A survey of the effects of a fourth year Introduction to Research Methods course

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Abstract

Research skills are important for any academic and can be of great benefit to any professional person. These skills are, however, difficult to teach and to learn. In the Department of Computer Science at the University of the Witwatersrand we have for a number of years included the completion of a research report as part of our Honours programme. This paper is a case study of how we have implemented an introductory research methods Honours course to increase our students' exposure to research and to help them cope better with the research reports. This course provides an effective way of introducing research to a relatively large class of Honours students. It has now been given twice.

Included in this study is a survey of students who took the course in 1999, focussing on the usefulness of the course for the research report, potential changes to the courses, plans for further research qualification and usage of LaTeX. Generally, the course was seen as useful. The results are presented and discussed, and suggested changes for future versions of the course are described.

Our experience with the course is positive and we believe it has made a major impact on the way research is done by Honours students. Many of the problems we encountered with the Honours research reports prior to the introduction of the research methods course have been alleviated.

1 Introduction

The ability to do research is an extremely important attribute for any academic. In fact, research skills can be of great benefit to any professional person. In the Department of Computer Science at the University of the Witwatersrand we believe that our graduates need to develop an understanding and appreciation of research. Our approach to this has been to replace practical projects with research reports in the Honours year of study and for a number of years have included the completion of a research report as part of our Honours programme. In this way we hope to develop academics as well as provide highly educated graduates for industry and commerce.

In 1997 we decided that our students needed to acquire certain research skills in order to more successfully tackle the research report. It is unreasonable to expect students who have been focusing on dealing with lower-level concepts and principles to be able to immediately pick up the very different skills required to do research. The students need to adjust to an important new paradigm in their educational experience which shifts the focus from answering focused questions to taking responsibility for presenting a well argued thesis. For a reasonable sized class of seventeen to twenty Honours students, it becomes worthwhile to provide a course on research methods to help the students to come to grips with this new educational experience. Thus in 1998 we included an Introduction to Research Methods (IRM) course in our Honours programme and repeated it in 1999 with a different lecturer.

We believe that this course plus the Research Report (RR) component of the Honours degree gives our students a very valuable introduction to research which will be of great benefit if they are going on

to a higher degree in Computer Science and also will assist students who do not continue their studies. Specific benefits which we see are that doing these research courses could encourage students to do a Higher Degree but even if this is not the case they will learn to read and understand scientific papers, learn to argue logically and coherently and improve their writing and presentation skills.

This paper discusses our motivation for the course (Section 2), what we believe are the skills needed to do research (Section 3), the aims and objectives of our IRM course (Section 4) and the approach that we have taken to teach these skills to our students (Section 5). Some of the results of teaching this course in 1998 are discussed (Section 6) and we present the results of a survey carried out in 1999 (Section 7). Two appendices present details of the questionnaire and the raw numerical data.

2 Motivation for Course

For a number of years our Honours programme consisted of 8 lecture courses, a self-study and a research report. The selection of courses offered in any year contains some courses which we have defined as being *core*, while the remainder of the courses depends on the interests of staff available. The self study has been used as a vehicle for covering some material which is not covered in the other coursework. It has also been a vehicle for the students to undertake individual learning and to practise their reading and writing skills. The aim of the research report is to give the students the opportunity to develop an understanding and appreciation of research.

Over the years, though the final research report produced was, on average, of a high quality, we experienced a number of problems with the process, many of which we ascribe to the students' lack of understanding of research methods when they start.

Traditionally, students learn research methods by doing, by being supervised on a particular project, and by trial-and-error. There are advantages to this process, but it has several problems. It discourages students from reflecting on what they are doing; they become focussed on system building—thus the students can only learn methods of research unconsciously and through osmosis. The initial phase of research can be particularly difficult: deciding a suitable question, choosing a scope of an appropriate size; and developing a method of answering the question.

We found that our students started their research projects without understanding what research means and what our goal is. Although making mistakes is one way to achieve learning, in the limited time that the students had for the research report this was not an effective approach. Some symptoms of this problem were as follows.

- The research question was a statement of a system that the student wanted to build: e.g. I want to build a neural network using Java, parallel processing and some fancy graphics.
- The scope of the project was far too big. To answer the question was nowhere near feasible in the time allowed, and what could be done could appear too simple.
- The initial proposal often did not have a plausible accompanying methodology for solving the problem.
- Students did not know how to use the literature effectively.

The consequences were: deadline slippage as students floundered, frustration on the part of students, costly mistakes, increased demands on staff supervision time, extra work for students, and in many cases an end product that was not as good as it could have been.

We believe that many research skills can be far more efficiently and effectively acquired by undertaking a series of small, guided exercises and readings that deal with issues ranging from philosophical questions of the nature of research to nitty-gritty issues like how to cite papers, leaving the students far better equipped to undertake their research project. We thus decided to replace the self study with an Introduction to Research Methods course (IRM) focussed on preparing the students for their research reports but also giving them wider exposure to research methods and research topics.

