

## A TELECOMMUNICATIONS COURSE TO DEVELOP LIFELONG LEARNING SKILLS.

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**ABSTRACT:** Communication engineering is a vast and rapidly changing subject. It is therefore possible for students to learn, during their undergraduate course, only a small part of the information which may be important to them in their careers as Communication engineers. A Communication Engineering Stream has recently been introduced to the undergraduate Electronic Engineering degree at La Trobe University. Rather than overload the new stream with content, it has been designed with two main aims: to give students technical expertise in the areas which are most likely to be useful to them on graduation and to develop their lifelong learning skills. This paper describes the unit designed to develop these lifelong learning skills.

To make the unit interesting and relevant, it was based around the topical theme of digital mobile telephone systems. Students, working in pairs, researched one aspect of the mobile phone system. Classes on the use of the Internet and the library were also based around this theme. Students presented talks and prepared posters on their topics. Feedback from the students was overwhelmingly positive. The students felt that they had developed skills which would be important during their careers.

### LIFELONG LEARNING SKILLS

Keeping up-to-date in a fast changing discipline such as communications engineering is difficult and requires at least two quite distinct skills: the ability to locate and understand information on a specific subject as required for a particular project, and the ability to skim a vast volume of information and extract and remember the key points for later use. During the development of the course we informally surveyed a number of academics and engineers about the ways they kept up-to-date and the sources of information they found most useful in their speciality. A wide range of responses were obtained. For those involved with computers, networks and software, computer newsgroups were an important source of information. A researcher in the bioengineering field, gained most information from attending conferences. A management lecturer kept up-to-date in aspects of management by attending some workshops and reading books. Technical information supplied by manufacturers was a major source of information to some. The 'Technical Research for Communications Engineers' unit was designed to develop many of the lifelong learning skills which were identified and make students aware of the many sources of information which are available.

### STRUCTURE OF THE UNDERGRADUATE COURSE AT LA TROBE UNIVERSITY

The Bachelor of Electronic Engineering course at La Trobe is structured with the first two years fixed and taken by all students. In third and fourth year, students choose a speciality. Currently four specialities are offered:

Communication Engineering, Biomedical Engineering, Electronic Systems Engineering and Optical Engineering. There are three specialist units in third year, and two in final year for each stream. As well, there are as a number of subjects shared by the streams in third and fourth year. The specialist units have nominally 24 lectures. Third year units also have a component of laboratory work. Students also complete a major final year project on a topic associated with their speciality.

The unit which is the subject of this paper is entitled Technical Research for Communications Engineers. It is run in the first semester of third year. There are no communication engineering subjects in first and second year. Introduction to Communications, which is taken by students in all four specialities, and covers subjects such as modulation, also runs in first semester.

The students taking the Technical Research unit, therefore have very little prior knowledge of communications. In many ways this has been an advantage. The students are forced to extract the information they require for their assignments, from technical papers which they do not completely understand. They develop the skill of understanding information only to the level required, of extracting what is necessary and ignoring what is not: an essential skill in a field which is large and rapidly changing. They also developed confidence in their ability to take on a project in a technical area in which they had little formal training, to gain the necessary information through their own researches, and to complete a task using this information.

In the second semester of third year, students begin a literature search and develop a project plan for their final year project. With the Technical Research unit running in first semester, the students were able to apply the skills, which they had acquired, to these later tasks. Students who had taken the unit produced very markedly better literature surveys than those who had not.

#### DESIGN OF TECHNICAL RESEARCH FOR COMMUNICATIONS ENGINEERING UNIT

The unit was designed to develop the students lifelong learning skills and their ability to present technical information in both oral and written form. In 1995, the unit was based around the GSM digital mobile phone system, which has recently been introduced in Australia.

##### Introductory Lectures

The unit began with a number of introductory lectures. The first explained the rationale and structure of the unit. A typical engineering undergraduate course requires students to master a very well defined amount of information. In contrast, a typical task for an engineer is much more open-ended. It requires him, or her, to identify what information is required to solve a task, find the information, work out what is, and what is not relevant, understand in the most efficient way, to a level required to solve the current problem, the material which is relevant. It was explained that the unit more closely resembled the task of an engineer, than a typical lecture course.

The next few lectures outlined the fixed and mobile telephone networks. These were intended to give the students a framework which would enable them to research their particular topic. It also formed a common background so that students did not have to repeat basic information in their talks. Topics included the basic concept of cellular phones, signalling, switching, traffic, time-division-multiplexing, numbering systems, ISDN. An overview, rather than a deeply theoretical approach was taken.

