

A Research Methods Course in IT

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Abstract

Information Technology differs from most other disciplines in that the object of study is usually not a natural or human phenomenon — often the intention of research is to show that something can indeed be done in some ‘elegant’ way. This differs from most natural or social sciences where researchers observe (or experiment with) natural phenomena. This does not mean that the usual research methods of other natural and social sciences — such as experiments and surveys — are not used in Information Technology research. They are indeed used, but they are supplemented by methods such as constructing models, building prototypes and mathematical argumentation. Only if a (new) researcher knows the tools that are available for the trade will this person be able to select the appropriate tool.

This paper describes the author’s experience with teaching such a course at various educational establishments.

1 Introduction

Many subjects view themselves as a ‘science’, as can be seen in the prefaces to textbooks on those subjects. Often this view is further motivated by introducing students to the approach to doing research in the particular subject early in the student’s undergraduate studies. These descriptions of research methods are often rigorous guidelines that are to be followed and are indeed reflected in research done in those subjects on postgraduate level. In some cases, research methods become a recipe that almost guarantees success for a postgraduate degree if carefully followed.

Explicitly prescribing a specific research method happens less often in natural sciences than it happens in some other disciplines, but the nature of natural sciences is often such that research is a natural extension from the approach that a subject follows during initial training in the subject: Proving a new mathematical theorem is not unlike proving a well-known theorem by a first-year Mathematics student; doing an experiment in Physics by a first-year student is not unlike doing an experiment for true research. The major differences between education and research in cases such as these

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are that (1) it is harder to find a proper question for research purposes than for educational purposes and (2) fewer clues usually exist to answer the research question than is the case in an education setting where the context often provides many clues.

Computer Science is one of very few subjects that proclaims itself as a science in its name; very few textbooks attempt to motivate this in any way. In addition, the skills that are instilled during pregraduate education of students are vastly different from that expected from someone doing research in the subject. Skills such as programming, database design, software engineering, networking, etc often focus on the engineering side of the discipline, rather than on the research side. When students do progress to a research-based qualification such as many master's degrees and doctoral degrees they are expected to acquire research skills on their own (in consultation with their study leaders or promoters). Our interest is not only in Computer Science, but in the broader discipline of *Computing* or *Information Technology (IT)*.

The premise of this paper (and of the courses it describes) is that a student who is introduced to research skills formally, is not only able to make the transition to research easier, but should also be able to apply research methods in his or her work environment even when the student is not interested in postgraduate studies or research *per se*.

This paper is structured as follows: Section 2 contains some background information. Section 3 outlines the course and section 4 outlines the author's major experiences from presenting the course. Section 5 concludes the paper.

2 Background

Many books have been written about specific research methods and many of those methods are applicable to Information Technology. Examples include surveys (see [2] for an example), experiments (see [3] for an example), case studies (see [8] for an example), and many more. In most cases such books are useful to the student in Information Technology, although they often include variations of those methods that are seldomly seen in Information Technology research. A skilled researcher is often able to ignore those variations, but this may be problematic to the new researcher. Published books that focus specifically on research methods in Information Systems do exist (see [5], for example), but the emphasis of those books is also on empirical research methods as commonly used in the social sciences.

In addition to the specific research methods, a course on research methods typically covers scientific writing. Again many books exist that may be used as the basis for this — see [7] for example. One shortcoming that exists in many of these texts is the fact that some of them prescribe a particular form of referencing other texts, such as the Harvard system, while references in Information Technology often tend to be more flexible and do not fully adhere to a specific system. An innovative approach to teach communications skills is presented in [1] where a student conference is used as basis; however, their intention to have research methods taught by their Education department

rather than by their Computing Science department is fundamentally flawed for the reasons given above.

Research Methods courses in IT are apparently becoming more popular. A search on Northerlight.com for the terms "research methods course" "computer science" yielded over 500 results, many of which are applicable (search conducted May 2000). The need for such courses is further evidenced by local reports such as [4].

3 The course

The Research Methods course considered by this paper originally developed from a need expressed by technikon where their fourth-year BTech-students are expected to complete a Research Methods course, but where the generic course available from the technikon is only partially applicable to IT-students for the reasons described in section 2.

