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Developing a New Course for the Software Development Pathway on the AUT Bachelor of Applied Science Programme

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ABSTRACT

Within the Bachelor of Applied Science (Software Development Pathway) - a new course of study at AUT aimed at producing capable software developers, we have included a course on Networking and Telecommunications. This paper describes the whole process of designing a new module entitled "Networking & Telecommunications", for the software development pathway (the Pathway). The aim of this module is to enable students to develop an in-depth knowledge of data communications and networking requirements including networking and telecommunications technologies, hardware and software. Emphasis is upon the analysis and design of networking applications in organisations, so that software developers can better understand the features of the technology environment in which their applications may be developed.

The paper begins with a justification - why the course is needed? We then describe the course philosophy and approval process, learning outcomes, topics, and approaches to teaching & learning.

We also focus on the assessment plan, moderation, course evaluation process, and the delivery aspects of the course. The course has yet to be run (semester 2, 2000), so final conclusions about the effectiveness of the course will follow from course evaluations at the end of the year.

Keywords

Data communications, summative assessment, formative assessment, learning outcomes, moderation, evaluation.

1. INTRODUCTION

The need for a background in networking and telecommunications concepts has been identified as an integral element of the graduate profile for the analyst/ programmer or software developer. The NACCQ professional development working group (Clear, 1998), have recommended that an intermediate level of skill in networking and telecommunications be acquired by a graduate in the analyst/programmer generic jobstream. In delivering software "solutions" for the typical New Zealand small or medium scale business enterprise, software developers need to possess a broad range of skills including frequently the ability to specify, design or critique proposals for the networking infrastructure of an application in addition to the application itself. In addition to this general requirement, networking & telecommunications companies, both nationally and internationally, have a huge demand for graduates who are capable of developing software for their specialised technology domains.

Within the Pathway - we have included a course on Networking and Telecommunications. This is at level 6 or second year degree level; and constitutes 15 credits (150 hours of student learning, or one quarter of a full semester's course of study).

The aim of this module is to enable students to develop an in-depth knowledge of data communications and networking requirements including networking and telecommunications technologies, hardware and software. Students will develop an understanding of management of telecommunications networks, cost-benefit analysis and evaluation of connectivity options. Emphasis is upon the analysis and design of networking applications in organisations, so that software developers can better understand the features of the technology environment in which their applications may be developed.

The main objective of this paper is to describe the whole process of designing a new course entitled Networking & Telecommunications, for the pathway. The paper is organised as follows. First we present the course philosophy and approval process. The learning outcomes and course topics are listed in the subsequent section. Approaches to teaching and learning are described. Discussion of the assessment plan, moderation and module evaluation process are followed by a brief conclusion.

2. COURSE PHILOSOPHY AND APPROVAL PROCESS

2.1 Course Philosophy

The philosophy that underlies the degree programme is expressed through the graduate profile of the Applied Science programme. The standard graduate profile for the degree also encapsulates in a broad sense the required attributes for graduates of the pathway. In this profile graduates are expected to possess a combination of academic capabilities, professional capabilities and personal capabilities. Typical examples of each category are given below:

Academic capabilities

- A central belief is that graduates from this programme should have developed the capability of approaching problems in a logical and scientific manner utilising fundamental knowledge and available literature. These skills are of little value if they are not able to write and deliver clear and succinct reports of scientific work.
- A graduate from the Bachelor of Applied Science programme will be capable of:
- Analyzing and solving theoretical and practical problems
- Communicating effectively

Professional capabilities

- The most desirable characteristic of graduates of this programme is that they should appreciate the need for high quality performance in the work place.
- A graduate from the Bachelor of Applied Science programme will be capable of:
- Applying previously acquired skills and knowledge to solve problems in the workplace
- Showing an awareness of the continuing need to acquire new knowledge to develop new skills
- Earning the respect of clients and colleagues and employers
- Working in coordination and harmony with other people

