

U

O

W

# Research Methodology: An Introduction

Dr. Yudi Zhang

Faculty of Engineering and Information Sciences  
University of Wollongong



UNIVERSITY  
OF WOLLONGONG  
AUSTRALIA

# Welcome back!!!

## Everyone is welcome.

UOW takes pride in  
the diversity of our  
community.

Find out more, seek support, or  
join the UOW Ally Network:

[uow.info/ally](http://uow.info/ally)



# Acknowledgement of Country



Photo by artist Samantha Hill



# General Information

- **Lecture:**
  - ❖ **Time: Monday 11:30 – 1:30 pm (for 13 weeks)**
  - ❖ **Check the Moodle site/SOLSMail for this subject regularly!**  
**Any information posted to the Moodle site is deemed to have been notified to all students.**
- **Consultation:**
  - ❖ **Time: Monday/Tuesday 2:00 pm – 4:00 pm**
  - ❖ **Consultation link is available on Moodle**

# General Information

- **Delivered by Dr. Yudi Zhang**
  - ❖ **Lecturer in SCIT, EIS**
  - ❖ **Field: cyber security, cryptography, blockchain...**
  - ❖ **Email: [yudi@uow.edu.au](mailto:yudi@uow.edu.au)**
  - ❖ **Please use your UOW email account for emails**
  - ❖ **Email subject should start with CSIT440/940 with your request, e.g. CSIT440 resource request**
  - ❖ **Do not submit your assignments via email (need Plagiarism check)**

# General Information

- **Who should take this subject**
  - ❖ **Integrated PhD**
  - ❖ **Master of Philosophy**
  - ❖ **Masters in Computer Science & IT/IS**
  - ❖ **Honours**
  - ❖ **Pre-Requisites of other subjects**
  - ❖ **ISIT990 (Professional Practice and Research Project)**

# General Information

- Lecture schedule

Week Beginning	Lecture Topics	Tutorial/Workshop/Laboratory/Demonstration/Field Work	Readings/Other subject information	Task Due
Week 1 26 Feb 2024 (Monday)	Introduction	N/A	Lecture presentations and references therein	
Week 2 04 Mar 2024 (Monday)	Literature reviews and annotated bibliographies	In-class workshop	Lecture presentations and references therein	
Week 3 11 Mar 2024 (Monday)	Research problems	N/A	Lecture presentations and references therein	
Week 4 18 Mar 2024 (Monday)	Research design	N/A	Lecture presentations and references therein	Assignment 1
Week 5 25 Mar 2024 (Monday)	Research proposal and latex	N/A	Lecture presentations and references therein	
Week 6 01 Apr 2024 (Monday)	No Lecture, public holiday. Qualitative research	N/A	Lecture will be recorded.	
Week 7 08 Apr 2024 (Monday)	Data collection	N/A	Lecture presentations and references therein	Assignment 2
15 Apr 2024	Mid-Session Recess			

# General Information

- Lecture schedule

<b>Week 8</b> 22 Apr 2024 (Monday)	Sampling	N/A		
<b>Week 9</b> 29 Apr 2024 (Monday)	Quantitative statistics	N/A	Lecture presentations and references therein	
<b>Week 10</b> 06 May 2024 (Monday)	Quantitative Statistics (continued)	N/A	Lecture presentations and references therein	Assignment 3
<b>Week 11</b> 13 May 2024 (Monday)	Experimental design	N/A	Lecture presentations and references therein	
<b>Week 12</b> 20 May 2024 (Monday)	Case study and ethics	N/A	Lecture presentations and references therein	
<b>Week 13</b> 27 May 2024 (Monday)	Revision	N/A		
<b>03 Jun 2024</b>	<b>Study Recess</b>			
<b>10 Jun 2024</b>	<b>Examinations</b>			
<b>17 Jun 2024</b>	<b>Examinations</b>			



- **Subject Learning Outcomes**

- ❖ Undertake scholarly research through the conduct of a **systematic literature review**.
- ❖ Define and construct research problem, research design, data collection, data analysis and statistical analysis.
- ❖ Interpret theoretical, practical and professional information and gain communicate knowledge, ideas and procedures to **non-experts, professionals** and **stakeholders**.
- ❖ Employ **independent** learning strategies to update own knowledge in the field and keep pace with innovations techniques, industry trends and standards.

# General Information

- **Assessment**

- ❖ **Assessments in this subject are as follows:**

- ✓ **Assignment 1 (10%)**

- ✓ **Assignment 2 (15%)**

- ✓ **Assignment 3 (25%)**

- ✓ **Final Examination (50%)**

- ❖ **Assignments are designed to review papers, conduct literature reviews, draft a report with proper typesetting tools and presentation.**

# General Information

- **Assessment**

No.	Assessment Name	Assessment Weight	Mapping to Subject Learning Outcome	Task Due
1	Individual Assignment	10%	SLO1	22 Mar 2024 (Friday in Session Week 4) Final submission time: 11:30pm
2	Individual Assignment	15%	SLO2, SLO3, SLO4	12 Apr 2024 (Friday in Session Week 7) Final submission time: 11:30pm
3	Individual Assignment	25%	SLO1, SLO2, SLO3, SLO4	10 May 2024 (Friday in Session Week 10) Final submission time: 11:30pm
4	Exam	50%	SLO1, SLO2, SLO3, SLO4	The final exam will be held during the UOW exam period. Students will receive a SOLSmail advising full details of the delivery format, time, and date of the final exam as they become available in the SOLS Exam Timetable.