The particular approach was developed by the author while presenting a course at Pretoria Technikon in 1997 and used in 1998 and 1999 at Wits Technikon. He has also used the approach to present honours-level courses at RAU in 1999 and 2000. The material used for the course [6] has been used at various other universities and technikons in South Africa as the basis for their courses.

The primary focus of the course is to expose students to research methods that are commonly used in Information Technology research, such as literature surveys, models, prototypes, mathematical proofs, experiments, surveys and case studies. The focus is on breadth, rather than depth, since it is assumed that a student who needs a more detailed acquaintance with a particular method will easily find material on that method; this is in contrast with a student who is faced with a research problem and do not know which options exist to address the problem and therefore does typically not know what he or she is looking for.

While the course gives an overview of each method, students are expected to experience the methods in practice by reading relevant research papers (and are expected to evaluate those research papers).

The course also addresses scientific writing, presentation of papers and other relevant issues such as reasons for doing research in the first place.

Evaluation of the course combines a number of elements: written reports on the research papers that they evaluated as well as a (research) report of a (small) research project that they are expected to complete and an oral presentation on their research project. The reports have to be written in the style of a scientific paper and the oral presentations are handled in the style of a conference.

4 The experience

While it seems that the course is received well by most students, a number of problems have been highlighted over the years and will receive particular attention in future.

This paper presents the experience from the author's point of view. Little has been done thus far to correlate these observations with observations from other lecturers.

Firstly, it has been noted that students, who have had very little exposure to research papers, have trouble identifying suitable papers from the university library to study. This happens because either they do not have the required (technical) background to follow the papers they consider, or the application of particular research methods are not entirely clear. To address this problem a compendium of papers is currently being compiled that should give students a wide overview of the various methods. Stated differently, with such a compendium of papers, students will be able to read many more 'suitable' papers, rather than hunt for a few 'suitable' papers.

Secondly, even though the (lack of) scientific quality of material found on the Internet is stressed, it seems that students are becoming less and less able to find material from other sources (such as the library). A minimum number of references has always been set for their research paper; it seems that a minimum number of non-Internet references may have to be set in future. Obviously this does not apply where the material found on the Internet has appeared in another form, where it has gone through a peer or other suitable form of review.

Thirdly, plagiarism is a recurrent problem. This ranges from students who submit others' work without modification, through students who cut and paste others' work to students who quote others' work without explicitly marking it as a quotation. It seems that training in pregraduate years where students are encouraged to use published algorithms, existing libraries and canned solutions makes them less sensitive to the fact that plagiarism is a crime. Plagiarism has been observed by the author in enough institutions to know that the problem is widespread. A search on the Internet reveals that many lecturers are faced by the same problem. This is further illustrated by the fact that at least another research methods course [1] explicitly lists plagiarism as one of the aspects considered when evaluating students' work. In the course described in this paper, significant attention is given to the ethical and legal aspects of plagiarism. In addition, a known evaluation schema that highlights aspects that are expected in student's papers and that do not commonly occur in papers found (especially) on the Internet seems to be effective.

Finally, the major problem experienced by students are finding a suitable research question for the course. While possible topics are discussed during the course, many students prefer to select a brand new topic for research. In 2000 this was evidenced, for example, by a number of students who were interested in WAP (*Wireless Application Protocol*). However, turning from such an area to a suitable research question seems to be non-trivial to students. This is currently handled by expecting students to discuss their research question with the lecturer before commencing their research. In addition to the problem of finding a suitable research question, students often select questions

that cannot realistically be expected to be answered in the time available to them during such a course; it is often necessary to discuss how to limit the scope of the questions they have selected with them.

During these individual discussions students are also often confronted with the question how they intend addressing the question. This often highlights problems they are experiencing with individual research methods. Very often, for example, if they intend doing a survey, they have not carefully considered sample selection. And, while limiting the scope to a very small aspect during such a course is acceptable, selecting a non-random sample is not.

5 Conclusion

This paper described some observations the author has made during presentations of a Research Methods course in IT. These observations are presented in the hope that it may further stimulate teaching of Research Methods in IT. They are also presented in the hope that they may serve as input to a proper scientific consideration of the value of such a course in the first four years of a relevant qualification.

References

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