A problem we encountered was a lack of material on research methods that relate specifically to computer science research. Research in computer science appears to have some significant differences to traditional forms of research, either in the natural or social sciences. This means that we had to tailor a course appropriate to the discipline. The next section of this paper discusses the competencies which we feel are necessary to successfully undertake research and Sections 4 and 5 discuss our course in more detail.

3 Skills needed to do research

Traditionally, becoming a researcher has had similarities with an apprenticeship—through association with a supervisor the student is exposed to the methods and process of research. Rudestam and Newton [5] describe the dissertation process as a ritual of socialisation into the community of scholars, but preparation for research can go beyond this, and there are clearly identifiable competencies that will be of use to any researcher.

Phillips and Pugh [4] describe research as a craft, hence the basic educational process involved is learning by doing. They argue that no relevant procedure, skill or technique should be used for the first time in the thesis project, but should have been practised beforehand. They speak specifically about doctoral research, but the same general principle applies to all levels of postgraduate research. In general, one can't make students into researchers, but one can give students the exposure, the skills and the tools needed as part of being a competent researcher. Hence a desirable goal is to give the students opportunities to develop and practice a range of research related skills such as:

- critical thinking
- the ability to find literature in libraries, on-line databases and on the WWW—this includes the ability to choose suitable words, partial words and phrases for searching
- critical reading as well as quick evaluation of the relevance and value of other research
- the ability to summarise and capture the essence of a piece of research
- the ability to see the similarities and differences between two pieces of research
- the ability to present a logical and coherent argument
- identification of what a research question is and the development of realistic and testable hypotheses from this question
- presentation skills (both verbal and written), since research is of no use if it is not communicated to other people.

Beyond these skills, there is certain knowledge which is valuable to students and will help them during the process of research:

- an understanding of the different types of literature, and how much importance to assign to it
- an understanding of the complexity of choosing and applying experimental and statistical techniques
- an understanding of the scientific method and how it can be an unreachable ideal, and that research is not necessarily the smooth, tidy process described by the scientific method
- an understanding of different research methods

- an understanding of research in computer science and how it can differ from traditional forms of research. Some computer science research uses methods from the social sciences, such as computer science education, some research uses proof, and yet other research appears to be in a distinct category where a number of test cases (which are justified) are used to test a hypothesis.

Furthermore, there are tools which are important to researchers which should be introduced:

- tools for literature search such as collections of abstracts, on-line databases, the WWW
- research-oriented document production software such as LaTeX and BibTeX.

4 Aims and Objectives of the IRM course

4.1 Aims

The overall aim of the course is to start the process of introducing students to research methods (the process is continued in the Research Report course). The course is designed to give an initial exposure to the skills discussed in Section 3. This is achieved by working through various stages of the research process—starting with reading and analysing papers, finding literature, studying research methods, analysing hypotheses and experiments, coming up with hypotheses, and finally preparing a prototype research proposal. Some specific aims of the topic are to assist students

- to develop an appreciation for research
- to develop an understanding of the nature of research
- to be able to critically evaluate scientific literature
- to develop an ability to synthesise knowledge from a number of sources
- to be able to understand the nature of a research problem
- to develop the ability to make a logical argument
- to improve their reading, writing and presentation skills

4.2 Objectives

By the end of the IRM course we expect that students should be able to

- understand a paper of moderate difficulty
- find material related to a research topic
- make comments on the value of a paper
- identify the strengths and weaknesses of a paper
- write a review of the literature on some topic
- present a hypothesis for testing
- decide how to test a given hypothesis
- design an experiment to test the hypothesis
- write a research proposal

5 Teaching the necessary skills

The course is structured in such a fashion that the students work through a number of the steps of the research process with constant feedback and assessment. These have been chosen to cover the skills, knowledge and tools described in Section 3. We have set the course up so that one member of staff is in overall control of the course and is responsible for most of the assessment but other members of staff contribute to various of the tasks and are involved in giving feedback to the students.

The various tasks which the students work through are outlined below. The course itself was divided into 8 phases (Phase 0 to Phase 7), and each task was part of a phase.

- The students attend lectures (where class participation is encouraged) and are given reading as an introduction to research methods. They are tested on the material covered in the lectures and in the reading. This runs throughout the course. Some of the books used for reference in this phase are Leedy [2], Dominowski [1] and Meyers and Grossen [3]. (Phase 0)
- The students do small group work during class involving data analysis and data collection techniques. (Phase 0)
- They are given a computer science survey paper which they are expected to work through (in collaboration with their classmates) until they fully understand the material covered in the paper. They are tested on the material covered in this paper. (Phase 1)
- They are given a paper which they are asked to read, understand and then present to their classmates. (Phase 2)
- They are given two papers on a very similar topic and are expected to compare and contrast them. (Phase 3)
- They are given a list of references on a given topic and are expected to find the papers and prepare an annotated bibliography of the papers. Members of the department provide the topics and comment on the final documents. (Phase 4)
- They are given a number of papers and asked to do a literature review of these papers. Again staff members of the department offer topics and comment on the students' work. The students also present their literature reviews. (Phase 5)
- They consider various research hypotheses and how to test them. They also work through the process of formulating and testing hypotheses for focussed research problems. (Phase 6)
- They are given a Research Report written by a previous Honours student to review. (Phase 6)
- They prepare a prototype research proposal based on a given literature survey. (Phase 7)

