Developing generic skills of first-year science students

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Introduction

Students, governments and employers are increasingly expecting a higher education qualification to imply that certain skills have been acquired that can be transferred to employment. In particular, in 1998 a survey was conducted which suggested that graduates in Australia were under-equipped for employment. Employers expressed dissatisfaction with the generic skills of graduates. These generic skills—also referred to as transferable skills or graduate competencies—include communication skills (report writing, presentation), quantitative skills (numeracy), reasoning skills (interpretation, problem solving, analysis and appraisal, critical thinking), teamwork and computing and information skills.

Our approach

The Faculty of Science of Monash University responded by developing a new Bachelor of Science which aims to provide a "broad, general science education, equipping graduates for employment in both the public and corporate sectors where the emphasis is on generic skills which include numeracy, data analysis and presentation skills, and the capacity to work in teams."[1]

As part of this new BSc, students undertake a core subject, with the main aim of learning the generic skills they are likely to need during their course and in employment. The core subject was developed in the context of what is known as the "scientific method"; the objectives were defined around the basic tools and skills needed to "do" science.

The core subject involves the development of core generic skills for scientists, namely analytical, computing, information retrieval, teamwork and communication skills. Students learn these skills in the context of the scientific method. Although mathematical and statistical skills constitute a large part of the core subject, this is not a mathematics subject; students learn how to apply mathematical and statistical tools and concepts together with other skills relevant to their course and future career.

Teaching method

The core teaching and learning activities take place in weekly two-hour workshops where students work on their projects. In each project, which usually spans two weeks, students address a particular question and follow the scientific method to obtain an answer. This answer is then communicated to the tutor and peers in the form of a written scientific report or a poster presentation. Projects require a variety of approaches to tackle scientific questions including formulation of hypotheses, design of experiments, collection and analysis of data, modelling of data and mathematical modelling. Projects allow for freedom of development and encourage exploration, they do not give a tightly prescribed experiment, neither do they provide a recipe. Some projects also involve teamwork.

[1] Monash University Undergraduate Handbook, 2001.

Students also attend two weekly lectures. The role of the lectures is to provide an overview of the subject and to present case studies and the basic analytical and modelling tools students will need to carry out their projects. The lectures are hence supporting the workshops. The workshop is where most of the learning occurs, lectures convey the information that will help students in workshops.

The subject is currently assessed with 5 projects and a poster which assess the attainment of the analytical, communication, information retrieval and computing skills, and a final examination which is used to validate the project work and to assess analytical skills and the understanding of how scientific knowledge is build.

Challenges

The development and delivery of the subject presented several challenges to the lecturers responsible for designing the projects and giving the lectures, the tutors conducting the workshops and marking the projects, the students and the administration.

Challenge 1: Defining the subject objectives. The core subject required a multi-disciplinary approach, as examples, case studies, and project topics had to be drawn from all areas of science.
Challenge 2: New teaching methods had to be used. Up until now, lectures have been used as the main resource for learning in science. The generic skills based subject required a culture change in the way science is taught and the way academics perceive their role as teachers, and as any change implementation in higher education, it had to be managed carefully.
Challenge 3: The increased role of tutors. Tutors have a very important role in this core subject as the projects—carried out in workshops conducted by them—constitute the core learning activities of the subject. However, tutors are less experienced than lecturers and hence required proper training.
Challenge 4: Changing students' approaches to learning. At the start not all students reacted positively to the subject, very few saw it as an important subject which would prepare them for the study of other subjects and for employment. It was surprising to find out how many students view teaching as "done by the teachers", expecting well structured lectures with a set of lecture notes which they can learn and later reproduce in the exam. Students need to be persuaded about the value of the subject objectives.
Challenge 5: The administrative structure. The administration supporting the university programs also needed to be made aware of the different nature of this core subject, which had implications on the physical teaching environment, timetabling, and credit transfer.

Conclusion

Our teaching programs must continuously adapt to the changing nature of higher education. A fundamental reinterpretation of the roles of lecturers, tutors and learners in the learning process is needed to help students to prepare for "life after exams", for the world which requires individuals who are flexible and adaptable, individuals who have the capacity to learn and change with the changing needs of organisations. The process of reinterpretation of roles needs to be managed as a culture change in higher education and requires time, reflective practice, training of teaching and administrative staff, and changing students attitudes towards, and perception, of learning.