Part 2: Research Quality and Creativity

CA546/CA625: Research Skills

MSC in Software Engineering
European Masters in Business Informatics
MSC in Bioinformatics

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It can take skill and imagination to spot such hidden useful nuggets.

Poor research may nevertheless contain the essence of a good idea.

Experimental methodology, analysis of data, reporting, etc.

Limited clear:

Good research will in general make its aims and objectives, claims and

and to assess the strengths and weaknesses of each.

It is important to learn to distinguish good research from poor research.

What contributes to good research?

Introduction
The usual starting point for research, whether or not you are starting with a clearly defined research problem, is to read about the subject:

- Find out about the background.
- Identify unanswered questions or controversies.
- Can lead to small scale investigations or pilot studies.
- Breaking down questions or hypotheses. Once the problem is defined it can be broken down into a set of specific

Questions and hypotheses are referred to as "operationalizing".

This should help suggest the most appropriate line of investigation.
Literature Review

Ask yourself:

- Does each one seem to define the research problem explicitly, e.g. as a list of hypotheses?
- Does the focus emerge as the research progresses?
- Is there any indication that the research problem changed in direction or emphasis during the research?

Exercise: scan (do not spend time reading them in detail) through some research papers or existing dissertations or theses.
Research Methodologies

A research methodology is a rationale for gathering and processing data, deciding on what sequence and what data to use. It is a well-informed and argued case for designing a piece of research in a particular way. Good argument involves paying attention to counter-arguments, and in general justifying your choice against the alternatives.

Exercise: Look for how the methodologies are argued for in some papers and theses; do the arguments seem reasonable to you? Are there omissions or untroubling assumptions?

Research Methodologies
Competence in Research

Exercise: When reading papers and theses consider whether you think that data collection exercise from being repeated?

- Constraints of time, location or availability of resources can prevent a
- The data is know to be accurate.
- Important line of investigation. Such observations can only be trusted if
- Sometimes something important can turn up leading to a new and
- Can inspire confidence in the solution.
- Accurate as possible.

Data collection in research investigations needs to be as relevant and

___ Competence in Research ___
A paper or thesis should be much more than a presentation of the data collected in your research. Evidence can be from the literature (properly acknowledged) or data gathered forward. Evidence has to be collected and presented to take the argument forward.

To make a case:
The notion of arguing a "case" in the manner of a lawyer can be useful here. Specific solutions to a research problem. It should be a well-documented and well-argued case for one or more specific solutions to a research problem. A paper or thesis should be much more than a presentation of the data collected or a report of the work carried out.

Academic Argument and Academic Discourse
Academic Argument and Academic Discourse

- It is vital to distinguish between existing work from literature and your own work - plagiarism is a serious offence in research degrees (and in research in general).

- Counter arguments need to be explored and dealt with rigorously and fairly.

- The language in which the case is argued should be precise and clear, and not be clouded with irrelevancies.

- Selecting what to include and what not to include requires careful thought.

- A thesis or paper should develop the argument like a lawyer; not report events like a journalist!
When reading a research article try to identify the case being made for the presented research. When reading a research article try to identify the case being made for the presented research.

Look in particular at:

- the abstract.
- the first and last paragraph of each chapter or section of the report.
- the first and last paragraph of the article.

Do you find the arguments convincing?

Do you feel anywhere that the cases are blurred with "padding"?

Do you feel that counter arguments are dealt with fairly?

Academic Argument and Academic Discourse
Research Outcomes

Research sometimes throws up important unexpected findings which can change the anticipated direction of the research. You should be alert to this possibility in your own work. If something unexpected does turn up, you should then be able to spot it, recognize its potential significance, and consider whether to change research direction.

In order to spot unexpected results, you should try to predict what sorts of outcomes you expect to see. If something unexpected does turn up, you should then be able to spot it, recognize its potential significance, and consider whether to change research direction.
Use of Literature

Literature should be used as "evidence" to support argument and counter-argument in building a research "case".

Merely lists of references in a catalogue style are not acceptable.

Direct quotations should only be used for purposes of illustration, not to replace your own original case.

But, in a thesis, you need to show a thorough reading and knowledge of the field, so you need to work carefully to bring references to other work meaningfully into your discussions.

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Exercise: Look at the citation of literature in papers and dissertations.

Use of Literature

- Something else?
- Validity or limitation of data, findings, conclusions?
- Suitability of research design?
- Gap in knowledge?
- What type of case are they supporting:
  - A mixture of both?
  - As evidence to make or support a case?
  - Mere to illustrate knowledge?
- To what extent is the literature used?
Presenting data is not enough. It has to be processed and meaning imposed on the findings. Presenting data is not enough.

Exercise: Scan papers and dissertations.

Have the authors argued the cases for their findings or conclusions? Has the data been processed appropriately? Meaning something? Is there any argument for the limitations or conditions for which that meaning is valid?
Originality and Significance

A thesis or research article should make its claim for original contribution clearly, even if only implicitly. Sometimes significance is clear, other times it is not, and examiners (or reviewers) may sometimes disagree over the contribution of the work.

