REELING IN D.E. STUDENTS: EQUITABLE PROFESSIONAL DEVELOPMENT FOR IT STUDENTS THROUGH CMC

Angela Schlotzer & Alison Ruth
Faculty of Informatics and Communication
Central Queensland University, AUSTRALIA
a.schlotzer@cqu.edu.au, a.ruth@cqu.edu.au

Abstract

The use of the Internet and computer-mediated communication for facilitating project-based learning is one way of producing collegiality and fostering professional development in geographically separated teams. This paper investigates some of the ways in which students collaborate and hence begin to be 'en-cultured' within the profession of Information Technology. It focuses on a course in the software engineering stream offered by the Faculty of Informatics and Communication, Central Queensland University. It concludes that computer-mediated communication facilitates team-based learning and development of professionalism using email discussion lists.

Keywords

Keywords: Email, CMC, Professionalism, Teaching, Technology

Introduction

The Internet has brought to the business world many opportunities for interaction among geographically separated individuals, allowing for collegiality and increased sharing of knowledge among members of a team. In a rapidly changing environment, as is the case in information technology (IT), keeping abreast of changes requires lifelong learning skills and professional development. Universities are an integral part of the process of providing the foundations of lifelong learning skills and professional development, and programs of study leading to qualifications that enable students to enter professional occupations. These programs are often "value-added" through accreditation with a professional body such as the Australian Computer Society (ACS) to make them more attractive to students. In these cases, programs are purposively designed to comply with the requirements of the professional body.

Essentially, many of the requirements of the ACS are intended to develop professionalism and professional attributes. Among the required skills and competencies identified in the ACS Core Body of Knowledge (1997) are - an understanding of ethical behaviour and team work, the ability to undertake project management, as well as interpersonal communication skills. Like most other professional bodies, the ACS has a code of professional conduct and practice, and states that "[c]ompliance with the Code is mandatory for Members of the Society" (ACS, nd a).

Professionalism, Competencies and Lifelong Learning

So what then defines professional and professionalism? While the ACS does not specifically define professionalism, the requirements for entering the IT profession are listed as requiring "… appropriate qualifications and training for persons entering the IT profession, relevant experience and varied job opportunities, and considerable continuing education …" (ACS, nd b). This rough definition is confirmed by the OED (1989, online) which states that a professional has reached "a standard or having the quality expected of a professional person or his [sic] work, competent in the manner of a professional". It further defines professional as a person who "is trained and skilled in the theoretic or scientific parts of a trade or occupation, as distinct from its merely mechanical parts". Professionalism is defined as having the

"quality, character, method, or conduct, the stamp of a particular profession". The professional is therefore distinguished from the "amateur" and professionalism is related to "the position or practice of a professional". Competencies and skills associated with a profession, and hence a professional, tend to shift and change somewhat, depending on the current requirements of the associated industry.

A recent survey of generic IS (Information System) graduate attributes (Snoke and Underwood, 2000) found that, although the required competencies have essentially remained the same, their importance in terms of ranking between industry and academia varied (see appendix A). Variations in ratings could be in part due to early case studies, which found that commonly underrated aspects of the computing disciplines included the importance of communication and interpersonal skills (Edwards and Kay, 2001). Being a weakness identified early in IT education perhaps sways academics towards rating communication and interpersonal skills higher than industry. Further investigation of why this variation of ratings exists would be valuable but is outside the scope of this paper. However, the competencies most highly valued by both academic and industry professionals were those that dealt with lifelong learning skills to meet the competencies outlined by the professional body.

Lifelong learning skills and professional development are highlighted within degree programs. These programs, and specific courses within them, provide models of interaction for students to establish ways of interacting professionally on many levels. The development of professional values and professionalism within students requires forethought and attention to the requirements of the professional body. This occurs at the macro level where the faculty defines, at the program (degree) level, the set of skills that students require upon completion of the program and which cover the accreditation requirements of the professional body. At the micro level students undertake activities/courses designed to foster development of the required knowledges and skills.