Personal capabilities

- In addition to technical skills graduates should now show a high level of social responsibility.
- Graduates from the Bachelor of Applied Science programme will be capable of:
- Demonstrating a sense of responsibility to clients who are dependent on the result of his/her work
- Showing an awareness of the need for accountability in his/her work

More specific to the course, we believe that:

1. Industry demand will be met by rounded graduates with strong technical skills
2. The topic of Telecommunications & Networking is an important one for software developers, and plays an important role for the economic development of this country and in the global conduct of enterprise
3. Learning can be enhanced by adopting an investigative problem-solving approach
4. Hands-on experience is an integral part of learning in telecommunications and networking
5. Learning should include a strong practical element
6. Technical graduates should be able to integrate theoretical and practical knowledge

2.2 Course Context Within the Degree

The prescribed core courses of study for all students of the Applied Science degree (chemists, ecologists, lab technicians and software developers) are scientific communication, mathematics & statistical models and a two semester project course. The standard scientific subjects such as Physics, Chemistry and Mathematics are available as elective courses for software development

students but they are not constrained in their choices and may elect business, electronics, languages or other topics.

An overview of the software development pathway is given below (see table 1). As can be seen the Networking and telecommunications course occurs in the fourth semester of student study.

2.3 Course Approval Process

The networking and telecommunications course has been approved within AUT's internal quality assurance processes. These include such steps as an academic review via the Board of Studies, and review via the Local Advisory Committee. This support from the local advisory committee ensures that an industry perspective is included regarding the relevance of the syllabus, the skills demanded of graduates and the general need for the course. These perspectives were included from the outset in developing the pathway, and members of our local advisory committee were active participants in the original working group.

3. LEARNING OUTCOMES AND TOPICS DELIVERY

3.1 Learning Outcomes

The learning outcomes for the module are listed below. On completion of this module students will be able to:

1. Describe the developments in telecommunications.
2. Discuss the relative merits and demerits of the various media, topologies, encoding, and protocols employed in computer and telecommunications networks.
3. Outline procedures for design, installation and configuration of local and wide area networks, and apply the techniques of cost-benefit analysis to the evaluation of hardware, software and connectivity options.
4. Explain how various areas of network management impact on the management of local and wide area networks.
5. Investigate the delay-throughput performance analysis, including performance monitoring of a typical network.
6. Explain the purpose and use of Intranet and Internet, and discuss issues related to security, privacy, and reliability in data communications networks.

Semester of study	Course name			
One	Programming	Principles of Computing & Information Systems	Scientific Communication	Elective
Two	Programming	Information Systems & Decision Modelling	Mathematical & Statistical Models	Elective
Three	Software Engineering	Data & Process Modelling	Logical Database Design	Elective
Four	Physical software Design & Implementation	Networking and Telecommunications	Physical Database Design	Elective
Five	Intelligent Systems	Human Computer Interaction	Software Project Management & Professional Practice	Project
Six	Operating Systems & Concurrent Programming	Internetworking & Web Development	Elective	Project

Table 1: Overview of the software development pathway

3.2 Development of Student Capabilities

In this module the following capabilities should be enhanced:

1. Application of new knowledge to practical issues and situations
2. Conceptual thinking applied to network management, technologies, and hardware and software
3. Technical competence in networking
4. Problem solving
5. Teamwork
6. Communication, oral and written, via class discussion and written assignments

3.3 Topics and Suggested Assessment Percentage

Table 2 shows the topics and suggested assessment percentage for the module.

3.4 Weekly Programme

The course will be delivered over 13 weeks, 4 hours class contact per week. Table 3 shows an overview of weekly plan for topic delivery.

4. APPROACHES TO TEACHING AND LEARNING

This module is approximately 65% theory and 35% practical work. Approaches to teaching and learning have been designed to provide students with both theoretical and practical knowledge of networking and data communications including telecommunications technologies, hardware and software.