Each of the above tasks can be related back to the skills, knowledge and tools in Section 3. The knowledge items are covered during the lectures and small group work, with reinforcement during the assigned work. Critical thinking is an important aspect of both our undergraduate and Honours degrees, and it is not emphasised any more than usual in this course. The ability to find literature is exercised during the annotated bibliography and literature review phases, and the students are given an introduction to various databases by the library staff. This also gives experience in the use of search tools.

Critical reading is important for most of the work done in the course, as the students are required to read with thought before taking an assigned piece of work further. Summarising is dealt with during the annotated bibliography, and comparison is dealt with in two assignments—the comparison of two papers and the literature review. The generation of hypotheses and research questions is dealt with in the hypothesis stage and in the prototype research proposal. The argument and presentation skills are emphasised whenever the students produce documents or give presentations. Although not compulsory,

we also encourage students to use LaTeX and BibTeX, and for some phases, provide document templates from which they can work.

As can be seen by this, the course is structured to deal with each skill at least once so that the student can gain experience. In addition, because the students read numerous articles they are exposed to different forms of research—this was not the case in the past.

The students are encouraged to discuss any problems they have with the lecturer, and feedback is an important part of the whole process. Students receive both individual feedback, as well as a summary which is sent to the whole class highlighting issues relevant to a number of students.

The Research Report then allows the student the opportunity to further practise the skills that they have learned in the IRM course by going through the full research process on a small contained problem.

6 Evaluation

Unfortunately as with many educational innovations, much of the initial evaluation of the new course is anecdotal, especially as we have relatively little hard 'before' data and it is very difficult to set up any controlled experiments. We surveyed the 1999 Honours class after the completion of their Research Reports and believe that this gives us some useful feedback. The results of the survey are discussed in Section 7.

The remainder of this section discusses our experiences of the course to date.

6.1 Experience teaching the IRM course (1998/9)

The course is a challenging one to teach. It takes time to choose appropriate materials that will fulfil the objectives, and both lecturers have not been completely satisfied with their choices. We do, however, feel positive that the students are benefitting even if the choice of materials is not 'perfect'. The course also requires a great deal of regular assessment and feedback to the students. The nature of the work means that this assessment and feedback is very demanding on the lecturer's time—the marking is both intense and difficult.

It is at times difficult to convince the students that this course is as important as the other lecture-based subject-specific courses and sometimes they do not work as consistently as we would like. This is clearly something that we have to apply our minds to for the future. We feel that this issue can at least to some extent be addressed by all members of staff being involved in and supportive of the course. Certainly there was more staff involvement in 1999 than 1998 and the students seemed to appreciate this.

It is an enjoyable course to teach because of the opportunities for interactions with the class, particularly during the lectures; and for discussions with students about aspects of research. It is also a very rewarding feeling to see their presentations improve as the course progresses and also to note improvements in writing style.

We also feel that it is an important opportunity to let students know of the possibility of further research-related study such as research degrees, and to encourage students to study further. This is something which our earlier style of teaching research did not offer.

6.2 Impact on the research report (1998/9)

The first place where benefits from the IRM course may be seen is the research project which students complete after the IRM course. The research project consists of several phases and milestones, the most important of which are the research proposal and final document. These projects are conducted under the supervision of a member of staff and the major documents are also read by a second member of staff. There is also a member of staff who acts as coordinator for the research reports and is responsible for the overall marking and running of the process.

The process of conducting the research reports in 1998 and 1999 appeared to be much smoother than in previous years (though the 1998 class was also smaller than the classes we usually have). It was noticeable that there were far fewer serious problems than in the past, and the serious problems that did

exist were attributable to other factors (e.g. a supervisor being away at a critical time, or the student not doing any work). On reflection, both from the supervisors' and the research report coordinator's viewpoints the process was much smoother.

The positive aspects were:

- The proposals were on average better, with greater focus and understanding of both the form and content of what a proposal should contain.

  The students appeared to have a greater understanding of what research was about. They all—even the worst—understood that they needed to have a proper research objective and this understanding was reflected in the considerably better sections which discussed their research objectives and contributions. Two students who had chosen ill-defined research topics recognised that they were in trouble, and understood the problems with what they had proposed.

- The students' ability to use the literature was better. They started the research project with an understanding of the different types of resources, where they could be found and how they should be analysed. There was still a tendency for literature reviews to be a list of brief summaries of papers, but on the whole the reviews were more integrated and critical.

- There was a better understanding of the need to do a proper evaluation. From the beginning students knew that they had to have a proper method for answering a research question. In the past it took much more effort on our and the students' part to understand this.

