Integrating Professional Skills into the Curriculum

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Abstract

The need for the teaching of professional skills to undergraduates in areas such as communications, team work, conflict resolution, and ethics has for some time been articulated by the information systems profession. These skills are particularly required by information systems graduates. Changes to the traditional systems development life cycle towards use of package software, prototyping, distributed computing, JAD etc have all placed a further demand on interpersonal skills as opposed to technical skills. While this need has been recognised by some universities, there have been a number of approaches to the incorporation of these skills into the teaching programme. This paper describes how professional skills teaching has been introduced within the University of Tasmania's undergraduate programme.

1 Introduction

In 1994 the Department of Computer Science at the University of Tasmania undertook a major revision of its undergraduate teaching programme. Over the twenty years of the Department's existence, a computer science programme had evolved which was comparable with that taught in computer science departments throughout Australia. In addition, an information technology programme had been introduced in 1987 as a second major, primarily aimed at students from Humanities and Commerce. Each of these programmes had undergone periodic revision on a three to four year cycle.

This paper discusses the major outcomes of that course revision and, in particular, focuses on the introduction of professional skills training into all years of the undergraduate and honours curriculum.

1.1 Background

The 1994 course revision took cognisance of several reports that had recently been released, including the DEET Discipline Review of Computer Science [1], the AVCC Review of Computer Science Honours [2] and various reports of the Business/Higher Education Round Table [3].

The DEET report cited the concerns of employers at the communications and interpersonal skills of graduates. It also called for the provision of education on cultural, social, legal and ethical aspects of information technology. The report also said there was a need for information technology professionals to be able to appreciate philosophical questions and to appreciate issues relating to the social impact of computing.

Following this report a number of different approaches have been taken to introducing or expanding the degree to which information technology courses address these issues (e.g. [4] and [5]).

The Department of Computer Science at the Sandy Bay campus of the University of Tasmania undertook a comprehensive restructuring of its curriculum in 1994. Rather than revamping the existing course structure, the course review began by considering the characteristics of the graduates which should be output from the Department's teaching programme. Several parameters were important in determining the structure of the resulting courses:

- the existing Department was predominantly a traditional computer science group, with a small computer systems engineering section, and an information systems group that was attracting increasing numbers of students at both the undergraduate and postgraduate levels. At the time of the review about 40% of the undergraduate students were enrolled in IS units, and about 30% of the postgraduates were engaged in IS related research.

- the Department teaching was mainly confined to three year bachelor degrees, with honours being the only significant graduate coursework programme.

- the projected enrolments envisaged only modest growth for the Department. The majority of this growth was expected to be in the IS area.

- the Department taught across at least six degrees, and could not afford to offer individual programmes for any of these degrees.

Early in the review process it was decided to develop a course structure which would produce professional graduates in the following areas:

- Software Engineering
- Information Systems
- Computer Systems Engineering

In addition, students could select appropriate course units to develop a major in computer science and proceed to research in computer science.

From a map of topics considered necessary to achieve a professional level in each of the designated areas, a programme of course units was developed to cover up to 50% of an undergraduate degree. At each year the topics which were common to the three professional streams were grouped into a common, core unit.

The overall outcome of the review was an efficient teaching pattern that ensured that all streams of students would receive a grounding in a range of required topics. The range of topics covered was much richer than the previous curriculum, and there was far greater focus on the quality of graduates produced. This was all achieved with a 20% reduction in teaching load, due to the elimination of redundant topics from the old programme. The quality of the new programme was assessed by inviting review from academics external to the University of Tasmania.

The restructured courses were introduced at first year level in 1995. The second year courses were introduced in 1996, and the undergraduate programme will finish conversion to the new structure in 1997. Consequent changes to the honours programme are currently under consideration. The course components of the restructured streams are at Appendix A.

The new streams have the following common core units:

KCA122 Computer Science 1 or
KCA123 Computer Science 1C
KCA220 Computer Systems
KCA318 IT Project

The first digit in each unit code signifies the year at which the unit is offered.