This course combines large classroom teaching with small laboratory style instruction and self-directed learning. A case study scenario will be used throughout to relate each lesson with real-life situation. Students will be expected to do extensive background reading from a variety of sources, including textbook, library periodicals & magazines, and Internet web sites. Theory presented in lectures will be enhanced via laboratory demonstrations, and practical exercises. The suggested teaching and learning activities are listed below:

- Small-group discussion of supplied technical articles and practical exercises
- Lecturer-led discussion and lecture-style presentation of information
- Guest lectures and mini lectures
- Case studies, company scenario and problem based learning techniques
- Small-group problem-solving, critical analysis and reporting
- Live demonstrations using available hardware and software resources
- Self-directed learning
- A guided tour of AUT and/or a commercial local and wide area networks.

The following resources will be used to support teaching and learning:

1. Library
2. Internet access and recommended web sites
3. Periodicals and magazines
4. Demonstration equipment:
   - Voice communication over optical fibre
   - Wireless communication using Infrared
   - Oscilloscope and signal generator
   - Hubs, switches, bridges and routers
   - Network cards
   - Cables (twisted pair, coaxial, optical fibre)
   - LAN analyser software
   - Cable tester

Topics	Suggested assessment percentage
Telecommunication Developments	2
Computer and Telecommunications Networks	30
Network Design and Configuration	20
Network Management	15
Network Performance Analysis	25
Internet and Network Security	8

Table 2: Topics and suggested assessment percentage

Week	Topic	Learning outcomes
1	Introduction Telecommunication developments Network hardware, software, and applications	1
2	Data communications media Network topologies	2
3	Data encoding methods	2
4-5	Network architecture and protocols	2
6	Network design and configuration Installation and configuration of LAN and WAN	3
7	Operation and use of hubs, switches, bridges, routers, and gateways	3
8-9	Network management	4
10-11	Factors affecting network performance Delay-throughput performance analysis	5
12	Tools for monitoring & performance analysis of data communications networks	5
13	Internet and Intranet Network security	6
14	Final Exam	1-6

Table 3: Weekly plan for topic delivery

5. ASSESSMENT STRUCTURE

5.1 Summative Assessment

Consistent with standard practice for the pathway, there are three summative assessment items for this module which are described below:

1. A written assignment #1 of around 2-4 pages on a given company scenario which will require students to provide a cost-effective solution for the company. For this task students will need to conclude an analysis, design and justification for each item they proposed. The weighting of this assignment is 25% of the module total and the completion time is 4 weeks from the date of issue. This assessment assesses learning outcome 3.
2. A written assignment #2 of length around 3-6 pages. The idea is to demonstrate a deeper understanding of the key areas of network management, including installation and performance analysis, by exploring the scenario given in Assignment 1. The weighting of this assignment is 35% of the module total and the completion time is 5 weeks from the date of issue. This assessment assesses the following learning outcomes 4 and 5.
3. A written examination (closed book, duration 2 hours) will be held at the end of the semester. This assessment assesses the learning outcomes 1-6. This controlled assessment (occurring in a formally supervised environment) complements the assignment work by providing some formal check in the assessment programme that students are submitting their own work.

Assessment type	Group/ Individual	Weight %	Issue Week	Week Due	Min. Pass %
Assignment 1	Individual	25	1	5	45
Assignment 2	Group	35	6	11	45
Examination (closed book)	Individual	40	14	14	45

Table 4: Summary of assessment and weighting

5.2 Formative Assessment

The more practical elements of the course are explored via a series of formative exercises. A number of learning exercises will be set, but not marked. Constructive feedback and suggested solutions will be discussed in the class. Students who attend labs regularly and submit the "non-assessed" exercises will be in a better position to achieve the learning outcomes, and pass the final examination.

