Topic: How to do a Research Process

Introduction

Most of undergraduate students begin to learn the research process when they are preparing the bachelor thesis. They learn it on their own using trial and error. Students waste much effort in the process and are frequently driven to frustration.

Because the research is an integral part of the Masters Course, you need a lot of special knowledge about it.

1. What is Research?

Good research practice suggests that we should begin by defining our terms. The Oxford Concise dictionary defines research as:

1. the systematic investigation into and study of materials, sources, etc, in order to establish facts and reach new conclusions;
2. an endeavour to discover new or collate old facts etc by the scientific study of a subject or by a course of critical investigation.

This definition is useful because it immediately focuses upon the systematic nature of research. In other words, the very meaning of the term implies a research method. These methods or systems essentially provide a model or structure for logical argument.

However, this definition is not sufficient. In a real life it is known that the research isn't information gathering, because:

- Gathering information from resources such books or magazines isn't research.
- No contribution to new knowledge.

Also, the research isn't the transportation of facts, because:

- Merely transporting facts from one resource to another doesn't constitute research.
- No contribution to new knowledge although this might make existing knowledge more accessible.

Is possible to assert that the research is "…the systematic process of collecting and analyzing information (data) in order to increase our understanding of the phenomenon about which we are concerned or interested" [Leedy P. D. and Ormrod J. E., Practical Research: Planning and Design, 7th Edition. 2001].

Accordingly, is possible to point the main characteristics of the research:

- Originates with a question or problem.
- Requires clear articulation of a goal.
- Follows a specific plan or procedure.
- Often divides main problem into subproblems.
- Guided by specific problem, question, or hypothesis.
- Accepts certain critical assumptions.
- Requires collection and interpretation of data.

Research may be categorized as either Basic or Applied:

- Basic research looks at causes, effects, and the nature of things
- Applied research tries to find answers and solutions to specific problems.

Generally, the research focuses on "solving problems" – at minimum, as it concerns "Computer Science", answering the defined research question(s). Otherwise, research addresses the perceived "problem" of missing or inadequate information on a particular topic.

Research begins with a problem. Identifying this problem can actually be the hardest part of research.

NOTICE: This problem need not be Earth-shaking.

Many of us have professional experience which can lead to possible research. Always be careful to differentiate between research and self-enlightenment. In general, you can search the Research Problems in these sources:

- Observation.
- Literature reviews.
- Professional conferences.
- Experts (look on [1], for examle).

When examining a potential research topic, for instance when reviewing the different phenomena introduced in "action research" narratives and searching for an explanatory perspective, the following types of questions may be useful. They may help identify a "problem" to be researched, or a hypothesis to be applied to a problem:

- What is actually happening in this situation
- Would it still happen this way if …
- In this context, if X does this, would Y then …
- What causes X to react to Y in this way

More concretely, when reviewing possible research "problems," your questions could include the following [points 1-3 would be preliminary to posing a theoretical approach, with points 6-8 required to 'test' the theory. Points 4-5 develop the working theory (or hypothesis) itself]:

1. What bothers you about a particular "problem"? What information seems to be unclear, or incomplete, or missing, or improbable as stated?
2. What are the essential concepts and issues relevant to the problem?
3. Does the description or implementation of the problem vary? If so, how and why?
4. Can you state a relationship between the variables of your problem?
5. Can you hypothesize an answer?

6. Can you collect primary and secondary data to test the hypothesis?
7. Can you collect original data to further test the hypothesis?
8. Is the problem you identify part of a larger problem?

Once you've identified a research problem, state it clearly and completely and determine the feasibility of the research.

2. The Research Process

Generally finished research project includes the following stages:

1. identify research area;
2. design research study;
3. carry out research;
4. analyse research results;
5. publish research results.

As you see, the research process is the step-by-step procedure of developing one's research. However, one can seldom progress in a step-by-step fashion as such. Therefore, research is an extremely cyclic process. For example, later stages might necessitate a review of earlier work. This isn't a weakness of the process but is part of the built-in error correction machinery. Because of the cyclic nature of research, it can be difficult to determine where to start and when to stop. Hence, in practice, points 1-4 should be realized as follows (more detailed):

Step 1: A Question Is Raised

A question occurs to or is posed to the researcher for which that researcher has no answer. This doesn't mean that someone else doesn't already have an answer.