In addition there is another first year unit, KCA173 Information Processing 1, which can be taken by Bachelor of Arts students wanting an Information Systems major.

2 Professional Skills

In 1993 the Department introduced a programme of professional development within the honours year. Each honours student was expected to attend 1–2 hours of professional skills training each week. An external facilitator was contracted to deliver workshops on communication skills, teamwork, assertiveness, group formation and group problem solving. In addition, Departmental and guest lecturers conducted workshops on a variety of topics, including cross-cultural relationships, career visualisation, interviews, presentation skills and thesis writing. The introduction of this programme was partly funded through a Committee for the Advancement of University Teaching (CAUT) Teaching Incentive Grant. The level of participation by honours students in the programme was very high, and the feedback received from employers was very positive.

However, this programme was only available at the honours level. The 1994 course revision identified the need to introduce professional skills training at all levels of the teaching programme. It was considered essential that this training take place across all years of the degree programme, rather than being isolated to one year. As students matured in their understanding of the discipline more advanced topics could be covered, that were relevant to the other topics they were studying. For example, teamwork, team leadership, conflict resolution and negotiation were considered appropriate for third year students when they were about to embark on large, team-based project work.

The introduction of the programme was achieved by adding professional skills training to each of the common units in years 1 to 3, and enhancing the programme which already existed within the honours year. Students were to attend a one hour workshop per fortnight in professional skills training throughout their undergraduate and honours years.

The objectives of the professional skills training component were:

- to introduce students to a range of professional skills considered essential for their effective operation as IT professionals;
- to develop skills and attitudes in students appropriate to IT professionals; and
- to ensure that at all times the acquisition of these professional skills are seen by the students as relevant to the technical and theoretical programmes which they are concurrently receiving, and as being essential for the well rounded graduate.

The second objective ensured that the professional skills training was a genuine skills-based programme, and not just an attempt to impart knowledge. Students are required to actively participate and to acquire appropriate levels of skills through experiential learning.

The specific topics for the professional skills stream, and the development of those topics over the three year programme and into the Honours year, were decided on the basis of the relative importance ascribed to these skills in the literature on this area [6, 7, 8 & 9] and on the DEET Information Paper on *Education and Training Needs of Computing Professionals and Para-professionals in Australia* [10].

The proposed course structure was subjected to external review by Judith Dwyer, noted author of [6]. Ms Dwyer has extensive experience in this area including as Head of Division (NSW) in Business Services in TAFE.

Ms Dwyer also conducted a one day seminar within the Department on teaching professional skills.

Assessment of the professional skills programme was initially seen as problematic, due to the general absence of capability-based assessment within the University of Tasmania. A compromise was reached whereby professional skills are assessed through assignments, such as essays and presentations, and also through the normal assessment contained within the remainder of the course. When setting an assignment a lecturer is expected to indicate which skills are expected to be displayed in the completion of the assignment. The relationship of the skills required in assessment and the professional skills training is then obvious to the students. This was a major improvement over previous practice where the required skills and capabilities for assignments were implied, rather than being made explicit to the students.

2.1 First Year

In the first year the emphasis is on introducing students to the range of non-IT specific professional skills which they may be called upon to use in their future careers. The sessions are presented as part of the practical component of the first year unit in which the student is enrolled. The first year curriculum is given in Table 1

	Semester 1
Wk 4	What is the role of an IT professional?
Wk 6	Ethics in computing
Wk 8	Study skills
Wk 10	Report writing
Wk 12	Cross cultural communication
Wk 14	Legal issues
	Semester 2 *Basic Communications Concepts*
Wk 15	Introduction
Wk 17	Information gathering
Wk 19	Interviewing
Wk 21	Organisations: groups & teams
Wk 23	Meetings & decision making
Wk 25	Marketing, presentation skills
Wk 27	Presentations by students
Wk 28	Presentations by students

Table 1: First Year Curriculum

The specific objectives of the first year are:

- to develop an appreciation of a wide range of issues relevant to IT professionals;
- to develop an awareness of the importance of good communications skills to the effectiveness of an IT professional; and
- to develop an awareness of the range of communications skills required;

A text book [6] on business communications is prescribed for the professional skills sessions, and this book is also used in subsequent years. Other books, such as Johnson and Nissenbaum [11], are used to supplement that book in specific areas.