  What was quite striking were the debates that the research report coordinator had with a number of the students at various phases about what type of data was required to answer a question and how the data should be analysed. These discussions showed a greater insight into the process of research than had been displayed in the past.

- Related to this, students had an understanding of the research report as a process and not just as an end in itself.

- As students had a better insight into the process, supervisors could spend more time with students on the particular problem, rather than on the process. For example, as students had some understanding of what was required in a literature review, supervisors could focus on the particular literature review the student was writing, rather than the general principles of what goes into a literature review.

- The general standard of the reports as documents presenting the research was better, and the quality of presentation of the reports was much better than previously. In 1999, this affected other courses as well—a number of lecturers commented on the quality of the reports and other assignments submitted both in terms of the quality of the documents and the presentation and analysis of results.

- The presentations for the research report were much better compared to 1997 and earlier, with the students more confident when presenting. Also there was an small improvement in the standard of the presentations from 1998 to 1999.

- The course in 1999 covered more different types of research and more information on statistics than the course in 1998.

Some suggestions for changes in the course were as follows:

- There should be more focus on project management such as time planning, and monitoring and controlling progress against a plan
- More emphasis should be placed on getting English spelling and punctuation details correct
- There could be more involvement by staff, for example in discussions about the nature of research.
- Students should use given document outlines and structures, but should be encouraged to modify them if they do not fit the material they are reporting on.
- There should be more material on supervisor/student interaction.

6.3 Pragmatic issues (1998/9)

- *Workload:* The lecturer in charge of the course does have to put significant work into the course, and some involvement from other staff is required. While not a very intensive course for staff, it cannot be done on the cheap, and the staff member who does the work has to get proper credit. The work required by the lecturer for a class of 17 students in 1999 was 220 hours in total (with an additional 70 hours because the lecturer is new to the course). Part of this is a shift in workload as previously the place in the curriculum was used for a self-study project where individual members of staff supervised students.However, it does appear that overall the introduction of this course has increased the workload on staff slightly.
- *Time for research report:* One negative effect of introducing the IRM course is that the time available for the research project is reduced. This put increased pressure on the students and shortened the time from the start of the research project to its conclusion. There was some disagreement among academic staff how serious the first problem was, but there was general consensus that the time available for the research project was not sufficient. In 1999 we tried to address these problems by (i) slightly reducing other workload and (ii) starting the research project about six weeks earlier than in 1998. This also meant a reduction in the number of hours. For IRM in 1999 the students were expected to put in around 220 hours of work for this course—120 hours in 3 intensive periods (40 hour weeks) and 100 hours spread over 12 weeks. As there were unplanned alterations to the Honours programme during the second half of the year, it is difficult to judge the effects of changing the timing in 1999.

6.4 Student Feedback (1998)

One or two of the students in the class felt that there were too many similar tasks required of them in the IRM course—they saw comparing two papers as the same thing as doing a literature review of five or six papers—and felt the course could have been shorter. These same students did however, after the completion of the research report, say that they had found the course to be a valuable learning exercise and felt that we should definitely continue offering it.

In general the students seemed to see the importance of the course once they had embarked on their research reports. In fact, some of the 1998 students reported at the end of the year that they had felt quite comfortable doing their Research Reports as they had an idea of the process and felt that the research would have been much harder to do without the IRM course. Student feedback from 1999 is presented in the next section.

	Average	Agree	Disagree
Generally, I found what I learnt in the IRM course useful for the research report	4.59	17 % 100	0
I believe the research report would have been more difficult without the IRM course	4.41	17 % 100	0

Table 1: Questions 1 and 3(j)

7 1999 Survey

We decided that we should survey the students towards the end of 1999, to get feedback from them on how useful they felt the IRM course was in doing RR. We also asked them about how the course could be changed, whether they were planning to do a further research degree and whether they used LaTeX during the IRM course. See Table 8 on page 18 in Appendix A for the questionnaire used.

7.1 Sample

The 17 students who had taken the IRM course were asked to complete the questionnaire in the last 20 minutes of a scheduled lecture slot. All students completed questionnaires although some questions were omitted by individual students, and some questions were incorrectly completed. These issues will be discussed below, as well as in Appendix B.

7.2 Analysis

This section gives the analysis of each question. Questions are grouped in terms of focus. As the sample size is small, most questions will be looked at in terms of counts and percentages.

7.2.1 Question 1 and Question 3(j)

These questions looked at the usefulness of IRM course in general with respect to the Research Report. These questions (and questions 3(a) to 3(i)) are based on a five-point Likert scale together with a 'Don't know' option, so that respondents who have not formed an opinion or have no experience of the issue at hand can indicate this, instead of using 'Neutral'. For each question, an average has been calculated. This average is the sum of all responses (with 'Strongly agree' equal to 5, down to 'Strongly disagree' equal to 1), excluding 'Don't know' responses and divided by the number of responses (again not counting 'Don't know' responses). A percentage as also been calculated for those that indicate some level of agreement ('Strongly agree' and 'Agree'), and for those indicating some level of disagreement ('Strongly disagree' and 'Disagree'). As can be seen in Table 1, the averages for both statements are very high, and in fact, all students were in agreement.