Development of Professionalism

This paper will examine how a software engineering course, which deals specifically with the analysis and specification phase of software development, promotes the development of professionalism. In particular it will focus on the first time that this particular course was offered - Autumn term 2001 – with some reference to the offering in Autumn 2002. Given the geographical distances between students and their need to work in teams in this course, computer-mediated communication (CMC) was used to facilitate teamwork. Salmon (2000) states that CMC "has often been adopted where programmes of study involve the sharing of professional or sectarian knowledge, such as management, teaching and technology". Since all students are expected to have access to the Internet and are automatically provided with an email account when they enrol, email was considered the most appropriate medium for the majority of intra- and inter-team communication.

The following sections provide an overview of the course and the student cohort, and discussion on how the combination of course requirements and student interactions contributed to students' professional development. Students' emails to the instructor and to the general course email list were used as the basis for the analysis in relation to the Generic IS Graduate Attributes (Snoke and Underwood, 2000, appendix A)

Course Overview

The course is an advanced level course in which students are introduced to the concepts and skills of software engineering in relation to how it is applied to the analysis and specification phase of software development. The course is mandatory for students enrolled in the Bachelor of Business (Information Systems) program and an elective for Bachelor of Information Technology students.

Although students enrolled in other programs can take the course, typically the vast majority will be enrolled in one of the two programs referred to above. Students would normally take this course in their second year of full-time study or equivalent.

On commencement of the course, students are expected to have an overall understanding of the software system development process and various process models that can be applied from their previous studies.

In addition, they are expected to have some skills in developing software system models through graphical representations such as data flow diagrams, entity-relationship diagrams and "use cases". They will also have an understanding of other tools that are used in software system development.

In this course students gain more depth and breadth in the knowledges and skills required to perform rigorous software requirements analysis and to produce a detailed set of software system specifications. To demonstrate their increasing knowledge and skills, students are expected to produce a software requirements document that adheres, as a minimum, to the IEEE/ANSI 830-1993 standard for such documentation.

This course has a website that provides access to resources, course profile, lecture notes, assessment requirements, weekly activities list and listing of the teams. As with the majority of the Faculty's courses, an email discussion list is also provided.

Student cohort

A total of 119 students (not including international campus students) completed the course in Autumn term 2001. Of these, 60 were internal students located on the Bundaberg, Gladstone, Rockhampton and Mackay campuses and 59 were distance education (DE) students. The composition of these students was typical for the Faculty of Informatics and Communication at Central Queensland University. The cohort of students included those who had entered university directly from high school and those who have been in the workforce for a significant period of time. A small number of the students were already actively engaged in the IT profession, but had no formal qualification and were undertaking studies to achieve this. Atypically for IT courses, there was approximately the same number of female as male students enrolled. The majority of the DE students were located within Australia, but a small number of students were located in countries such as the United States of America, Papua New Guinea and India.

Course Requirements

A number of requirements are associated with this course:

- completion of two major assessment items – a feasibility report and a software requirements document that are linked;
- subscription to the email list;
- participation in a team;
- weekly activities that each team is expected to complete.

The feasibility report and software requirements document, which form the major assessment component of the course, are developed on the basis of the case study provided. Students are expected to analyse the case study in terms of the functionality required for a new software system. Although the software system identified through the case study is simplistic compared to the complex systems typically developed in today's world, the documentation created for the feasibility report and software requirements document is substantive, and incorporates concepts and skills that are new to students. Typically, the software requirements document submitted would be approximately fifty pages in length if all sections have been developed as anticipated. Most of the weekly activities that students are expected to complete are directly linked to the formation of the software requirements document; that is, students are developing sections of the document throughout the term.

Subscription to the email list is essential. The email list provides the lecturer with the opportunity to communicate with all of the students if an important point needs to be raised, and also provides additional learning support for DE students through the discussions that occur (McDonald, 2001). Additionally, team leaders who are DE students are required to submit a report on the team's weekly activity to the list. A proportion of the overall mark for the course is based on this participation.

