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ABSTRACT

Edproj, a project team of faculty from the departments of computer science, software development and education at Monash University (Australia) investigated the quality of teaching and student learning and understanding in the computer science and software development departments. Edproj's research led to the development of a training program to prepare postgraduate students for their role as teachers. Budget cuts led to the development of the Tutor Training Program, which began in 1996 with the following objectives: (1) to share teaching techniques; (2) to improve tutors' teaching skills; (3) to make tutors aware of the main ideas put forward in lectures; (4) to increase the level of student participation; and (5) to promote tertiary level study skills. The Tutor Training Program drew on the experience gained from Edproj's research in the previous year, which led to insights into barriers to student learning, a bank of strategies for promoting better learning, and a fundamental list of teaching principles. The initial program consisted of six sessions. After the initial training, a survey was distributed to the participants (n=22) to find out what they thought about the initial training; the overall reaction to the training program was highly favorable. An appendix presents positive tutor/demonstrator strategies generated (semester 1, 1196). (AEF)

Tutor Training in Computer Science: Tutor Opinions and Student Results

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In 1994, the Dean of the Faculty of Computing and Information Technology (FCIT), at Monash University, approached the Dean of Education for assistance in tackling a perceived problem in the teaching of programming.

Two education faculty academics (Macdonald and Mitchell) were assigned to make a preliminary investigation on the quality of teaching and student learning and understanding in the departments of Computer Science and Software Development. The initial investigation was performed by a project team called "Edproj" which was established towards the end of 1995. Edproj consisted of members from the Department of Computer Science, Software Development and Education.

Monitored observations by Edproj showed that some tutorials degenerated into pseudo mini lectures. The initial observations made by group revealed the following:

1. A wide range of teaching skills, some were excellent but these practices were isolated and rare.
2. A majority of tutors had very primitive teaching skills; with the quality of questioning being particularly low. Some tutors spent the majority of class time talking and writing with few students paying attention. Several tutors spent the tutorial dictating code, another spent much of the tutorial talking with his/her back to the class, and another spending the whole lesson explaining answers.
3. Tutors often were not aware of the main ideas put forward in the lectures, and introduced their own interpretations and idiosyncratic methods.
4. There were very low levels of student talk and participation (sometimes only 2-3% of class time) and during some weeks less than half the students were attending classes.

Many tutors and demonstrators also lacked the skills to build student interest, intellectual engagement and motivation which had a number of negative consequences on student learning, such as:

1. Concepts which were not stated as being for assessment were ignored. Tasks intended by lecturers to be gateways to exploration and reflection were seen by students merely as hurdles to be negotiated.
2. Students wanted to get set tasks done, then they stopped. Students were satisfied once they had the solutions written down in their notes.
3. Many students believed that if they could follow the dictated code they learned the ideas behind it.
4. Students remained passive and tried to learn by listening and note taking rather than by doing.

The 1996 Tutor Training Programme

The Edproj research led to the development of a training programme to prepare postgraduate students for their role as teachers. The programme consisted of a teaching intervention that comprised an initial 3-day programme and ongoing fortnightly training/meeting sessions (Mitchell et al, 1996).

The initial training discussed the nature of good learning and set out a framework of good teaching theory and practice. The Programme discussed Edproj's insights into barriers to learning programming, exposed postgraduates to a bank of strategies for promoting better learning, and introduced a set of fundamental teaching principles that stressed the importance of questioning and linking. The fortnightly meetings provided tutors and demonstrators with the time and skill to discuss student learning needs and made it possible for tutors and demonstrators to share teaching ideas and discuss ways of dealing with student learning difficulties (Carbone et al, 1996).

Goals of the 1997 Tutor Training Programme

Budget cuts in 1997, meant that the Department of Computer Science could no longer afford the expertise of the intervening Education faculty experts, and as a result the Tutor Training Programme was delivered by a staff member of Computer Science and adapted accordingly to reflect the findings in 1996.

In 1996, the Tutor Training Programme began with the following objectives:

1. To share teaching techniques.
2. To improve the teaching skills of tutors.

3. To make tutors aware of the main ideas put forward in the lectures, and avoid different interpretations and idiosyncratic methods.
4. To increase the level of student talk and participation.
5. To promote tertiary level study skills within students.

By the end of the year, the project had built momentum to improve the quality of teaching and student learning. Improvements in the quality of teaching were characterised by the high level of energy, interest and enthusiasm demonstrated by the front-line teaching staff. Observations on the quality of teaching and student learning were made via monitoring classroom activities and interviews with tutors and demonstrators in 1996. Data showed vastly improved teaching practices that linked more closely to the lectures and course aims. As a consequence two new teaching innovations were initiated and developed; the Scavenger Hunt and the First Year Advanced Student's Project Scheme (Carbone 1996). Improvements in student learning were monitored by increased student attendance at tutorials and higher levels of student engagement in these classes (Carbone et al, 1996).

