employers. Then it mentioned the effect of changes in technology. Finally we consider the prospects for graduates. Ten years after leaving university few graduates do survey field work, however many still require knowledge and experience in these skills in a management role. Some graduates move into the broader Geomatics fields others move further away from their skills training. In some large organisations groups of surveyors are being managed by someone with no survey background. Similarly, some surveyors are managers of 'departments' that are not surveying based. Government departments and universities that employ surveyors are often being run more like commercial enterprises than service providers. Will this continue in the

future? Some graduates will need to cope with redundancies and recessions. If they only have specific surveying skills then they will need to retrain or broaden their area of work. These concerns lead into the consideration of general skills in education.

3. General skills

Surveying degrees normally aim for students to learn knowledge and understanding specific to surveying and be able to demonstrate the application of surveying skills. If surveying knowledge was just applying facts, rules and procedures to straight forward problems then a student would just need technical training. For technical skills training, a teacher lectures and demonstrates, students listen, read, study and do practice problems, then teachers observe students and give them feedback. Previously it was claimed that if students are trained in technical skills this training will probably become out of date.

Sometimes a surveyor's work is not straight forward, it may require the surveyor to improvise, invent and test strategies. Value judgements may be required. Also some surveyors undertake a variety of work and their tasks require them to work in a field that they have not practised recently. So students need to learn facts and methods but also how to think like a surveyor, to be able to develop new methods to solve individual problems. These new methods can be based on experience and experimentation. Students also need to learn about the standards, care and attention required of professionals. Modern surveying (or geomatic engineering) degrees include more than just data acquisition (survey measurements) and data analysis (calculations).

As mentioned previously, universities and some employers want graduates to possess general skills, often called generic skills, as well as specific surveying technical skills. General skills are those that may be transferred when a surveyor works in a different discipline as their career path changes.

Examples of general skills for surveyors are skills such as problem solving, numeracy, communication, technology usage, knowing how to learn, time management, self

evaluation and self reliance, general business skills (e.g. basic accounting), critical thinking, and being able to work effectively in teams or independently.

Further explanation of some of these general skills follows. Communication skills include written, spoken, visual (drawings, plans, maps, graphs etc.) and listening, rational persuading, and negotiating. Problem solving includes analysis, evaluation, lateral thinking, organising thought, resources and action, and application of prior knowledge. Critical thinking can be classified into different levels. Firstly, do students understand the question or problem? Then, can they collect the relevant information? Next, can they put the information together and apply it? Finally, at the most sophisticated level, is their understanding good enough to allow them to extrapolate this problem to other applications and do they ask relevant searching questions?

Self evaluation and self reliance skills include ability to clearly identify their own skills, values, interests, strengths, and other personal attributes. A person with these skills seeks feedback from others, is able to identify areas for personal, academic and professional development, and has an underlying self-confidence in abilities, based on past successes.

Management skills include teamwork, Quality Control that looks for errors and tries to correct them, and Quality Assurance where errors are 'designed out' and prevented.

Further general skills include the capacity to:

- explore the assumptions in a statement or method, and evaluate the statements or methods in terms of evidence.
- detect false logic or reasoning in an argument.
- unleash inherent creative and entrepreneurial talents
- be alert to the ethical implications of what is being said or done, and to be able to distinguish fact from value.
- know how to learn, especially concerning the understanding and capacity for carrying out a research project.
- be familiar and confident in the use of information and communications technology.

- develop themselves as a whole person, in academic study, personal fitness, cultural environment, student involvement on campus and in the broader community.
- apply and transfer what they know and their skills to a range of new situations and problems.
- have an open mind, be responsive to ideas and phenomena, have some scepticism, and sensitivity and responsiveness.
- understand the hidden tensions and power struggles within organisations.
- adapt goals in the light of changing circumstances.