All students are required to work as part of a team throughout the term. Teams of four students (where possible) were created by the lecturer during the first week of the term. They consisted of at least one internal student with two or three DE students. Gender balance was also considered in team member

selection. No other criteria were used to determine team membership. Having an internal student on each team allowed for feedback to other team members on issues, points or arguments raised during lectures and tutorials that might otherwise not have been communicated or available to DE students. This construction of teams would not have been possible without students' access to email.

Course Philosophy

The philosophy of the course centres primarily around three main concerns – the need to reflect ACS accreditation requirements in one or more areas; the need to provide a learning framework that is appropriate to content, suits required outcomes and supports students' learning needs; and the development of professional values, attributes and skills.

In terms of ACS accreditation, a number of areas specified in the Core Body of Knowledge (ACS, 1997) are addressed. The requirement for students to interact as members of a team, produce a document to a specified standard, and work to a project schedule relate to the Group 1 Mandatory (ACS, 1997) areas of study of Interpersonal Communications, Ethics/Social Implications/Professional Practice and Project Management and Quality Assurance. Many of the skills associated with these Group 1 Mandatory areas are also generic skills that are a component of lifelong learning skills. They can equally be applied in areas other than the IT profession. The course very specifically deals with the Group 2 (ACS, 1997) area of Software Engineering and Methodologies. The content of the course presents the concepts and models of the analysis and specification phase of software systems development in terms of software engineering approaches and methodologies. The need to develop a software requirements document also addresses elements of other Group 2 areas of study such as Conceptual Modelling and Systems Analysis and Design. The concepts and skills associated with the above areas of study can be mapped to a significant number of the generis IS graduate attributes (see Appendix A) identified by Snoke and Underwood (2000).

The normal "deliverable" or product of the analysis and specification phase is a software requirements document. In the "real" world, a team would develop this document. Based on this, it was decided that the most appropriate teaching and learning strategy was the project-based approach (Ehrmann, 1997; Jonassen, 1998). This allows a simulation of the real world experience to be provided for students. A simulation was deemed as more appropriate than an actual experience because it allows for complexity of the task to be controlled and emphasis to be placed on the concepts and skills students need to acquire. It also means that students who are located in isolated areas are not disadvantaged. Students actively engage in activities required of the profession whilst learning the concepts and skills associated with analysis and specification. Students can thus be seen to be developing professional attributes, skills and values.

The project-based approach addresses the three attributes of effective learning identified by Alavi (1994) – active learning and construction of knowledge; cooperation and teamwork in learning; and learning via problem solving. In this case, project-based learning also has the advantage that students are directly engaged in activities that contribute to their outcomes for the course. This tends to increase the degree to which students engage in activities. "Engaging students is critical for them to learn something well enough to use it again in a new situation" (Guzdial and Soloway, 2002, p.18).

The underlying course philosophy, although evident in the course profile, is communicated to students early in the term through a posting to the email list by the lecturer. Students are made explicitly aware of the intent to develop professional values, attributes and skills. Thus requirements such as the need to work in teams, post weekly activities to the email list and adhere to specific standards in documentation development are better understood and appreciated. This is evidenced by the willingness of students to engage in email list discussions, share knowledge and resources, comment on email list submissions by other teams and request feedback from other students. For example, the following is an extract from a team's reflection on the benefits and drawbacks of teamwork that was sent to the email list early in the term. It should perhaps also be noted that one of the lectures early in the term is entitled "Managing People". This reflection is one of the weekly activity requirements.