Students are assessed on the basis of attendance and participation, and on the completion of two assignments, a short written report, and a two minute presentation on a topic of their choice. The assessment constitutes 10% of their practical mark.

2.2 Second Year

The second year unit, Computer Systems, covers systems analysis and design, operating systems and communication systems. As with the first year, the sessions are presented as part of the practical component of Computer Systems.

The objectives for the second year professional skills programme are:

- to provide a knowledge of factors that contribute to effective inter-personal communication.
- to develop an appreciation of ethical considerations of the computer profession, including codes of conduct.
- to be able to apply group problem solving methods to small problems, and understand different modes of thought for problem solving.

As one of the key themes for the second year is working in groups and teams, the students are allocated to small groups of about four to six, and as far as is possible, they remain in these groups for the year. Most sessions use group exercises as part of the learning process. The second year curriculum is given in Table 2.

	Semester 1
Wk 2	Groups and teams
Wk 3	Information gathering
Wk 5	Interviewing and ethics
Wk 7	Interviewing
Wk 10	Interviewing exercises
Wk 12	Metaphors
Wk 14	Metaphors
	Semester 2
Wk 16	Group dynamics
Wk 18	Meetings
Wk 20	Team decision making
Wk 22	Group problem solving
Wk 24	Group problem solving
Wk 26	Presenting a proposal
Wk 28	Group presentations

Table 2: Second Year Curriculum

Students are assessed on the basis of attendance and participation, and on the completion of two assignments;

an individual written report and a ten minute group presentation. The assessment constitutes 10% of their practical mark.

2.3 Third Year

The third year professional skills will be presented as a component of the IT Project unit. Some professional skills were covered in this unit prior to the restructuring, but these were mainly in the area of teamwork, interviewing and decision making, most of which is now covered in the second year. This has enabled some more advanced professional skills to be covered in third year.

The focus of the IT Project unit is on project management methodologies and techniques. In addition to coursework material which is presented in the first semester, students are assigned a major project over the two semesters, and are allocated to teams each of which deals with a specific aspect of the project. This structure requires that students not only work effectively within their teams, but that their teams collaborate effectively to enable the completion of the project. By structuring the project in this way, an environment close to that which will be experienced in industry is provided.

The third year professional skills programme will build on the introductory teamwork issues covered in second year, and concentrate on developing skills used by individuals to become effective within teams, such as assertiveness, negotiation and conflict resolution skills.

Specific areas which will be covered in the third year include:

Teamwork
Team leadership
Presentation skills
Assertiveness
Negotiation, conflict resolution
Career visualisation
Skills/education for life
Contract negotiation
Detailed case study analysis

2.4 Honours

The nature of the professional skills covered in the honours year will dramatically change in character, as many of the topics now covered will have been presented in earlier years. This will allow for topics which are more appropriate to that level. In particular this will allow for topics which may be more relevant to a person considering a research career rather than a career in the information technology industry generally.

This segment of the professional skills programme will not be introduced until 1998, and the detailed implementation of the programme will be considered in 1997 as part of a review of the honours programme to consider the impact of the graduates from the new undergraduate programme.

Specific areas which are currently considered appropriate for the honours year include:

Advanced ethics, legal issues
Critical analysis
Research skills
Presentation skills
Thesis writing
Organisational contexts

3 Programme Appraisal

One of the more interesting aspects of the introduction of the professional skills programme was the response of a number of students in the old course structure, who requested that this material be made available to them, as they felt significantly disadvantaged by not participating in it. This request was accommodated as far as possible within the restrictions of the old curriculum.