The 1997 Tutor Training Programme

In 1997, the Tutor Training Programme in the Department of Computer Science was delivered by a member from FCIT, without the intervention of Education Faculty experts. The Programme drew on the experience gained from Edproj's research in the previous year, which led into insights of barriers to students learning, a bank of strategies for promoting better learning, and a fundamental list of teaching principles. The initial Programme consisted of six sessions (each of 90 minutes duration) and ran over one and a half days.

Below is a brief description of the material covered in each session.

Session 1

The first session outlined the objectives of Edproj; to improve the quality of teaching and student learning and to understand a technical discipline such as Computer Science. Tutors and demonstrators were introduced to the importance of student learning in the tutorial and laboratory environment. They were exposed to an icebreaker activity and the importance it plays in the initial stages of establishing trust between fellow students and the teacher. Following that, postgraduates worked in small groups to compile a list of statements about their role as a demonstrator and tutor, and the students' role as a learner. The list brought out attitudes that were challenged and collectively discussed.

Session 2

Session 2 covered factors that affect learning; such as lack of student motivation, the nature of student/teacher interaction, transition issues and the nature of programming. The tutors/demonstrators were asked to draw from their own experience and identify barriers to their own learning. Findings from the Edproj investigation were also discussed with the focus on ways to overcome barriers to quality learning. Some of the barriers to learning observed by the Edproj group included:

1. Lack of teaching skills (due to absence of training)
2. The nature of programming (very cumulative)
3. Lack of a clear and coherent view of the entire course
4. Big Ideas are obscured from the high task demands of coding
5. Lecturers view course in terms of abstractions - students saw course as getting programs to compile
6. Low levels of student talk
7. Laboratory situations overloaded studentsí short-term memory
8. Lack of consensus within experts in the domain

Session 3

Session 3 examined conditions of learning *(choice, time and abilities)* and the process of learning through *selection, translation and storing*. Two example role plays were given by experienced tutors highlighting different approaches to teaching; one that encouraged active student participation and one that involved passive listening. Postgraduates were exposed to a small set of fundamental teaching principles which lead to a vigorous discussion on the outcomes of a successful lesson. These included:

1. Good learning involves making links between items of knowledge and with the real world.
2. Students construct their understanding based on the knowledge they bring into learning situations.
3. Active engagement not passive reception, characterises quality learning.
4. Student talk is a vital medium for the above to occur.
5. Student talk requires trust between student and teacher and with fellow students.

The principles selected were ones seen relevant to the most urgent needs of tutors and demonstrators as revealed by Edproj, and feasible to implement in the short time available. These concepts were used for subsequent planning and linked to the context in which the tutors operated.The course stressed the importance of reflection on practice as an essential tool for effective teaching and there was particular emphasis on the important role of student talk in different learning situations.

Session 4

Session 4 included an overview of positive tutor/ demonstrator strategies that were generated as part of the training programme in 1996. These are contained in Appendix A. The strategies covered ways to promote better learning and were obtained from a data bank of innovative teaching ideas collated during the previous year. Postgraduates worked in small groups to apply some of the strategies to a range of small programming tasks that involved teaching

concepts such as Strings, Functions, Arrays, Looping, Structures, Sorting, Searching, Files, Input/Output. The session was concluded by tutors and demonstrators participating in the first year student orientation programme.

Session 5

In session 5, the lecturers were invited to meet with the tutors and demonstrators and present their 'Big Ideas' of the course. The session was aimed at helping postgraduates promote the linking of key ideas. After the lecturers had concluded, tutors/demonstrators were issued with information on how to prepare for their lessons, and attempted to organise their first two lessons for the semester.

Session 6

The final session was devoted to preparing the first two laboratory and tutorial sessions. Demonstrators/Tutors registered themselves on their accounts and systematically worked through the exercises in the first two laboratory sheets, planning their ice-breaker and other activities for their lesson. The remainder of the session was devoted to administrative details including: entering students' marks into a database called the Marks Entry SyStem (MESS) database, the method for casual staff to claim the teaching hours via the Payment Entry SyStem (PESS) database, and a review of the teaching evaluation forms available at Monash (known as MonQueST).

Evaluation of the 1997 Training Programme and Evidence of Effectiveness

Ranking the sessions

After the initial training, a survey was distributed to the participants to find out what they thought about the initial training. Participants were asked to rank each session and provide comments. Twenty two surveys were completed. Of these, all the participants found the Programme well organised and presented. Ten found the material useful and twelve found it interesting. All participants believed that the Tutor Training Programme addressed their needs and recommended that it be continued in the following year. Typical comments from participants in relation to the sessions, included:

1. The ice-breaker was a useful activity for people that find it difficult to remember names.
2. Session 1 was very useful to develop trust between the tutor and fellow member.
3. Session 1 helped tutors start to get their mind on the job and handle it professionally.
4. Session 1 helped tutors know that students should be aware of their responsibilities.
5. It was beneficial in that some of the important points which don't come to mind at first (i.e., "making friends") were reinforced.
6. The discussions in session 2 appeared to be to general, it needed to be adapted to a particular situation.
7. The group work in session 3 that converted code to diagrams and used analogies and role plays was a good way to liven up boring stuff.
8. I found the orientation seminar in session 4 useful because it synchronised the information between the tutors and the students.
9. The preparation check list, in session 5 was a good idea.
10. In session 6, PESS was confusing, an online demonstration would have been better.