DIFFUCULTIES SUMMARY:
The following is a précis of the members' feelings regarding difficulties:
1. Geographical location
2. Tasks require some effort
3. The lives and schedules of each team member are different
4. Inability for face to face communication
5. All course materials were not available to a team member from the start
6. Lack of access to a personal computer – access during business hours only
7. Time delay in communications can cause wrong conceptions
8. Making sure right message is communicated

POSITIVE FINDINGS:
The following is a précis of what the team believed to be positives
1. We found we did not because of the way we went about it initially have conflicting opinions which were not easily resolved, we shared our thoughts and as a team respected each others ideas, all this was coordinated by the Team Leader.
2. We were surprised at how well the team can work and contribute to learning and getting the tasks done. We have got things done on time.
3. We all have performed well as team members and leaders and fulfilled the responsibility of these.
4. A mixed group of people can when put together produce a great team

CONCLUSION**:**
Team XXXXX from the above findings feel that although there are difficulties in getting assignment prepared that with a solid structure and plan these can be overcome with teamwork.
Finally each team member would like to add that they are proud to be members of the professional Team XXXXX project.

Both of these extracts show the progress made towards establishing professionalism through the way they have managed to build coherent and cohesive teams within a four week period despite the difficulties associated with juggling study and work commitments, and the lack of immediacy in email interactions. The next section explores how growth in professional attributes is demonstrated by interactions exhibited in email exchanges between students and the work produced by teams.

Examples of Professional Attributes

The following highlights some of the professional competencies displayed in email interactions and is based on the generis IS graduate attributes as delineated by Snoke and Underwood (2000). The list of generic attributes is reproduced in Appendix A.

The competency *Consider the quality of the solution* was evidenced by the preoccupation of students towards establishing their solution near the end of term. Students were seen to be questioning aspects of their work that related to the outcomes of the course. These students used a strategy, which is often exhibited by students in face-to-face situations and could be called "checking in". In effect, this strategy allows students to check the quality of their solution without asking for it to be marked before submission. Checking in often refers to other students' work, whether a friend in the class or, in the case of email discussion lists, is based on questions and assumptions previously raised by other students. The following excerpt from an email is an example of this strategy, which relates directly to the *Consider the quality of the solution* competency.

> I am just tidying up the data dictionary for team C, and have noticed that no other team seems to have included reports in their dictionary. Isn't this a requirement of the weekly task, or is it taken from the available data, and so not included?

As one of the most common interactions, this competency allowed students to focus on the course requirements and fostered team development. Team development relates to the competency *Work as a part of a team in a productive and cooperative way*. Within the team environment, whether considering

the established team or the whole class, students are able to check their progress and have a record of their interactions using email. This record becomes important in establishing the outcomes of the team – a part of the "not-so-hidden" curriculum of teamwork.

The teamwork competency *Work as a part of a team in a productive and cooperative way* allowed students to focus on another competency *Define problems in a systematic way* as shared understanding is important for achieving goals within team situations. Both these competencies, together with *Consider the quality of the solution,* are underscored by the following interchange by two students. This message indicates all three competencies at some level (previous messages are highlighted by lines beginning with >).

> >As Visual Basic is the most popular programming language on this planet, it
> >must have something going for it.
>
> As software engineer, Linux is definitely more stable than Win95 and Win98SE, for that matter, Win NT 4 with service pack 6. But most of the developements happen on Windows. Why ? Because large population of world like the "user friendliness". Just these simple words, Windows rules the world. Walk out to the street, would you choose a "stick" car or an "auto" car ? To edit an ASCII text file, do you choose WinWord.exe or Unix's vi ?
>
> All these to point to the level of skill sets. All the Unix gurus are trained professionals. Years of hard-core C and command lines. Solid structure programming and a mixture of C.A.S.E. The use case to edit an ASCII text file would be using vi; switching between buffers, switching line number(s) and histories. So for this group of people, "user friendliness" is a ..... *why move a mouse when two key-strokes can achieve the same result so much faster.* [quality of solution]

This dialogue shows considerable effort on the part of the second student to answer the question of the first (the entire post was considerably longer). An understanding of the profession, particularly "skill sets" and "years" of work, promotes the concept that lifelong learning skills with respect to the IS industry is paramount to success. This understanding in effect relates to the *Retrieve, evaluate, and use relevant information* competency and the *Analyse, synthesise and evaluate the various solutions* competency, both of which relate almost directly to Bloom's (1956) hierarchy of learning. Thus, a single message has displayed multiple competencies. Lifelong learning skills are underscored by the competency *Be able to participate in continued learning and intellectual development and develop critical, reflective and creative thinking.*