3.1 Student Response

The response from students involved with the professional skills programme has been quite positive. Initially, there was some scepticism – one student was overheard at the first such sessions saying "What are we doing in here, there are no computers?"

Those students who had some work experience were able to see the value in these sessions much more clearly.

> I definitely support the concept and like the look of the content. I'm one of these people who have come from a technical background (mainly in PC's, comms and networks) and have been moved into a management type role. Senior management expect you to adjust and instantly learn all sorts of new skills such as communications, project management, cost benefit analysis, futures planning etc., however it's not quite as easy as that. (First year student, 1995)

Towards the end of first semester in 1995, an exercise in writing a short report was set for those students in the first year. A choice of topics was given, one of which was to write a report to a workplace supervisor concerning the student's progress at university. A number of students took the opportunity to comment on the professional skills being covered:

> The [professional skills programme] has been interesting and informative, and has not only been a benefit to my Computer Science course but other areas as well, as it deals with issues related to my future employment.

> There is serious consideration [in the professional skills programme] of all components of a professional in industry.

> My development in this course has enabled me to improve my business skills

At the end of second semester, the programme was subjected to student criticism through the Student Evaluation of Learning and Teaching (SETL) procedure at the University of Tasmania. This evaluation is conducted through the use of a questionnaire which is

collated by student administration and whose detailed results are made available to staff after the examination and assessment period. The survey was administered to students enrolled in KCA122. This unit is the first year core unit for students with previous programming experience. Seventy responses were collected, close to a 100% response rate.

Sixty four percent of students felt that the material covered was relevant to their future in the information technology profession, and seventy four percent felt it was a good introduction to the field.

Sixty one percent of students believed that they had learned to apply principles from the programme in new situations. It was also interesting to see that 44% stated that the sessions had stimulated discussion outside the classroom. Thirty six percent of students stated that they had reconsidered many of their former viewpoints.

Open ended comments from students ranged from "It was very boring" to "The PDU units were interesting, informal, and worked well as part of the course. Good work!" and "I did not want to do this section, but John made it bearable. On reflection, some very useful ideas (to anybody) were presented in the classes."

Given the size of the first year intake, over 190 students, there were eight repeated sessions on each topic. This presented a logistical problem when guest speakers were used. Asking a guest to repeat their session a further seven times was considered impractical, so sessions were videotaped and played back for the subsequent sessions. The repeated sessions were not considered to be successful, and this was confirmed in the student feedback. The use of videotaped sessions was dropped in 1996.

3.2 Staff Response

The majority of academic staff in the Department are supportive of the teaching of professional skills, indeed if that were not the case, then the programme would not have been introduced into the curriculum.

It should, however, be recognised that teaching these professional skills demands a very different teaching skill set from what is normally required of academics in the information technology field. This has implications for staff development, and making these skills available to academic staff.

This different mode of teaching, along with the lack of familiarity with many of the skills in the programme, lead to a degree of resistance from some staff outside the information systems area. This resistance took the form of concerns over the additional workload which the programme would require.

An alternative solution is to outsource the teaching of these skills, either to providers within the University who are competent in this area, or to external service providers. The risk with either of these strategies is the possibility of losing the information technology focus which is provided by experienced information technology professionals.

The Department of Information Systems at the University of Melbourne also has a professional skills component in its degree. It is currently developing an outsourced program for first year students in conjunction with the university's Learning Skills Unit. The approach being taken is to jointly develop the material to ensure that the IS context is maintained. This context is achieved by using IS discipline specific examples wherever possible - for instance, critical reading of IS literature. IS case studies will be used frequently, as will professional scenarios for role play and other experiential learning. This program will be carefully evaluated on its completion in November 1996.

3.3 Response from Employers

As the three year programme has not yet produced graduates, there has been no direct employer response to the students who have experienced it.

There has been positive feedback from the Tasmanian State Government on the impact of the original honours professional skills programme.