3.1 Teaching general skills

The previous list of desirable general skills provides quite a challenge for students and their teachers. Some students will get some general skills while doing their course even without any intentional actions by their teachers, but with conscious effort by teachers more general skills might be acquired. For example, students need to acquire time management skills to allow submission of assignments on time and suitable preparation for examinations. Also students need to learn to cope with pressure at examinations. It is important that teachers assess the students' time management and ability to handle difficult situations under pressure and give them feedback. One way is for students to submit log books of time spent on a project or to give a client costing with their submission.

General skills can be taught at the same time as specific skills. Specific skills are important, but teachers need to assess and give feedback on general skills as well as specific skills. Teachers need to look at students' process, problem solving, group work and critical thinking. It may be useful to advise students (in language that a student can understand), what are the teacher's aims and to give examples of general skills.

An example of a way to see if students have acquired the general skill of learning how to learn to use a new type of software follows. Teach them one version of a software, then later give them a newer version of this software or similar software from a

different company and observe how well students can teach themselves the use of the new software.

Students should have the opportunity during their course to reflect on their personal development and record their progress, receive clear feedback on their progress, and receive advice on career planning. Giving students feedback on their general skills is the sort of thing teachers may put in references to prospective employers. It is in addition to marks or grades for specific skills subjects. It includes comments on leadership abilities, self confidence and self awareness. Another approach to documenting general skills abilities is for students to prepare a portfolio that includes examples or evidence of their specific and general skills.

4. Life long learning options

Previous sections have considered the problems facing university education of surveyors and the suggestion that general skills and specific surveying skills are important. This section looks at two aspects for surveyors after leaving university, firstly learning new skills themselves and secondly once they become more senior, how to teach new staff.

One way to further or update their knowledge and skills is to enrol in a university degree (undergraduate, graduate diploma, Masters degrees, or PhD) [UNSW has a full range]. Some courses can be studied by distance education. Combined degrees where students do two undergraduate degrees in slightly longer time than it takes to do one degree and postgraduate degrees and diplomas in a non surveying field have recent popularity with students. Also people with non surveying backgrounds are coming to Geomatics and Surveying for a second degree.

Another approach is to participate in shorter Continuing Professional Development (CPD) seminars, congresses, and workshops run by Institutions of Surveyors and by universities. However, to be most beneficial emphasis needs to change from collecting hours of occasional CPD training to emphasising the outcome such as increased proficiency. This improvement in the effectiveness of CPD could be

achieved by requiring attendees to apply some of their learning to their work after they leave the CPD course and then to report on their efforts and get feedback.

Alternatively, surveyors may choose to learn a new field themselves. One way is to collect and study as much literature on the topic as possible. Then experiment and try to implement some actions in this new field. Often the quality of practical experience is more important than the quantity. Commitment to lifelong learning includes learning from experiences, good and bad, and reflecting on them.

Attending courses or self learning are two approaches, a third is to find an advisor or coach. The advisors should have good practical experience or theoretical knowledge in this new field and be able to explain and teach others. An advisor can assist learning by saying what mistakes the learners have made, by demonstrating better or alternative methods, or by working with them to do the task. That leads into the next topic: on the job training.

4.1 On the job training

On the job training has a long tradition in surveying, with Master Surveyors being the advisors of pupils. The methods of master and pupil can also be used for teaching new techniques or new technologies. There are different methods of teaching, each or a combination of them, is appropriate for different contexts because students are not all similar - they learn in different ways. So include a variety of training methods. Gibbs and Habeshaw (1989) say: "There is no one way to teach effectively" "see if it works for you". Here are some ideas for surveyors on how to train, coach or teach new recruits or retrain existing staff into a new speciality, Schon (1990) has more details.

- New staff can learn by **practising**, by doing tasks themselves and gaining experience. If possible, give them freedom to learn by doing tasks in a setting with low risk (like university **survey camps**), with access to advice if they need it. However, lowering their anxieties in this way might also remove some of their motivation for doing good work. The work should involve a lot of thinking about

what they have done (reflection) and discussion with others. One way to get students to do more reflection is to ask them to think of alternative methods or improvements and ask them questions while they work. Another way is to ask them to write a journal describing their actions but also the thinking that goes with doing the work. New ideas or understanding may come to them while writing their journal. Also, documenting thoughts clarifies and preserves them.