The training also had the effect of instilling some positive teaching behaviours amongst the new tutors, which included:

1. I will prepare for my lessons from the viewpoint of the student - catering for students of all types.
2. I will aim to use role plays and analogies in my first two lessons.
3. I will aim to learn my students names.
4. I will refer to the list of teaching strategies, and realistically look at my teaching methods and their effectiveness.

Table 1 gives a summary of how participants ranked each of the session. Sessions were ranked from 1 to 5 (i.e., 1 being the most useful and 5 the least). From this data a final overall ranking of each session was obtained. The data shows that session 5 (the lecturers presenting their Big Ideas of the course) was the most useful session, then followed by the introduction, barriers to learning and teaching strategies. The session considered least useful was the session covering the administration details.

Table 1.
Overall Ranking and Rating of Sessions

Session Number	Overall Rank	Rank 1	2	3	4	5
		Rank Distribution				
1 - Introduction	2	5*	7	7	3	0
2 - Barriers to Learning	4	5	3	4	7	3
3 - Teaching strategies	3	5	7	4	3	3
4 - Orientation						
5 - Big Ideas of the course	1	9	4	4	3	2
6 - Getting started - administration	5	2	5	3	2	10

**Numbers inside the table represent the number of participants giving that rank*

Feedback received from the twenty two co mpleted surveys was very positive. Eighteen participants believed that the Programme did address their needs and nineteen participants recommended that the training be continued in the following year. More general comments about the initial training and the ongoing fortnightly meeting included:

"When I began my Honours year in Computer Science (in 1997) I decided to become a demonstrator. I found the initial training course for demonstrators to be a very informative and energetic introduction to the life of a demonstrator."

"The fortnightly meetings between demonstrators and lecturers were used to gauge how students are progressing and coping with the course, and whether of not any changes need to be made. If changes were needed they were made during the course and not after the course had completed. We could compensate for the problems now rather than taking the approach, We'll get it right next semester."

Impact of the Training Programme on students' marks

To determine the educational impact of the Training Programme on the students' academic performance, the correlation of studentsí test, practical mark and exam marks during 1996 and 1997 was examined. Average marks of students were monitored for the mid-year exam, and at the mid-semester test, to determine if the average studentsí marks increased or decreased. Table 2 contains the average mark and standard deviation of the students in 1996 and 1997 respectively.

Table 2.
Average mark and standard deviation of the students in 1996 and 1997.

	Average percentage mark and (standard deviation)		
Student Year	practical mark	mid year exam	test 1
1996	76.00	56.10	57.75
(328 students)	(4.2)	(15.8)	(6.4)
1997	78.00	58.00	60.4
(375 students)	(7.8)	(32.5)	(7.5)

The average marks for the 1997 practical component, the mid-semester test and exam, was slightly higher than their respective 1996 scores. Although the three assessment instruments are comparable and at the same level in each year, it is not possible from the above results to draw any firm conclusion regarding the contribution of the Tutor Training Programme on the students' academic performances, it is reasonable to conclude that the training did not appear to be detrimental.

Conclusion and Future directions

The overall reaction to the Training Programme by its participants was highly favourable. Both the tutors/ demonstrators and lecturers showed healthy signs of interest and dedication. Participants enjoyed the training and the Programme is working towards fulfilling its objectives of:

1. Sharing teaching techniques,
2. Improving the teaching skills of tutors,
3. Making tutors aware of the main ideas put forward in the lectures, and avoid different interpretations and idiosyncratic methods,
4. Increasing the level of student talk and participation,
5. Promoting tertiary level study skills within students.

Analysis of studentsí academic performance, in particular performance of the tests and mid-year exam results tends to indicate that the Programme does not appear to be detrimental. However, there is scope for some ìfine tuningî if it is to operate again in 1998.

Currently, funding for the Training Programme comes from the Department. Only with continued funding can such programmes be introduced, improved and sustained. However, under the current economic climate it is unclear whether any funding can be devoted to address the needs of postgraduates and Honours students who are newly appointed tutors and demonstrators.

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Appendix A Positive tutor/demonstrator strategies generated (semester 1, 1996)

1. Find ways to liven up boring topics
2. Admit to past mistakes
3. Know students by name
4. Ask questions for discussion
5. Pick up and follow student responses
6. Spread questions around
7. Plan some approaches before hand. Prepare several solutions
8. Closure on student questions
9. No answer without some student response first
10. Relevant anecdotes
11. Reward good thinking
12. Use small words and simple concepts
13. Provide information about the course
14. Find out what student does and does not understand
15. Help set mastery goals
16. Pass understanding, not just quantity
17. Localise problem area
18. Have students step through and explain
19. Rephrase questions
20. Praise students for what they have done
21. Question students regarding content of the lecturers, tutorials and labs to encourage linking
22. Admit to mistakes, work through them and praise student
23. Establish an environment where students feel free to dispute tutor/demonstrator or other students

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