7.2.2 Question 2 and Questions 3(a)–3(h)

These two groups of questions look at the usefulness of the various phases and aspects of IRM with respect to the RR.

Question 2 is a ranking of the usefulness (from 'Most useful' equal to 1 to 'Least useful' = 9) of the phases. Note that Phase 6 has been split into two phases, as the two parts were distinct. This question was not completed correctly by all students and hence the number of respondents has been reduced to 11. See Appendix B for more details. The data was analysed by looking at the percentage of students

	First	Top 3	Bottom 3	Last
Phase 0: lectures about research methods, small group work, test		1 % 9.09	8 % 72.73	1 % 9.09
Phase 1: reading, summarising and being tested on a paper		1 % 9.09	8 % 72.73	2 % 18.18
Phase 2: presenting a paper	1 % 9.09	5 % 45.45	2 % 18.18	
Phase 3: comparing and contrasting two research papers		2 % 18.18	3 % 27.27	
Phase 4: doing an annotated bibliography			6 % 54.55	3 % 27.27
Phase 5: doing a literature review and presenting it	2 % 18.18	7 % 63.64	1 % 9.09	
Phase 6: defining a research hypothesis and how to test it	2 % 18.18	5 % 45.45		
Phase 6: refereeing a research report		2 % 18.18	5 % 45.45	5 % 45.45
Phase 7: writing a prototype research proposal	6 % 54.55	10 % 90.91		

Table 2: Question 2

ranking the phase in various categories, namely First (percentage who allocated the phase a 1), Top Three (percentage who allocated the phase a 1, 2 or 3), and Bottom 3 and Last (with similar definitions).

From Table 2, it can be seen that Phase 7 was ranked as the most useful, followed by Phase 5 and Phase 6 (Research Hypotheses). Phases that were ranked as less useful include Phase 0, Phase 1, Phase 4 and Phase 6 (Refereeing). For the other phases (2 and 3), there were more mixed responses.

Questions 3(a) to 3(h) looked at the various aspects of the course in a more general fashion, and required respondents to indicate the usefulness of the aspects for the research report. They have been analysed in the same fashion as question 3(j) (described in Section 7.2.1). Additionally, the percentage of 'Neutral' responses is also shown.

The statistics are given in Table 3 ordered with respect to average. As can be seen from this table, the prototype research report was found to be the most useful, followed by the presentation and the research hypothesis exercise. The compare and contrast exercise and the annotated bibliography were found to be the least useful.

7.2.3 Question 3(i)

This question asked students about how useful they believed the IRM course would be in their careers and which particular aspects would be useful. The first part was analysed in the same manner as the rest of Question 3. For the parts (i) and (ii), similar answers were grouped together, and expressed as percentages of those that agreed.

The data are given in Table 4. Generally, students were positive that the course would be useful for their careers, and the most useful components were report writing, presentation and proposal writing. Only responses for which there was more than one response are indicated. Other responses dealt with learning how to do research, planning projects, communicating ideas and solutions, literature review, and understanding and evaluating new material. The one negative response stated that the student was not sure that they would be doing academic research.

		Average	Agree	Neutral	Disagree
3(h)	Prototype research proposal (Phase 7)	4.59	17 % 100		
3(b)	Presentations (Phases 2 and 5)	4.19	14 % 82.35	2 % 11.76	
3(f)	Research hypothesis exercise (Phase 6)	4.06	16 % 94.12		1 % 5.88
3(e)	Literature review (Phase 5)	3.82	12 % 70.59	3 % 17.65	2 % 11.76
3(a)	Lectures on research methods (Phase 0)	3.65	11 % 64.71	5 % 29.41	1 % 5.88
3(g)	Refereeing of a research report (Phase 6)	3.56	9 % 52.94	5 % 29.41	2 % 11.76
3(c)	Compare and contrast exercise (Phase 3)	3.18	8 % 47.06	4 % 23.53	5 % 29.41
3(d)	Annotated bibliography (Phase 4)	3.18	7 % 41.18	5 % 29.41	5 % 29.41

Table 3: Questions 3(a) to 3(h) (I found the . . . useful for the research report)

	Average	Agree	Neutral	Disagree
Generally, I believe that what I learnt in the IRM course will be useful for my career	3.88	12 % 70.59	4 % 23.53	1 % 5.88

	Responses
Report writing	6 % 50.00
Presentations	5 % 41.67
Proposal writing	2 % 16.67

Table 4: Question 3(i)

	Responses
Report writing and document preparation were beneficial	5 % 29.41
Very intensive, lots of practice	2 % 11.76
Group work was beneficial	2 % 11.76
Enjoyable	2 % 11.76

	Responses
Workload too high, affected other courses, too many courses at once	6 % 35.29
Too many documents required, too many phases, make shorter	6 % 35.29
Add more information on statistics	3 % 17.65

Table 5: Question 4 and 5: comments and suggested changes

7.2.4 Questions 4 and 5

These questions asked for comments on the course and suggested changes. Since there was a large overlap of responses, the two questions have been analysed together. The same approach has been taken as for the open-ended part of Question 3(i), and only statements with more than one response have been tabulated.