5.3 Comment

The above assessment programme fits within the constraints of the assessment philosophy of the pathway. Typically this will limit to no more than three the number of summative assessments, in order to manage student workload across the semester and their several courses of study, and also to manage the marking loads of staff. This philosophy it is hoped will enable students to remain focused on learning as opposed to assessment, and as a consequence actively engage in formatively assessed work. Thus the above assessment programme combining summatively assessed assignments, group and individual work, an examination and formatively assessed practical exercises, makes up a balanced programme of uncontrolled and controlled assessment. This is also supported by many authors, eg. Crooks (1993), Gibbs etal (1998), Lester and Little (1997), Ward (1981), and Whitaker (1989).

5.4 Passing the Module

To pass this module, an average mark of 50% must be achieved. Students should achieve at least 45% in each assessment items. Late assignments will be accepted without valid reason up to five days after the due date. However, a penalty of 10% per 24 hour period will be imposed.

6. MODERATION

The module team keeps a check on its assessment programme and the instruments used to ensure validity in the assessment process and consistency of standards achieved. Most moderation occurs using appropriately qualified colleagues from within the computing group. Where there is a lack of suitably qualified staff a moderator may be sought from another institution. Reports of moderators, samples of assessment works, copies of all assessment instruments and marking schedule are among the documents archived for scrutiny by internal and external monitors, the board of studies, examination board and external examiners.

The module coordinator ensures that the module team carries out pre-moderation of all summative assessments (e.g. assignments, case studies, final examinations) before they use them in the class. The module team decides for each assessment who will set the assessment and who will moderate it. Note that the same person may not both set and moderate an assessment.

Both the pre-moderation and the post-assessment moderation are carried out internally by the teaching staff within the module team or department. An appropriate person may be appointed as moderator where a moderator is not available from within the module team. The post-assessment moderation process involves an audit check on marking of the assessment, checking 10% of the scripts or 5, whichever is the greater. Finally, the moderator provides the following documents for the programme leader:

- A report on each moderation undertaken
- A copy of the assessment
- A marking scheme for the assessment
- 7 samples (2 top, 3 borderline and 2 fail) of student assessment work.

7. MODULE EVALUATION

Module evaluation is a review by the teaching team of the module and its delivery. It draws on data from a number of sources, including the teaching team, students (through module evaluations) moderators (through internal moderation processes and reports), the Programme Leaders and Academic Group Leader (or Head of Department). Module evaluation enables us to reflect on what we do in our module and to take steps to change, and improve through ongoing course development. The evaluation process also documents the history of the module and enables us to evaluate our progress on a semester by semester or longer term basis.

The module should be evaluated in terms of whether:

- The content and learning outcomes are appropriate
- The learning strategies are appropriate to the learning outcomes
- The overall assessment is appropriate to the learning outcomes
- The assessment methods are fair, valid and reliable
- The module has adequate and appropriate resources to achieve the learning outcomes
- The learning outcomes remain relevant within the context of the programme as it develops
- Students feel that their learning needs are appropriately met within the module

To conduct a module evaluation we need information from both students and lecturers. Module appraisal forms are given to students to complete towards the end of each semester. Individual module appraisals are to be handed on to the module coordinator to summarise. Copies of summaries are to be forwarded to each member of the team and the programme leader.

Regular discussion and report back among the members of the teaching team will form an important part of module evaluation. The board of studies, local advisory committee, and faculty board (Science & Engineering) may review the evaluation report. The evaluation report is also included in developing the annual report for the programme, reviewing achievements and weaknesses in the programme and proposing an action plan for the next cycle.

8. CONCLUDING REMARKS

In this paper we have described the process of designing a new course entitled "Networking and Telecommunications" for the Bachelor of Applied Science Programme at Auckland University of Technology. The role and expectations of the course, where it fits within the programme, the content, the assessment programme and the quality assurance processes have been discussed. The course will be run for the first time next semester and we are confident that student reactions will confirm the course design and the value and suitability of the course within the pathway.

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