The question needs to be converted to an appropriate problem statement.

Step 2: Suggest Hypotheses

The researcher generates intermediate hypotheses to describe a solution to the problem. But this is at best a temporary solution since there is as yet no evidence to support either the acceptance or rejection of these hypotheses.

Step 3: Literature Review

The available literature is reviewed to determine if there is already a solution to the problem. Important thing to remember:

- existing solutions do not always explain new observations;
- the existing solution might require some revision or even be discarded.

Step 4: Literature Evaluation

It's possible that the literature review has yielded a solution to the proposed problem. This means that you haven't really done research. On the other hand, if the literature review turns up nothing, then additional research activities are justified.

Step 5: Acquire Data

The researcher now begins to gather data relating to the research problem. The means of data acquisition will often change based on the type of the research problem. This might entail only data gathering, but it could also require the creation of new measurement instruments.

Step 6: Data Analysis

The data that were gathered in the previous step are analyzed as a first step in ascertaining their meaning. As before, the analysis of the data does not constitute research. This is basic number crunching.

Step 7: Data Interpretation

The researcher interprets the newly analyzed data and suggests a conclusion. This can be difficult. For example, you have to remember that data analysis that suggests a correlation between two variables can't automatically be interpreted as suggesting causality between those variables.

Step 8: Hypothesis Support

The data will either support the hypotheses or they won't. This may lead the researcher to cycle back to an earlier step in the process and begin again with a

new hypothesis. This is one of the self-correcting mechanisms associated with the scientific method.

3 General advice

There is a bewildering diversity of research methods being used within the field of Computing Science (look in [3], for example). Methods choosing is often depends on the nature of the problems of research. However, there is a number of factors affect the success or failure of research, irrespective of the method that is being used:

- Clear problem definition.

If you don't understand the problem clearly then it is unlikely that you will arrive at a reasonable solution. This is an obvious remark. However, many research projects do little more than re-express a problem in a form that can then be addressed by subsequent research.

- Well defined research context.

There is a danger that you will `re-invent the wheel' if you do not have a good grasp of previous work in an area. Today we are well provided with web-based search engines, the University library is well equipped and staffed, the Department has many researchers who would be very willing to help you with advice and encouragement. It is critical that you spend some time consulting these sources BEFORE you embark on any research project. Otherwise you will find yourself repeating work that others have done before you. However, many research projects actively seek to replicate the results of previous investigations. This must be an explicit objective of your research and not an unfortunate product of poor planning.

- Good documentation.

It is critical that you spend some time documenting your daily activities when engaged on a research project. For example, it is common to find a vital URL or book reference and then lose it by not making a careful note or bookmark. Given that most research is conducted under time pressure, you only have three

years for most PhDs and under a year for an MSc, you cannot afford to waste time looking for such lost resources. A good rule of thumb is that it must be possible for someone else to follow your steps from your notes alone.

- Effective time management.

Research is labour intensive. It takes time to find books. It can take days to complete a proof. It can take weeks to complete a program or run a set of experiments. It can take many months to write up a thesis or dissertation. You will run out of time if you do not carefully plan your allocation of time to each of these components. It is also important that you plan for failure. Vital pieces of your research infrastructure can and do fail. For instance, printing resources are often stretched to breaking point in the hours before a deadline.

Conclusion

The research skills are the most important skills to have on the Master's programme because most of students didn't learned them before.

In this course we'll learn these main skills:

- reading for information;
- analyzing sources for meaning;
- organizing information (outlining);
- presentation of the research data in textual and oral forms, and other.

Self-study materials

1) Jason Eisner. How to Find Research Problems. 2013. URL: http://www.cs.jhu.edu/~jason/advice/how-to-find-research-problems.html.
   Abstract: Tips for new Computer Science Ph.D. students of the University of Pennsylvania.
2) Ian Watson. Introduction to Research in Computer Science. URL: https://www.cs.auckland.ac.nz/~cristian/i2rcs/ian_lecture02.PDF.
   Abstract: This article describes two alternative approaches to defining and realizing the Research Process.
3) Chris Johnson. What is Research in Computing Science? URL: http://www.dcs.gla.ac.uk/~johnson/teaching/research_skills/research.html.
   Abstract: In article were been described several most used methods of research in Computing Science.