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- The higher the level of degree (or publication?), the greater will be the expected degree of significance.

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- In general, it is better to state your claims to contribution clearly and succinctly in the Introduction and Conclusions, so that there is no chance of the examiner or reviewer missing them.

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Reliability of Research

If other researchers can repeat a piece of research and obtain the same results, it is said to be entirely reliable.

For numerical data the results are generally reproducible, although there may be questions over the reliability of numerical values, e.g.: the competence with which the data was collected.

Experiments with human subjects based on subjective answers, e.g.: happy, tired, cannot be exactly replicated by others in other places at other times.

Consistency of the instruments used to collect them.

The competence with which the data was collected.
Validity of Research

Where a piece of research achieves its objective it is said to be valid.

Validity of Research

Reliability can be increased, e.g., by double marking.

But marking essays will be less reliable, since opinions may vary.

Processes, as well as outcomes, essay questions are more valid.

If an important part of the assessment is to understand thought, be marked the same.

The most reliable form is tick-in-the-box answers, since they will always be marked the same.

Consider student assessment.

Valid and reliable can be hard to achieve at the same time.

Where a piece of research achieves its objective it is said to be valid.
Creative thinking in research can be encouraged through the use of various techniques — some obvious, some not so obvious. 

- Metaphor, analogy, hunches, etc.
- Ideals, new ideas themselves often originate in very different ways:

  While logical analyses can be used as a critical tool for the refinement of research, it is often thought of as involving only logical analysis.
How Does Intellectual Creativity Work?

Common elements of a creative solution for most people:

- There can be considerable time spent „mulling over“ the problem before arriving at a solution.
- There is no way of predicting how long this might take!
- The idea for a solution just „pops into their head“.
- Usually when they are not thinking about the problem, or probably anything else either.

Once the creative part of the problem solving is over, hard ground work needs to be done to develop a real practical solution to the problem.

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The following are some techniques which can prove useful in developing creative research:

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Talking things over with other people not only provides the benefit of their views and ideas, but people often find that the very act of talking seems to stimulate their own thinking.

You may choose to talk with an expert in the field in order to get their ideas or comments.

However, this is not necessary if you are talking things over to facilitate your own creativity.

The person merely needs to give you their time and commitment to listen to what you are saying.

Talking Things Over
Keeping an Open Mind

It's easy to close your mind to alternative solutions or interpretations of the data available to you.

Keeping an open mind is particularly important when talking to others;

• Consider if any might have any validity.

Try to keep an open mind by doing the following:

Identify all the unlikely or seemingly implausible interpretations and without it, one is liable to "hear" (i.e. "take in") what one is expecting to hear rather than what might actually be said.

Keeping an open mind is particularly important when talking to others;
Brainstorming is a well-known problem-solving technique, but may not always be useful in academic research.

Brainstorming is normally carried out in groups, but can be done individually.

It consists of listing as many ways to move the situation forward as possible, however improbable each suggestion might be, without pausing to evaluate them.

Only when the list is complete is the value and feasibility of each possibility considered.

Brainstorming
Negative Brainstorming

This can again be done individually or in a group.

Methods.

Negative brainstorming can be useful for solving academic research problems. Nevertheless, negative brainstorming really does have a proven worth. It can produce ideas that would never have been thought of via more direct methods. Nevertheless, negative brainstorming really does have a proven worth. It turns out to be meaningless.

This may seem a useless idea, and many of the reversed ideas often might be productive. When the list is complete, consider whether reversing any of them then, when the list is complete, consider whether reversing any of them. List as many ways as one can think of not to achieve the objective, and then, when the list is complete, consider whether reversing any of them. List as many ways as one can think of not to achieve the objective, and then, when the list is complete, consider whether reversing any of them. List as many ways as one can think of not to achieve the objective, and then, when the list is complete, consider whether reversing any of them. List as many ways as one can think of not to achieve the objective, and then, when the list is complete, consider whether reversing any of them.

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Viewing the Problem from Imaginary Perspectives

• Imagining solving the problem in a different time or place.

• Concentrating on anomalies in a different time or place.

Don’t ignore results that don’t fit the theory.

• Imagining freeing one’s mind and wondering what it would be like to ride on a light ray.

(Einstein is said to have started work on his theory of Relativity by giving his imagination free rein and wondering what it would be like to ride on a light ray.)
Focussing on Byproducts

Look for unexpected results, e.g. unpredicted trends within your results. Even if your results fit your existing theories, look among them to see if there are any other unexpected trends or details which suggest further investigation or require an extension of existing theories.

Interrogating Imaginary Experts

Imagine you are to interview an expert in your field. What questions would you ask? What questions would you ask if you were to interview an expert in your field.

Even if your results fit your existing theories, look among them to see if there are any other unexpected trends or details which suggest further investigation or require an extension of existing theories.

Focussing on Byproducts

Just developing the questions can open up unexpectedly original and valuable ways forward for your research.

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Viewing from the Perspective of Another Discipline

Talk the problem over with people from other disciplines to see how they would approach it. They may not technically fully appreciate your problem, but their comments and ways of exploring the problem may inspire new insights or research ideas.