• Students can learn by **working on their own**. Learning from personal experiences can be a valuable resource, however we may overuse this resource. Students need to learn to detect and correct their own errors. Learning on their own (such as leading a field party or managing a project) allows them to experiment and requires innovation, but it also means many things they learn will be 'reinventing the wheel' - an expert could have told them how to do it. Also, they may also not realise that there are better ways to do the task than the way they have chosen, and a remote supervisor may not notice some weakness or flaws in the student's work.

• Students can also learn by being **coached by master practitioners**. They can initiate students into the customs, methods, standards and traditions. This apprenticeship exposes them to real conditions of work. However some survey firms do not or can not provide the time and effort, and are unwilling to carry the risk of mistakes that accompany 'teaching' an apprentice. Also the master practitioner needs to be a coach not just an expert. Experts may be able to do a task well but not able to describe, explain or teach students well, or they may not wish to give their special expertise to others. So coaches have to be carefully selected. Demonstrations are useful when a technique is new to a student. A coach can break a problem into smaller tasks and demonstrate each part. Demonstrations should not be too complex or given too quickly. The student then imitates or copies the coach's demonstration and reveals what has been learnt. The coach comments on the students attempt at imitation. Students should think about the action as well as copying it.

• Another method is where the **coach and student work together**. To use this method a student has to have some ability and willingness, so it may not be appropriate for beginners. The coach should resist the temptation to solve the problem for the student, but could offer several solutions and let the student choose.

The master or coach must balance between too much supervision and not enough supervision. When students have plenty of talent, coaches should keep out of their way. A disadvantage of student and coach working closely together is that when a problem arises or when making a decision, students may ask for help instead of thinking for themselves and testing their idea by trying it. One effective method is to have the student perform the role of surveyor and the coach to perform the duties of the assistant (as well as watching the student's actions).

5. Conclusions and recommendations

At universities students learn some competence in technical skills, but in the process develop rigour, confidence and other general skills. As the required technical skills change in time, for example, to new versions of software or new equipment, or as data acquisition and analysis become easier, our graduates can adapt.

We all have something to do to cope with the future of surveying. The task for teachers is to teach surveying skills in a way that recognises the likelihood of future changes in technology and applications and to assist students to learn general skills. The task for students is to improve their general skills as well as to learn surveying skills. The task for surveyors is to update and maintain their skills, to convince their employers and clients of their abilities in general skills as well as excellence in specific surveying skills, and to assist the education of their junior colleagues.

6. Acknowledgement

Parts of the section on general skills are based on discussions with Dr John Hoddinott at the Professional Development Centre, University of NSW. Further details on generic skills in University education not specific to surveying can currently (1998) be obtained from his web site, starting at:
http://www.pdc.unsw.edu.au/Interests/Review/gs1.html

7. References

Clark, T. (1996) unpublished presentation at NSW Main Roads Surveyors Conference, Sydney, June 1996.

FIG (1996) Proceedings of Computer Assisted Learning and Achieving Quality in the Education of Surveyors, FIG Commission 2 Joint Workshop, Sept. 4-6 1996, Finland.

Georg, D. (1998) Creating an environment for people to enjoy their work, The magazine of the Institution of Engineers Australia, Civil Edition, Vol. 70 No 2, Feb 1998, p 23. A quote from Paul Dougas Managing Director of Sinclair Knight Merz (SKM).

Gibbs, G. & Habeshaw, T. (1989) Preparing To Teach, An introduction to effective teaching in higher education. Technical and Educational Services Ltd, Bristol, UK.

Harvey, B.R., and J.C. Trinder (1995) Content of the Bachelor of Engineering in Geomatic Engineering Degree Course at the University of New South Wales, The Australian Surveyor - Education Supplement, June 1995, pp. 14-18.

Schon, D.A. (1990) Educating the Reflective Practitioner, Toward a New Design for Teaching and Learning in the Professions. Jossey-Bass. 355p. ISBN 1-55542-220-9.