This data is shown in Table 5. The first table presents comments on the course, and the second table presents suggested changes. Single-respondent comments include interesting, exciting, fun, good to do presentations, and involvement of other staff avoids dummy projects. Single-respondent suggestions include more on presentations, introduce research at undergraduate level, more lectures on how to conduct research, combine with RR so that material relevant, give more choice of material, library presentations were unnecessary and less statistics.

7.2.5 Question 6

Question 6 looked at whether students were planning to do further research study. It was possible to divide the students who have decided to do further research into two groups—those that plan to do it immediately and those that plan to do it at some point in the future. Questions 6(b) and (c) are calculated as percentages of the students that are not doing a further research degree. One student did not compete this question.

From Table 6, it can be seen that the majority of students have decided not to do further research. The students who planned to do further research had no firm plans about when or where this would take place. For the students that did not plan to do a further research degree, the reasons why and when they made this decision are given in Table 6. As can be seen, needing to and wanting to work are the most common reasons, with reasons relating to perceptions of research coming next. About half of respondents not doing a further research degree decided before Honours not to do further research and half decided during Honours.

	Responses
Yes	2 % 12.5
Yes, but not immediately	2 % 12.5
No	12 % 75.00

	Responses
Financial reasons, need to work	5 % 41.67
Want work experience, want to work in industry, prefer practical work	5 % 41.67
Discouraged by Honours, worn out, tired of academics	3 % 25.00
Research not appealing, not for me	2 % 16.67

	Responses
During undergraduate	4 % 33.33
During third year	2 % 16.67
During Honours	5 % 41.67

Table 6: Question 6

7.2.6 Question 7

This question looks at the respondents' use of LaTeX. The questions are analysed in a similar fashion to above. The percentages for Question 7(a) and (b), were calculated in terms of the number of respondents using LaTeX. One student did not answer any of Question 7.

From the data given in Table 7 it can be seen that the majority of students used LaTeX, and found the templates provided to be useful. In general, students were split about equally about whether it was all easy or whether some aspects of LaTeX were difficult. The students who didn't use it complained about the irritating bugs and the compile errors. The final table gives additional comments that students made about LaTeX and the percentages are calculated on the whole sample. Single-respondent answers that were too much emphasis on LaTeX, rather use a WYSIWYG version of LaTeX such as Lyx, find an alternative to LaTeX, find an better environment for LaTeX, difficult to find things in LaTeX files, and introduce LaTeX at undergraduate level.

7.3 Discussion

It is clear from the results, that overall, these students felt that the course was useful for the Research Report and will be useful in their careers. Certain phases and aspects of the course were seen as more useful. From the data from Question 2 and 3(a) to 3(h), it is clear that the prototype research proposal was perceived to be the most useful, with presentations, the hypothesis exercise and the literature review also seen as useful. The remaining phases and aspects were seen as less useful and it is difficult to conclude from the data which was seen as the least useful since there are conflicting results from the two questions, although the annotated bibliography and the refereeing received low results in both. The compare and contrast exercise received a low score in Question 3.

However, we cannot necessarily conclude that these weren't useful, only that the students did not perceive them as useful. It may be the case that the usefulness was not as directly obvious as with the higher rated and ranked phases and aspects.

Clearly, the students saw benefit from the document writing and presentations, but these have immediate benefits. A question we need to consider is how to bring other aspects to the fore. It would be ideal if the students saw benefit from learning about research. However, the results may just reflect our emphasis on these more immediate benefits.

The students' suggestions for change indicate that there may have been timing problems with the course, and this is something we need to investigate. We know that our Honours programme is intensive, but we have purposefully designed it that way, and hence the suggestions do not necessarily imply the need for change.

Question 6 indicates that most students do not intend to take research further, mainly because of a need to work or a desire to work. It is not clear from these results how we can change this.

Finally, it appears that the students found LaTeX and the provided templates to be a good way to create documents.

7.4 Potential modifications to the course for 2000

At this stage, it appears that the course will be presented in 2000 and that the first author will be the lecturer. Hence, it makes sense to look at what we have learnt during the past two years and from our survey, and see if any modifications can be made.

Clearly the 1999 course was very successful in terms of report writing and presentations, and hence this aspect should continue. However, it may be necessary to have a greater emphasis on research, since obviously we want to present more than a writing and presentations skills course.

