

Dublin City University
School of Computing

CA640: Research Skills

Part 1: Introduction to Research

Why Research Skills?

- To learn the processes of scientific research:
 - Forming a research hypothesis
 - Literature review
 - Planning the investigation
 - Analysing results
 - Reporting your findings
- Preparation for the MSc Practicum

Transferrable Skills

This module will give you the opportunity to develop the following transferrable skills and probably others as well:

- Locating sources of information.
- Review, interpretation, contrastive analysis and summarised reporting of existing findings.
- Planning (work plans, time plans)
- Team working
- Reporting results (considering the audience, written reports, oral presentation).

Postgraduate Study

- Shouldn't treat it as an extension of undergraduate study.
- Plan to take responsibility yourself for your learning.
- You should not feel restricted to only studying course material.
 - e.g if a topic is interesting feel free to go beyond set material.
 - potential employers/research supervisors will often look beyond your qualifications to find out about your real interest in the subject
 - although you do need to focus on the syllabus and make sure you pass all the assessments!

Introduction to the Research Process

Research is a process through which we attempt to achieve systematically and with the support of data the answer to a question, the resolution of a problem, or a greater understanding of a phenomenon.

- Research is an *original contribution* to knowledge
- A research project (particularly in science and engineering) typically involves developing and testing a hypothesis.
 - If x is true then y is true
 - if a and b occur with c, then they should occur with d as well
- A project may involve the testing of a single (possibly quite complex hypothesis).
- Or the sequential or incremental testing of a number of smaller hypothesis leading to one or more conclusions

Research methodology usually involves

- A clear articulation of a goal.
- A specific plan of procedure.
- A specific research problem, question, or hypothesis.
- The principal problem usually divided into more manageable subproblems.
- Accepts certain critical assumptions.
- Collection and interpretation of data in attempting to resolve the problem that initiated the research.

Introduction to the Research Process

Research projects usually involve a cycle of forming and testing hypothesis

- If the current hypothesis is found to be true, then it is often refined or extended to form a new hypothesis that needs testing.
- If the current hypothesis is found to be false, then the next stage is to refine the hypothesis or to develop a new hypothesis which explain the result. The new hypothesis needs to be tested.

Thus research in a topic area is a never ending process of extending knowledge by hypothesis and testing

Fortunately, research degrees and even larger projects only need to make a appropriate contribution to be deemed successful.

Assessing Contribution

- Appropriate contribution varies depending on the qualification sought
 - MSc/MPhil requires less than a PhD
- Personal guidance on this should be available from your research supervisors
- It is also a good idea to look at some existing successful dissertations for the same degree from previous students from your course or School
- At the end of the day the decision of success or failure rests with the examiner
- Qualified researchers continue to face this situation repeatedly every time they submit work for publication or proposals for research grant funding. Reviewers will read and accept or reject their submission!

Research Training

- A postgraduate research project is a training qualification in conducting research within your discipline (Different disciplines can have different approaches)
- Reflection on your experience is a useful part of the learning process. So you might usefully ask questions such as
 - Did I spend too long reading before starting the experimental work?
 - Did I start the experimental work without sufficient literature review? Was this the best design of experiment possible to make maximum use of my time?
 - Did I wait too long to discuss this problem with my supervisor?
 - Did I rush to speak to my supervisor too quickly?

Research Projects

- A research project may be very clearly defined at the start with a well defined single hypothesis or series of hypotheses to be tested.

At the other extreme

- the project may only be vaguely defined. Supervisor decides “ this is an interesting area to work in, there are lots of interesting ad unsolved problems. let’s start work and see where it leads to

The first option is generally “safer” but often less exciting with less scope for sufficient personal contribution from the student.

Research Projects

A word of caution

- Beware of being the eyes and hands of the supervisor in the lab or office.
- It's great to get strong and enthusiastic support and guidance, but you will be assessed on what *you* have done.
- If you are concerned that you are not getting enough support or guidance, or that you are not getting enough freedom to develop your own ideas, discuss your concerns with somebody.
 - supervisor, course director, practicum coordinator, friends/colleagues.

Getting Started: Familiarity with the Literature

Goal: Find out what has been done and who has done it.

This is vitally important since it:

- delimits the research problem;
- identifies new and current approaches and trends;
- helps in identifying and understanding methods.
- helps prevent you replicating existing work (you might want to repeat existing work if you believe it to be deficient or that a reassessment would be timely for some reason.)

Getting Started: Familiarity with the Literature

Relevant literature can come from many sources:

- List of Abstracts
- Dissertations
- Journals/conference proceeding
- Books
- Web (Google Scholar)

Getting Started: Familiarity with the Literature

Observe

- be open minded
- work backwards, - z cites y which cites z - can lead to the key sources
- contrast sources and different types of knowledge
- evaluate content and style
- beware “common knowledge”
- keep review up to date as you find your references
- synthesis and reference

Identifying a Research Question

Observe

- Why is a particular experiment/methodology less than satisfactory?
- What can be learned by studying current practice?
- Why are some topics difficult to learn?
- Why are some topics measurements difficult to make?

Identifying a Research Question

Derive

- inspiration from published work, e.g. seek to verify, replicate, refute, extend, update.
- apply existing theory to your work.
- resolve conflicting and contradictory findings.
- correct methodology in earlier work.

Identifying a Research Question

Avoid

- Unresearchable topics: Is the topic amenable to methods proposed.
- Trivial topics: Is the answer obvious? Will you learn anything? is there any contribution to knowledge?
- Overworked topics: Do you have a new slant?

Identifying a Research Question

Consider

Personal Factors:

- Interested? Unbiased?
- Background and Skill?

Practical Factors:

- Equipment, tools, participants, TIME AVAILABLE?

General Factors:

- Will the data/method be applicable, new, worth having?

Steps in a Project

- Problem definition
- Purpose
- Literature review
- Methodology
- Data collection and analysis
- Write up

Conceptual framework

A conceptual framework

- outlines possible courses of action or presents a preferred approach to an idea or thought.
- is a type of intermediate theory that have the potential to connect to all aspects of inquiry (e.g., problem definition, purpose, literature review, methodology, data collection and analysis)
- is like a map that give coherence to the inquiry

Some Common Mistakes

- Poor definition of context- lack of theoretical or conceptual framework
- Poor Basis- unsupported claims and assumptions
- Data/Method,- without a defined purpose.
- Fitting Questions to a “batch” of data.
- “One Shot” research - conducting research unique to a given situation, permitting no expansion or generalisation.
- Failure to make assumptions explicit, recognise limitations of approach, anticipate alternatives.

Some Common Errors in Planning

- Time Available: everything takes longer than you think.
- Availability of data, software, equipment, is it here now? When will it (really!) arrive? Will it be here soon enough?
- Compromising: Limiting the scope of the investigation too soon. Not exploring the alternatives sufficiently.

Research Life

- Researchers have good days and bad days. Some things work and some things do not.
- Negative results can lead to the greatest insights or new ideas.
- Research can be highly creative, rewarding, potentially satisfying and even fun

Tools for Research

- Library
- Web (Scholar)
- R statistical and graphical system (Analysis)

Download from web at <http://cran.r-project.org/>

- Latex (Writing up)

Reference: Helmut Kopka, Patrick W. Daly (2003).
A Guide to Latex, 4th ed, Addison-Wesley

– 24 Hour Loan 686.22544536/KOP

– Main Lending 686.22544536/KOP

Download from web.

TexnicCenter, a front end tool for Latex, can be obtained at <http://www.toolscenter.org/>