Teamwork is also exhibited through communication skills that show individuals summing up previous discussion and ensuring that all students are aware of the tasks required to complete the project. As all students at some point in the project must undertake the leadership role, the competencies required for completion of the project are multiple. Perhaps ironically, project management skills such as these shown in the following extract, are rated towards the bottom of the spectrum by both industry and academics.

> Hello V Team,
> The weekly tasks are to form part of the SRD for asisgnemnt 3.
> They are as follows;
> Week 7 Tasks Context Diagram (done) Data Flow Diagram (done)
> Week 8 Tasks Entity Relationship Diagram (I'm doing this)

An understanding of the needs of the client for whom a project is being undertaken is central to the ability to *Define problems in a systematic way* as a measure of their success as a professional requires them to meet criteria established by other people. This includes the requirements of the course as well. This is demonstrated in the following extract.

> When you produce a program for money there are three main things a client wants to know; 1) How long will it take, 2) How much money will it cost and 3) Will it do what is required. If you can satisfy these three items, using what ever language, then you get the job.

Of course, in addition to the competencies presented above, the predominate use of email as a tool for interaction and collaboration and submission of weekly activities as attachments, and participating as an actively contributing team member also addresses the competencies of *Interpersonal Skills, Written Communication Skills,* and *With respect to the IS discipline be technologically competent (the person is able to use the current technology competently)*. These skills often tend to be taken for granted but are honed and extended with continued practice.

Outcomes

In terms of producing documentation, the learning processes of adhering to the specification standard is significant and is a course requirement. In the feasibility report, the language and structure used for framing functional requirements often do not fit these requirements. The following extract is typical of the level of understanding and processing shown by students at the midpoint of the course.

> **2.2.2.6 Portability**
> The system shall:
> 1. have all applications compatible with internal environment i.e. billing, payroll;
> 2. operate on a Microsoft NT/PC platform; and
> 3. interface with all current and expected future applications.

Following feedback and instructions that adherence to the specification standard is an essential requirement, students are generally able to produce the Systems Requirements Document to the standard. The following extract deals with the same requirement definition, but shows the correct format and meets the requirements of precision and verifiability.

> **3.3.1 Portability**
> **R049 - The System shall be able to run under any combination of each of the following operating systems:**
> **a. Windows 98,**
> **b. Windows NT,**
> **c. Windows 2000,**
> **d. Solaris, and**
> **e. Unix.**
> Rationale: The hardware architecture is not yet known so the System may need to run under any, all or some combination of the operating Systems stipulated above.
>
> **R050 - The System shall be able to meet the performance requirements of this specification when running on at least an IBM Compatible Personal Computer with a Pentium III 500Mhz processor with 128 Megabytes of RAM, a CD-ROM and 2 Gigabytes of free disk space.**
> Rationale: The hardware architecture is not known. The specified PC is regarded as a minimum level device. Hence, if the System can meet the performance requirements on this device, it should be able to meet them on higher performance machines.

This extract is one aspect of the documentation (user requirements) adhering to the standard and exhibiting the required level of professionalism. As the ACS Code of Practice states that "a characteristic of a professional is that they depend on the operation of a series of standards and procedures for efficiency and effectiveness" (ACS, nd a), these extracts show that the outcomes of the course align with the standards documents, the code of practice and the development of professionalism in students. Other researchers also highlight the importance of being able to write within the genre of a profession. Orr (1999, p.36) advises that "[s]tudents preparing for entry to a discipline need to develop competence in writing and using the profession's generic corpus in order to engage in professional work." He states that this is important because "[w]hen documents conform to the expectations of their intended readers, there is less risk of failure to accomplish the goals for which the texts have been designed" (1999, p.32).