The number of documents to be handed in will be reconsidered—it may be possible to have fewer or to make combined hand-ins; however, this should be accompanied by an increase in the quality of the documents if students are to have more time to work on a hand-in. For example, the annotated bibliography could be done at the same time as the literature review. In general, students felt that the

	Responses
Used LaTeX	14
	% 87.5
Did not use LaTeX	2
	% 12.5

	Responses
Templates were helpful	13
	% 92.86
Templates were not helpful	1
	% 7.14

	Responses
LaTeX easy	7
	% 50.00
LaTeX easy, but some parts difficult	5
	% 35.71
LaTeX difficult	2
	% 14.29

	Responses
LaTeX good for research documents, long documents	4
	% 23.53
LaTeX generates professional looking documents	2
	% 11.76
More lectures about LaTeX	2
	% 11.76
Difficult to learn/do complex things in LaTeX	2
	% 11.76

Table 7: Question 7

refereeing of a report was not useful; however we do believe it is important for the students to see a good example of an research report done for Honours, so it may be possible to include this in another phase of the course.

Although the compare and contrast exercise was not seen as crucial, we believe that important skills are developed in this exercise and hence we do not intend to drop this phase.

We will continue to encourage students to use LaTeX and to provide templates where appropriate.

Some students felt there were problems with timing. Due to circumstances beyond our control, there was extra time allocated to the Research Report in 1999. This seem to have worked fairly well, and this will happen again in 2000. A side-effect of this is rearrangement of the time for IRM but the details of this have not yet been finalised.

8 Conclusion

Our current view is that the IRM course has been a success, supported by feedback from both staff and students. We still see the Research Report as being the most important research component of the Honours programme, but the IRM course has shown that it can play a valuable supporting role, and hence we intend to keep it. This is not a view taken lightly—our Honours programme is very intensive and so we have to choose carefully what we put in and what we take out. In summary, the advantages of the course are:

- it gives students insight into the nature and methods of research
- it prepares students better for the research report that they must conduct
- we can introduce many research-related concepts, that would otherwise only be learned by trial-and-error or through considerable effort from the supervisor
- it gives a student a broader background into research methods in computer science (i.e. they are exposed not only to the research method they use for their research project, but other approaches that would be suitable for different types of problems).

In 1999 we made some modifications to timing, content and presentation, and this appears to have made some improvement. We are still struggling with some issues, mainly related to resources available: what material to cover and how to cover it; workload for staff and students etc. A related issue is involving more staff in the running of the course. We expect that it will take a year or two more before the course is fully developed but we believe it has already made a difference to our students' understanding of research.

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A Questionnaire and sample

The students were asked to complete the questionnaire given in Table 8, during the last twenty minutes of a scheduled lecture slot. Not all students were present at the lecture, but the rest were in the Honours workroom and were also asked to complete the questionnaire at the same time. Those that completed the questionnaire in the workroom did so in less controlled surroundings than those in the lecture room.

B Original data and analysis

Generally the questionnaires were well completed, however there were a few incomplete questions and incorrectly completed questions. The raw data for Question 1 and 3 is given in Table 9. As can been seen there are two missing values which represent 'Don't Know' answers and are not used in the calculation of the average.

For Question 2, a number of rankings were not completed correctly, in that there were repeats of ranks and missing ranks. These 6 incorrect rankings were excluded from the analysis. They are indicated in Table 10. Moreover, it became clear on further analysis of the questionnaire that some respondents had inverted the rankings and used 9 to indicate the most useful and 1 the least useful. These rankings were modified.

For the rest of the questions which were essentially open-ended, the responses were examined and a number of categories were devised.

Evaluation of our courses is important to us, from both a teaching and research point of view. Evaluation enables us to develop and improve them, and also to let other educators know about our successes and failures. Therefore, I would appreciate if you could complete this survey, as your opinions are valuable to us. *All responses will be treated in confidence.*

1. Generally, I found what I learnt in the IRM course useful for the research report (circle one of the following)

   Strongly agree *Agree* *Neutral* *Disagree* *Strongly disagree* *Don't know*

2. Rank the following from 1 to 9 in order of usefulness for the research report, where 1 is the most useful and 9 the least useful.

Phase 0	lectures about research methods, small group work, test	
Phase 1	reading, summarising and being tested on a paper	
Phase 2	presenting a paper	
Phase 3	comparing and contrasting two research papers	
Phase 4	doing an annotated bibliography	
Phase 5	doing a literature review and presenting it	
Phase 6	defining a research hypothesis and how to test it	
Phase 6	refereeing a research report	
Phase 7	writing a prototype research proposal	

3. Specifically,

   (a) I found the lectures on research methods (Phase 0) useful for the research report
   Strongly agree *Agree* *Neutral* *Disagree* *Strongly disagree* *Don't know*

   (b) I found the presentations (Phases 2 and 5) useful for the research report
   Strongly agree *Agree* *Neutral* *Disagree* *Strongly disagree* *Don't know*

   (c) I found the contrast and compare (Phase 3) exercise useful for the research report
   Strongly agree *Agree* *Neutral* *Disagree* *Strongly disagree* *Don't know*