As previously mentioned, the three year programme was favourably reviewed in February 1995 by Judith Dwyer, the author of the recommended textbook [6].

That these skills are significant to employers was reinforced at a Board of Studies meeting in March this year in comments from an industry representative.

A 1995 honours thesis [12] from this Department ranked the skills required for systems analysts by employers as in Table 3.

%	**Skill Area**
85	Communications
79	Problem solving
75	Teamwork
74	Technical skills
66	Business skills
55	Management and organisational skills
55	Specialist skills

Table 3: Employer ranking of skills required

Employers surveyed in this study also felt that many of these skills should be taught as part of the undergraduate programme.

The need for, and the employer support for, the teaching of professional skills remains strong. This need can be seen in the strong emphasis placed on non-technical professional skills in information technology recruitment advertising. The Australian Computer Society is currently preparing a document entitled *The Core Body of Knowledge for the Information Technology Profession* which addresses the need for professional skills teaching within accredited courses. ACS is currently seeking feedback from members.

Other professional bodies, such as the Institute of Engineers have demanded professional skills training

within their accredited degrees. While this has not yet happened in the information technology profession, it can be anticipated that this may well happen.

4 Conclusions

The professional skills programme was introduced in response to employer concerns with graduate standards in the areas of communication and interpersonal skills. Both empirical research and anecdotal evidence confirms that employers remain strongly concerned over the teaching of this area.

The Department initially introduced a professional skills programme as a component of the honours year. The teaching of professional skills was then introduced as a stream within core units over three years of the undergraduate programme. By planning the skills close to the lecture themes which call for these skills greater relevance can be demonstrated.

Spreading the units over three years has allowed more depth in skill development. By introducing the core communications skills earlier, it has been possible to include assertiveness, conflict resolution and negotiation skills into the curriculum. Over the three years the students develop both the discipline and life experiences to appreciate the relevance of the advanced topics. This will not only be beneficial to the graduates, but develop their personal attributes as students, and may well lead to an increase in participation in tutorials and a greater receptiveness to teamwork.

While integrating the professional skills programme over the three year undergraduate programme has proved challenging, it is more closely in accordance with the DEET and AVCC recommendations than restricting it to a first year or honours unit.

Students' responses have been very positive and there is evidence that discussion of the issues raised in the professional skills course occurs outside the scheduled sessions.

The current teaching pattern of one workshop per fortnight is not onerous and is in accordance with normal tutorial expectations of students. The use of external facilitators eases the load where it is possible and relevant to use them.

The inclusion of the professional skills programme complements the social and human aspects of information systems by giving real experience in organisational and team based activities, and focuses understanding of the impact of information technology at the interpersonal level.

Developing a facility for the professional skills in the programme should also improve research capabilities, especially for case studies.

On balance, the introduction of the teaching professional skills through this form of integrated structure is considered a success, although it is acknowledged that there are some areas, such as the need for staff development, where further developmental work will be needed.

5 References

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12 A Huxtable, "An Evaluation of the Skills which Employers require from Graduates Entering the field of Systems Analysis" Honours Thesis, Department of Computer Science, University of Tasmania, 1995

Appendices

A Professional Streams

A.1 Information Systems

Year	Unit Code	Unit Title
1	KCA122	Computer Science 1 **EITHER**
OR	KCA123	Computer Science 1C (25%)
	KCA180	Information Systems 1 (25%)

	KMA103	Linear Algebra (8.33%)
	KMA107	Mathematics for Computer Science (8.33%)
	KMA151	Applied Statistics 1 (8.33%)
		Arts units from any discipline (25%)
2	KCA220	Computer Systems (16.67%)
	KCA280	Information Systems 2 (16.67%)
		Computing Unit(s) (16.67%)
		Units from any discipline (50%)
3	KCA316	Advanced Computer Systems (16.67%)
	KCA318	Information Technology Project (16.67%)
	KCA380	Information Systems 3 (16.67%)
		Units from any discipline (50%)

A fourth year of study is available leading to BComp(Hons).