# General Information

- **Assessment--rules**

- ❖ **Need to get at least 40% in the final exam, TF will apply otherwise**
- ❖ **Overall need to get at least 50%**
- ❖ **<https://www.uow.edu.au/about/policy/UOW058680.html>**
- ❖ **Pay attention to deadline to each assignment**
- ❖ **Late submission: Penalties apply to all late work, except if student academic consideration has been granted (permission)**
- ❖ **Late submission will attract a penalty of 25% of the assessment mark per day including weekends**
- ❖ **Work more than three days late will be awarded a mark of zero**

- **Plagiarism**

- ❖ **“Plagiarism means using the ideas of someone else without giving them proper credit.”**
- ❖ **I strongly recommend you to read the websites for more information:  
<https://www.uow.edu.au/student/services/ld/students/UOW021315.html>,  
<https://www.uow.edu.au/academic-integrity/students/avoidingplagiarism/index.html>**
- ❖ **There are two primary concerns for us:**
  - **Students copying directly from sources, or copying without appropriate referencing.**
  - **Students copying each other.**

# General Information

- **Recommended reading**
  - ❖ **Lecture material on the Moodle site for the subject**
  - ❖ **Some reading material will be posted**
  - ❖ **There are a wide range of books which discuss in greater detail contain aspects of the subject**
- **References**
  - ❖ **Yogesh Kumar Singh. Fundamental of Research Methodology and Statistics, New Age International Publishes, 2006**
  - ❖ **Mark Balnaves, Peter Caputi. Introduction to Quantitative Research Methods: An Investigative Approach, SAGE, 2001**

# General Information

- **References**

- ❖ **John W. Creswell. Research Design: Qualitative, Quantitative, and Mixed Methods Approaches, 2002, SAGE Publications**
- ❖ **Matthew B. Miles. Qualitative Data Analysis: An Expanded Sourcebook, 1994 by Sage Publications**
- ❖ **C. R. Kothari. Research Methodology: Methods and Techniques, New Age International Publishers, 2004**
- ❖ **Robert K. Yin. Qualitative Research from Start to Finish, The Guilford Press, 2011**
- ❖ **Prabhat Pandey. Research Methodology: Tools and Techniques, Bridge Center, 2015**

# Outline

- **Introduction**
- **Nature of Research**
- **Steps in Conducting Research**

Write your answer to these questions:

- What is scientific research?
- Why should we engage in research?

Write your answer to these questions:

- What is scientific research?
- Why should we engage in research?

## Analogy

Research activity is similar to taking part in an open international debate. You find the appropriate point to join the debate and contribute your piece!

# Some Definitions

## Definition 1

“the systematic, controlled, empirical and critical investigation of natural phenomena guided by **theory and hypotheses** about the presumed relations among such phenomena” (Kerlinger 1986)

## Definition 2

“a systematic, formal, rigorous, and precise process employed to **gain solutions to problems** and/or to discover and **interpret new facts** and relationships.” (Waltz & Bausell 1981)

## Definition 3

“an activity that contributes to the **understanding of a phenomenon** - i.e. a set of behaviours of some entities that are of interest to a researcher or a group of researchers (research community). The activities a research community uses to generate understanding are its research methods” (Vaishnavi & Kuechler, 2004)

# What is science?

Science refers to a systematic and organized body of knowledge in any area of inquiry that is acquired using “the scientific method”.

The purpose of science is to create scientific knowledge.

Scientific knowledge refers to a generalized body of laws and theories to explain a phenomenon or behaviour of interest that are acquired using the “scientific method”.

**Natural science:** The science of naturally occurring objects or phenomena, such as light, matter, earth, celestial bodies, or the human body.

- Physical sciences
- Earth sciences
- Life sciences

**Social science:** The science of people or collections of people, such as groups, firms, societies, or economies, and their individual or collective behaviours.

- psychology: the science of human behaviours
- sociology: the science of social groups
- economics: the science of firms, markets, and economies

# Natural Science v Social Science

- The natural sciences are very precise, **accurate, deterministic** (probabilistic models are also used), and independent of the person making the scientific observations.
- The social sciences tend to be highly variable, less accurate, non-deterministic, or somewhat ambiguous.
- A high degree of “measurement error” in social sciences.
- Considerable uncertainty and little agreement on social science policy decisions.

# Scientific knowledge

Components:

**Laws:** Observed patterns of phenomena or behaviour.

**Theories:** Systematic explanations of the underlying phenomenon or behaviour.

Pillars:

**Logic (theory):** Provide meaning and significance to what we observe.

**Evidence (observations):** Help validate or refine existing theory or construct new theory.

## Example - Newtonian Laws of Motion

- Newton's First Law tells us what happens when an object is in a state of rest or motion.
- Newton's Second Law tells us what force is needed to move a stationary object or stop a moving object.
- Newton's Third Law tells us what happens when two objects collide.