A later lecture was devoted to telling the students about some of the information sources that are useful in communications. The range of literature in communications from overview to deeply technical was outlined. Examples of each type were given. A list of relevant international and Australian journals was provided. Some of the lecture was devoted to things which authors would have found useful but had not been taught: the importance of making and maintaining contacts in many forms, speaking to people, attending product launches, putting your name on mailing lists. A range of technical literature was available for students to browse through.

##### Internet Exercises

Students were introduced to the Internet. They used Netscape software to access World Wide Web information. The first Internet exercise involved a number of simple tasks intended to familiarise them with the Net and Netscape. A second exercise was more closely related to the research topics. Each student was allocated a World Wide Web site

and newsgroup related to communications. As many as possible were chosen to have information on mobile phones, but in order to find enough to give each student a different site and newsgroup, some had to be included which were related to communications but not to mobile phones. The directory of telecom information resources available on the Internet, produced by the University of Michigan was used to find sites suitable for this exercise. Students had to produce short, one page summaries of the information on their site and in the newsgroup. The intention was to duplicate them and distribute them to the other students to be used as another source of information, but time did not permit this in 1995. This like all the other written work required of the students was required to be quite brief. This forced the students to identify what was important, rather than just copy large slabs of information. It was also intended to limit the workload to a reasonable level.

##### Research Topics

Students were asked to arrange to work with a partner of their choice, and choose a research topic from the list shown in Table 1. Most of the rest of the unit was based around their research topic. A few students for various reasons, chose to work alone, but in general this was a less successful arrangement.

Speech coding for GSM mobile phones
Error correcting codes for GSM mobile phones and interleaving
Encryption
Frame format
GSM modulation format
Antenna design for cars
Electromagnetic interference and biological effects
Propagation in the mobile phone system
Cell size and shape
User-network signalling in the mobile phone system
Handover
Traffic
Data transmission over the mobile phone system,
SIM cards for GSM mobile phones
Comparison of spectral efficiency of the AMPS, GSM and CDMA mobile phone systems
GSM network components and integration with the PSTN

Table 1. Research Topic Offered

##### Library Class and Exercise

The students attended a library class which lasted for two hours and was given by a member of the library staff. The class covered fairly conventional topics such as how books are catalogued, the use of Library of Congress headings, how to find a book in the library, the use of CDROM indexes and the use of Current Contents. The class was made particularly

interesting and relevant to the students, as all the examples given were related to mobile phones. For example the Library of Congress headings related to mobile phones were found. The library catalogue was searched for books related to the mobile phone system.

The students were later given an exercise to do in their own time, which required them to apply the knowledge they had gained in the library class to their own research topic. This both reinforced the information given in the class and formed a significant first stage to the research required for the rest of the course.

### Talks

Each student was required to give an eight minute talk on their research topic. The class was divided into two with one member of each pair in each group. Students were only required to attend the talks for their group. Members of a pair were given the choice of using the same or different overhead transparencies. Students were taught how to use Powerpoint software to produce high quality overheads.

Staff members were available for consultation at a number of fixed times. Two weeks after the students had begun their projects, a number of very useful information sources were made available to the class which were not available through normal library sources, such as communication companies internal training documents. A number of students, through their own contacts added to this resource.

Because the topics were closely related, students were keenly interested in each others presentations. Students were required to fill in assessment sheets for at least two other students. This was both to provide the student giving the talk with some feedback on performance and to force the students in the audience to analyse what was good and bad about the presentations of other students.

At a later session devoted to a post mortem on the talks, students were asked to fill in an assessment sheet,. This time instead of evaluating the performance of others, they were required to assess themselves. They were not required to show their self assessment to anyone. They were then given the assessments made by others of their talks and were given time to consider to what extent this agreed with their self assessment. There followed a discussion about what were the best aspects of talks and which were the best overheads and why

### Poster Session

Rather than require the students to produce a written report on their researches, each pair was required to produce an A3 sized poster. A poster session was held, to which staff of the school and students from the second year of the course were invited. Because of the very limited amount of information that could be included, the students were forced to identify the key aspects and present them in a concise way. As they were working in pairs, there was considerable negotiation between partners. The poster session was very lively with genuine interest being shown by staff and by students.

A3 size was chosen for the poster as it allowed the posters to be photocopied readily. However larger posters would have had more visual impact and would have allowed students more flexibility in presentation.