   (d) I found the annotated bibliography (Phase 4) useful for the research report
   Strongly agree *Agree* *Neutral* *Disagree* *Strongly disagree* *Don't know*

   (e) I found the literature review (Phase 5) useful for the research report
   Strongly agree *Agree* *Neutral* *Disagree* *Strongly disagree* *Don't know*

   (f) I found the research hypothesis exercise (Phase 6) useful for the research report
   Strongly agree *Agree* *Neutral* *Disagree* *Strongly disagree* *Don't know*

   (g) I found the refereeing of a research report (Phase 6) useful for the research report
   Strongly agree *Agree* *Neutral* *Disagree* *Strongly disagree* *Don't know*

   (h) I found the prototype research proposal (Phase 7) useful for the research report
   Strongly agree *Agree* *Neutral* *Disagree* *Strongly disagree* *Don't know*

   (i) Generally, I believe what I learnt in the IRM course will be useful for my career.
   Strongly agree *Agree* *Neutral* *Disagree* *Strongly disagree* *Don't know*

      i. If Agree or Strongly Agree, which phases or aspects will be most useful?
      ii. If Disagree or Strongly Disagree, why not?

   (j) I believe the research report would have been more difficult without the IRM course
   Strongly agree *Agree* *Neutral* *Disagree* *Strongly disagree* *Don't know*

4. Any other comments about the IRM course? (was it enjoyable, how was the timing, was the involvement of other staff members useful, etc.)

5. Any changes that should be made next time the course is presented?

6. Do you plan to do a further research degree?

   (a) Where and when do you plan to do it?

   (b) If you are not considering doing a further research degree, why is this the case?

   (c) When did you decide to do or not to do a further research degree?

7. Did you use LaTeX for preparing documents during IRM and RR?

   (a) If you did use it, did you find the template documents helpful?

   (b) If you did use it, how easy did you find it to use?

   (c) If not, why didn't you use it?

   (d) Any other comments about using LaTeX

Table 8: Questionnaire

1	3(a)	3(b)	3(c)	3(d)	3(e)	3(f)	3(g)	3(h)	3(i)	3(j)	
4	2	3	3	2	2	4	1	4	2	5	
5	4	4	2	4	4	2	5	5	5	5	
4	4	4	2	2	3	4	3	4	3	4	
5	4	4	4	4	4	5	4	5	4	4	
5	4	4	2	3	3	4	2	4	4	4	
5	5	3	4	4	4	4	3	5	5	5	
5	4	5	4	3	4	4	4	5	4	5	
4	4	4	4	5	4	4	3	4	3	5	
5	4	5	5	2	4	4	5	4	4	4	
5	3	4	1	1	5	5	3	5	4	5	
4	4	4	2	2	2	4	4	4	3	3	
4	3		3	4	4	4	3	4	4	4	
5	4	4	4	3	3	4	4	5	3	5	
5	3	5	4	3	5	4	4	5	5	4	
5	4	5	4	5	5	5		5	4	4	
4	3	4	3	3	5	4	5	5	4	4	
4	3	5	3	4	4	4	4	5	5	5	
4.59	3.65	4.19	3.18	3.18	3.82	4.06	3.56	4.59	3.88	4.41	Average
17	11	14	8	7	12	16	9	17	12	17	Agree
100	64.71	82.35	47.06	41.18	70.59	94.12	52.94	100	70.59	100	%
	5	2	4	5	3		5		4		Neutral
	29.41	11.76	23.53	29.41	17.65		29.41		23.53		%
	1		5	5	2	1	2		1		Disagree
	5.88		29.41	29.41	11.76	5.88	11.76		5.88		%

Table 9: Raw data and statistics from Questions 1 and 3

P0	P1	P2	P3	P4	P5	P6	P6	P7	
3	7	5	6	8	4	2	9	1	
									Rejected
1	4	3	9	8	5	3	3	1	Rejected
7	6	3	3	4	4	2	2	1	Rejected
2	6	2	7	6	2	1	4	3	Rejected
8	7	6	4	5	3	2	9	1	
7	9	3	2	8	4	1	6	5	
8	7	6	4	5	2	3	9	1	
8	7	1	2	9	4	6	5	3	
5	6	3	7	8	1	4	9	2	
5	5	3	6	7	7	3	4	3	Rejected
7	6	8	4	5	2	1	9	3	
4	2	5	7	9	8	6	3	1	
7	8	2	6	9	1	5	4	3	
5	8	3	3	2	1	1	8	1	Rejected
8	9	7	6	5	2	4	3	1	
9	8	2	7	4	3	5	6	1	
		1			2	2		6	First
		9.09			18.18	18.18		54.55	%
1	1	5	2		7	5	2	10	Top 3
9.09	9.09	45.45	18.18		63.64	45.45	18.18	90.91	%
8	8	2	3	6	1		5		Bottom 3
72.73	72.73	18.18	27.27	54.55	9.09		45.45		%
1	2			3			5		Last
9.09	18.18			27.27			45.45		%

Table 10: Raw data and statistics from Question 2