# Scientific knowledge

Note that:

Scientific knowledge may be **imperfect** or even quite far from the truth. There may not be a single universal **truth**, but rather an equilibrium of “multiple truths”.

Theories are only explanations of a **particular phenomenon** from a **particular perspective**.

There may be good or poor explanations (theories), depending on the extent to which those explanations fit with reality.

# Two levels of scientific research

## Theoretical level

Developing abstract concepts about a natural or social phenomenon and relationships between those concepts (i.e., build “theories”)

## Empirical level

Testing the theoretical concepts and relationships to see how well they reflect our observations of reality, with the goal of ultimately building better theories.

# Two forms of scientific research

## Inductive

Theory building

Infering theoretical concepts and patterns from observed data.

Valuable when there are few prior theories or explanations.

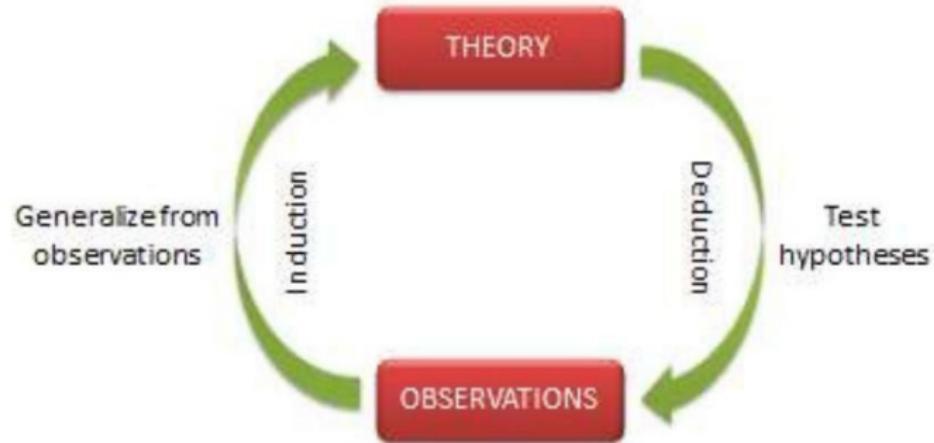
## Deductive

Theory testing, refinement, improvement and extension.

Test concepts and patterns known from theory using new empirical data.

Useful when there are many competing theories of the same phenomenon and researchers are interested in knowing which theory works best and under what circumstances.

# Two forms of scientific research



**Figure:** The cycles of research

## Deifnition

A standardized set of techniques for building scientific knowledge:

- how to make valid observations

- how to interpret results

- how to generalize those results

# Scientific method

## (1) Replicability

Others should be able to independently replicate or repeat a scientific study and obtain similar, if not identical, results.

## (2) Precision

Theoretical concepts, which are often hard to measure, must be defined with such precision that others can use those definitions to measure those concepts and test that theory.

# Steps in conducting research

A generic process that is applicable to most research:

- Choose a problem area (or a topic)
- Review the published literature in the area
- Define the research problem/question
- Develop a hypothesis [or objectives]
  - this is the same as developing a model of the problem
- Choose a method or methods to be employed in the research
- Carry out the research
- Analyse your data and benchmark against known results
- Write up your results AND draw conclusions
  - Identify significance, insights, limitations & future research
- Publish or Perish

# Topic Selection

Criteria could include:

- Access to information
- Access to resources
- Theoretical background
- Value of research
- Researcher's skills
- Is question big enough AND small enough?
- Overall probability of successful completion
- Interest to researcher

Important points to remember:

- Pick a topic that is sufficiently “**narrow**” that your research is focused, but **not so narrow** that you can't find any information on the topic.
- You must own the topic once chosen
  - it is your topic and NOT your supervisor's

# Reviewing the literature

This is perhaps the most important part in the early stages and during the research process.

Benefits include:

Mastery of the research field - knowing what is important in the area of study;  
Inspiration to generate new ideas;  
Being able to find the gap in the literature; Being able to pose the research question;  
Knowing what findings to expect and how other researchers measure (i.e. assess) their work/results; Avoiding re-invention of the wheel.

Begin by being organized: **collect**, **collate** and **annotate** appropriate papers.

How do you get information on your research topic?

Peer-reviewed conference and journal papers from: Library (e-library and physical library)

Internet - but be careful about Internet junk!

# Characteristics of a literature review

Documentation of the state of research on a given topic or given research area.

Summarizes and synthesizes the ideas or concepts, problems, and solutions other researchers in the field have produced over time.

Reflects the reviewer's understanding of the body of work existing in the field and may shed new light or provide new interpretation of previous works.

# Defining the research problem/question

A set of problem statements is the output of a properly conducted literature review.

Usually the research questions arise out of gaps identified during the literature review process.

The quality of the questions depends on the quality of the review.

We digress and look at how to conduct a good review.