### Assessment

The weighting of the various components of assessment is listed in Table 2

Computer exercise and laboratories	10%
Library Class and exercises	10%
Contribution to class discussion	5%
Assessment of log books	15%
Oral presentation on research topic	20%
Poster presentation on research topic	20%
Excursion (second semester)	20%

Table 2 Weighting of Components of assessment

Students were required to maintain a log book, throughout the unit. This was intended to develop in the students a habit of systematically documenting their work. If there had been any uncertainty about the contribution of members of a pair, it would have been used to estimate the work performed by each. This was the least successful aspect of the unit, and much more detailed guidance will have to be given if this is to be included in the future.

A small weighting was given to contribution to class discussions, to encourage students to attend the problem solving sessions and show interest in other students' talks.

### Excursion

In second semester, the class was taken on an excursion to the communications centre of the Melbourne based, Silver Top taxi company. This showed an interesting and practical application of mobile communications. Silver Top sponsored the excursion by providing taxis to take the students to and from the centre. The students were able to see how voice and data radio communications were used in each taxi and how a Global Positioning System (GPS) in each taxi located the taxi's position and relayed this through the radio to the communication centre. At the communications centre they could see how telephone, radio, networked personal computers and the GPS were all integrated to give a state-of-the-art system. A representative of the Melbourne based electronic company, Raywood was available to answer technical questions while Silver Top staff explain more commercial aspects. The students found both the technical and commercial aspects very interesting.

### STUDENT RESPONSES

Student response to the new unit was assessed both through written questionnaires and from many informal comments by students to the staff.

Of 22 students enrolled in the unit, 15 completed questionnaires. The questions were very open-ended. For each aspect of the unit students were asked to comment on how useful they found it and to make any suggestions about how it could be improved.

#### Introductory Lectures

In general the lectures were appreciated. However, students are used to lectures as a medium for presenting material which will later be assessed by examination. A few expressed unease at the informal nature of these lectures.

#### World Wide Web Class and Exercise

Most students appreciated the sessions on the use of Netscape to find information on the World Wide Web. The exceptions being the students doing double degrees in Computer Science and Engineering who were already familiar with it. Many students commented that they found it useful for subsequent research and some had developed a habit of using the Internet regularly.

#### Library Class and Exercise

The students also found the library class and exercise useful. Some commented that they had not realised how many different resources were available to them. Others had not previously understood how the library system was set up. Double degree students, who had completed a major computer science project the previous year, remarked that the skills which they had now acquired would have enabled them to do their computer science projects more successfully.

#### Research Topics

Most students found their research topics interesting and although they found the research difficult at times, felt that this was rewarded by the knowledge and skills that they gained.

#### Oral Presentations

A common complaint was that the time allotted for the oral presentations was too short. However other comments were more positive. One response read: 'good change from the norm, forced me to actually learn the work rather than regurgitate it'. One student commented that filling in assessment forms for other speakers helped him review his own presentation.

#### Poster Presentations

The poster session was popular too. Many rated it as very good or excellent. One student commented that he/she found he could communicate better in response to questions. One even found it fun! Another student noted that he/she learned to select the most relevant information and learned to work in a team with a partner. Several students would have preferred posters bigger than A3.

#### Log Books

The log books were the least popular and successful aspect of the unit and their use will be reviewed for next year. Some students found them useful and some commented that it helped them develop a useful habit, but others did not understand the need for a log book or understand what they were supposed to record in it.

#### Skills and Knowledge Gained

Most students felt that they had developed useful research skills. They now had a basic idea of the operation of the GSM digital mobile phone system as a whole and a detailed understanding of part of it. The talks and poster session had developed their confidence and communications skills and ability to work with a partner. They had also learned how to extract important information and omit the unimportant, for example one student said "I found I could read lots of information and get the basics out."

One mature age student who had previously had a successful career in a different discipline commented "Some of what was taught was what I found out the hard way in ...(other discipline) and could make the difference between a career or not eg. obtaining information, making contacts in industry etc. Sometimes I felt that this is more important than some of the more technical course content, eg. mathematics ..."

Only one of the responses was intended to be substantially negative: "Too much emphasis on having to find information rather than absorbing information. It seemed we were sent out to gather information the department didn't have and didn't understand."

#### CONCLUSIONS

Overall the unit was very successful. The students accepted it with enthusiasm, even although it was very different from other parts of the undergraduate course. Part of the success resulted from the unit being based on the topical theme of digital mobile phone systems and having students' topics closely enough related to be of mutual interest. Judging by the improved performance of the students in doing the literature survey for their final year project, the skills which they gain are transferable to other topics. The unit will be improved in future years by making the time available for the talks slightly longer and clarifying the role of logbooks.

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