If maths background is weak (for example, equivalent to an SA in TCE Maths Applied) then substitute KMA122 General Maths (16.67%) for KMA103 Linear Algebra (8.33%) and KMA107 Mathematics for Computer Science (8.33%).

The optional computing unit(s) in second year may include:

HGA222/322	Information & Society (10%)
HGA204/304	Quantitative Research Methods (10%)
HGA230/330	Qualitative Research Methods (10%)
HGA203/303	Social Research (10%)

A.2 Software Engineering

Year	Unit Code	Unit Title
1	KCA122	Computer Science 1 **EITHER**
OR	KCA123	Computer Science 1C (25%)
	KCA180	Information Systems 1 (25%)
	KMA103	Linear Algebra (8.33%)
	KMA107	Mathematics for Computer Science (8.33%)
	KMA151	Applied Statistics 1 (8.33%)
	BFA101	Introductory Accounting A (12.5%)
	BMA101	Introduction to Management (12.5%)
2	KCA220	Computer Systems (16.67%)
	KCA236	Algorithms (8.33%)
	KCA260	Software Engineering 2 (16.67%)
	KCA234	Computer Graphics (8.33%)
	KCA230	Microcomputer Architecture (8.33%)
	KCA237	Functional Programming (8.33%)
	KMA203	Algebra (8.33%)
	KMA224	Discrete Modelling 2A (8.33%)
	KMA225	Discrete Modelling 2B (8.33%)
	KMA251	Applied Statistics 2 (8.33%)
3	KCA316	Advanced Computer Systems (16.67%)
	KCA318	Information Technology Project (16.67%)
	KCA360	Advanced Software Engineering (16.67%)
	KCA322	Processor Architecture and Design (8.33%)
	KCA324	Digital Image Processing (8.33%)
	KCA327	Artificial Intelligence (8.33%)
	KCA331	Computing Trends (8.33%)
	KMA315	Discrete Modelling 3 (16.67%)

If maths background is weak (for example, equivalent to an SA in TCE Maths Applied) then substitute KMA122 General Maths (16.67%) for KMA103 Linear Algebra (8.33%) and KMA107 Mathematics for Computer Science (8.33%)

In all years there are optional units that may be substituted for units from other departments. If continuing to software engineering honours, take 33.33% of Maths in year 2.

A.3 Computer Systems Engineering

Year	Unit Code	Unit Title
1	ACM110	Engineering Fundamentals (24%)
	ACM150	Engineering Design (12%)
	KCA122	Computer Science 1 (25%) **EITHER**
OR	KCA123	Computer Science 1C (25%)
	KMA102	Calculus and Linear Algebra 1 (25%)
	KRA170	Chemistry of Materials (14%)
2	AEA201	Circuit Theory (9%)
	AEA202	Electronics (9%)
	AEA204	Communications Systems 1 (9%)
	AEA211	Electrical Materials and Devices (9%)
	KCA220	Computer Systems (15%)
	KCA230	Microcomputer Architecture (8%)
	KCA236	Algorithms (8%)

	KCA260	Software Engineering 2 (15%)
	KME271	Engineering Mathematics (18%)
3	ACM381	Engineering Accounting (4.5%)
	ACM382	Project Management (4.5%)
	AEA301	Electrical Design 1 (9%)
	AEA302	Digital Electronics (9%)
	AEA306	Transients and Control (9%)
	AEA311	Signals and Linear Systems (9%)
	KCA316	Advanced Computer Systems (15%)
	KCA318	Information Technology Project (15%)
	KCA322	Processor Architecture and Design (8%)
	KCA354	Engineering Design 2 (CSE) (15%)
	KME300	Numerical Methods for Engineers (9%)
4	ACM481	Engineering and Economics Management (6%)
	ACM482	Engineering Business Planning and Law (6%)
	KCA454	Engineering Design 3 (CSE) (20%)
		Seven other units from an approved list (68%)