The above extracts from the documentation together with those from the discussion list indicate the teams' growth in the ability to analyse, synthesise and evaluate, all competencies required by the profession.

From the students' perspective, the outcome of most significance is the final grade that is achieved. For this particular cohort of students (i.e. those that completed the course), slightly more than 90% achieved a successful outcome. The majority of the teams attained a grade of Credit or better.

Conclusion

There is considerable debate in the literature about the efficacy of computer-mediated communication to function as an integrative medium for distance education students in an online learning environment. Various authors provide evidence of both positive (Pence, 1999) and negative experiences (Hara and Kling; 2000; Ng, 2001) in its use. The results of this paper suggest that computer-mediated communication can be supportive of distance education students' learning experiences and needs. Results also indicate that effective learning communities (Maring, Wiseman and Myers, 1997) can be established even within the narrow time frame – essentially 12 weeks – of a course.

The collegiality of students within the email discussion list contributed to the 'synergy' inherent in social models of learning and in effect contributed to the building of learning communities (Joyce, 1997). The promotion of professional values and skills, on a number of levels, also ensured that course outcomes were met.

Use of email discussion lists did facilitate the development of professionalism by allowing students to reflect on their learning, engage in teamwork with other students and share knowledges, concerns and resources with the larger group. Without CMC this level of professional and skill development would be much more difficult for DE students to achieve. In essence, this paper has indicated that:

1. The instructor's knowledge that email was available to all students allowed appropriate learning and assessment strategies to be applied to both internal and DE students.
2. The current implementation of email *did* facilitate the development of professional skills and attributes.
3. It was a positive experience for students.
4. The students achieved the outcomes.
5. Students exhibited growth in Professional development.
6. The cohort of students effectively became a community of learners engaged in an activity that will be required of them in their professional career.

Further research should focus on the elements of a course that lead to successful outcomes for students in online learning environments. As Internet technologies become more popular, it is essential that mapping of philosophies of teaching and styles of learning be achieved to ensure that each application provides the best scenario and outcomes possible.

Competency	**Industry Ranking**	**Academic Ranking**
Self motivation	1	9
Retrieve, evaluate, and use relevant information	2	3
Be able to participate in continued learning and intellectual development and develop critical, reflective and creative thinking.	3	2
Analyse, synthesis and evaluate the various solutions	4	8
Confidence about their ability to learn independently	4	15
Consider the timeliness of the solution and its timeliness	6	11
Embrace change and be obliged to engage in incremental improvement to keep up with the rapid change in technology	7	14
Work as part of a team in a productive and cooperative manner	8	1
With respect to the IS discipline be technologically competent (the person is able to use the current technology competently)	9	12
Value the ethics of the Information Technology profession	10	13
Oral communication skills	11	4
Define problems in a systematic way	12	5
Interpersonal skills	13	7

Work independently	14	18
Written communication skills	15	6
With respect to the IS discipline possess coherent, extensive, theoretical and practical knowledge	16	10
Ability to reflect on own strengths and weaknesses	16	23
Participate in on-going professional development	18	19
Possess a sense of basic curiosity about technology	19	24
Time management skills	20	17
Sensitivity to differences in gender, culture and cutoms	21	20
Research Skills	22	28
Demonstrate practical knowledge and understanding in at least one computer language	23	20
With respect to the IS discipline possess theoretical and practical knowledge in at least one reference discipline which include behavioural science, computer science, decision theory, information theory, organizational theory, management theory	24	16
Adapt to unfamiliar cultures and operate in a coially and culturally diverse environment	25	26
Knowledge of how a business operates, is structured or is orientated	26	22
Understand the profit motive of business	27	29
With respect to the IS discipline possess the theoretical and practical knowledge of related disciplines. For example, business, law, education, data communications, computer science or leisure recreation	28	25
Project Management Skills	29	27

Appendix A – Generic IS Graduate Attributes As Ranked by Industry and Academia (Snoke and Underwood, 2000)

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