

# Research Methodology: Research & Publishing

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# Messages

## □ Research:

- Should be about some problem that encourages enthusiasm (for you) and interest (for others)
- Is often generated from the thought “what we’ve got now/from the past isn’t quite right/good enough – we can do better...”
- Consists of work that leads to a meaningful contribution
- Generates, in some way, a better solution to the problem

# What Is Research?

## □ Merriam-Webster's definition:

**1** : careful or diligent search

**2** : studious inquiry or examination; *especially* : investigation or experimentation aimed at the discovery and interpretation of facts, revision of accepted theories or laws in the light of new facts, or practical application of such new or revised theories or laws

**3** : the collecting of information about a particular subject

## What Is Research? (2)

- ❑ “A combination of investigation of past work and effort in the present that will help others in the future”
- ❑ A set of opposites
  - Fun and frustration
  - Small steps and large insights
  - Building on others’ work and contributing your own work
- ❑ Finding or developing something new that changes the world....

# What is Research? (3)

- Quantitative vs. Qualitative Research
  - Quantitative – use of statistical, formulaic or numerical analysis to generate results
    - Main approach: analysis; causal determination, prediction, generalization of findings
    - Results: “This solution is **N%** better”
  - Qualitative – not quantitative; use of non-numeric techniques
    - Main approach: discovery; illumination, understanding, extrapolation to similar circumstances
    - Results: “This is a new way of solving our problem”

# Scope of Research

- ❑ Varies by level of work
  - Ph.D. students – contribution expected at world level; e.g.
    - ❑ background investigation on all past work
    - ❑ make meaningful addition to world knowledge
  - Undergraduate students – contribution can be at local to national to world level; e.g.
    - ❑ background investigation at university up to world level
    - ❑ make meaningful addition to university up to world level of knowledge

# What Isn't Research

- ❑ Playing with technology
- ❑ Book report
- ❑ Programming project
- ❑ Doing what others have already done
  
- ❑ However, each of these can be done as part of research

# Who Does Research?

- ❑ Graduate Students
  - Masters Degree (lower standard)
  - Ph.D. Degree (higher standard)
- ❑ Researchers at universities
  - Post-Doctoral students
  - Faculty members
- ❑ Researchers in industry
  - Research scientists
  - Many other technical workers
- ❑ Undergraduate students



## Who Does Research? (2)

- ❑ Individuals
- ❑ Teams
  
- ❑ Teams almost always make the process easier
  - Division of labor
  - Feedback from team members
  - Each member can work to own strengths

# Research Process (Methodology)

- ❑ Initial Idea
- ❑ Background Investigation
- ❑ Refinement of Idea
- ❑ Core Work
  - Investigation and Development
  - Documentation
  - Prototype (if appropriate)
- ❑ Evaluation
- ❑ Identification of Future Work
- ❑ Presentation

# Research Process – Initial Idea

- ❑ Stems from critical thinking
- ❑ Be on the lookout for and open to seeing problems
  - Gaps in framework
  - Repetitive behavior that's slightly different (and can be generalized)
  - Manual solutions (that can be automated)
  - Inelegant solutions
- ❑ Ask questions
  - “Is something missing here?”
  - “Can this be done in a better way?”
  - “Is there a need for a new approach?”
- ❑ Should be an area you're interested in, as:
  - You'll be spending a lot of time with it
  - It won't always be easy/fun to continue...

# Research Process – Background Investigation

- ❑ Given an idea, need to determine:
  - Has this work been done previously?
  - What similar work has been done leading up to this point?
  - How is any previous work distinguished from what I'm planning to do?
  - What group of people will be positively impacted by the research?
- ❑ Tools
  - Literature Review using library resources (e.g. online databases such as ACM and IEEE, popular magazines)
  - WWW search

# Research Process – Refinement of Idea

- ❑ Based on background investigation, need to refine idea
- ❑ Issues:
  - Precision – focus on precisely identifying:
    - ❑ Problem
    - ❑ Possible solutions (plural!)
  - Scope – need to “build fences”
    - ❑ What’s an essential part of this work? (fence in)
    - ❑ What’s tangential, additional, or for any other reason best left for later/someone else? (fence out)

# Research Process – Core Work, Investigation and Development

- ❑ Provide yourself with infrastructure
  - equipment / software
  - additional knowledge (“get up to speed”)
- ❑ Do the work
  - Experimentation (scientific process)
  - Develop opinions
  - Look for better ways of solving problem
    - ❑ Can you generalize?
    - ❑ Can you develop a framework?
  - Discuss, brainstorm
  - Reevaluate as you proceed
    - ❑ Look for improvements, changes to your original ideas

# Research Process – Core Work, Investigation and Development (2)

## □ Process

- Work regularly
  - Easier to keep going if have a commitment to a regular work time
  - Helps you keep your past work in mind
- Allocate large block of time for research
  - Takes time to get going/back to speed
  - Make sure can do something significant each work session

# Research Process – Core Work, Documentation

- ❑ Need to document as you go
  - Don't want to lose any information
- ❑ 1) Maintain a journal for day-to-day thoughts
  - Can be paper, electronic, ...
  - Keep it with you at all times
    - ❑ Never know when good ideas will hit
- ❑ 2) Keep an updated task list
  - Focus on accomplishing something each work session
- ❑ 3) Write up your work
  - Periodically, write a few pages on a subset of your work
    - ❑ Summarize work, accomplishments, problems
  - At end, write up a summary document
    - ❑ Can be based on steps discussed here



# Research Process – Core Work, Prototype

- ❑ Need to demonstrate the merit of your ideas
- ❑ If work is non-theoretical, do this through a developed system
  - No need to build the entire system
  - Just need to demonstrate the value of the core ideas

# Research Process - Evaluation

- ❑ Perhaps the most difficult part....
  - Best if can show others are already using your work
- ❑ Quantitative
  - Test your prototype
  - What improvements exist over currently available alternative?
  - How much of an improvement do you see?
- ❑ Qualitative
  - What can you do now that couldn't be done before?
  - What are the benefits of your solution?

# Research Process – Identification of Future Work

- ❑ Helps you organize any future efforts
- ❑ Helps others build on your work
  
- ❑ Sources:
  - What you excluded in your idea refinement
  - New problems that have surfaced during your work

# Research Process - Presentation

- ❑ It's not a contribution to the field if no one knows about it or can use it
- ❑ Presentation/Dissemination
  - Conferences, Journals, Web
    - ❑ e.g. National Undergraduate Research conference
  - Papers, Talks, Poster Sessions
    - ❑ e.g. UWEC and UW System Research Days

# Where to send you papers?

□ Conference:

□ Journal

□ Workshop

□ TR

# Where to send?

## □ Conference:

- 3 kinds
  - accept  
“everything?”
  - IEEE (less than  
50% accept rate)
  - Less than 20%  
accept
- Quick

# Where to send?

## □ Journal

- archival
- respectable
- experience
- magazine

# Where to send?

## □ Workshop

- PASTE
- IWPC



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- ICSE Workshops

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# Why write and publish research papers?

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- Ideally –
  - to share research findings and discoveries with the hope of improving healthcare.
- Practically –
  - to get funding
  - to get promoted
  - to get a job
  - to keep your job!

# Getting a paper published

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- Competition for space in journals is intense
- Cost of publication is high, \$360/page for APS
- Rejection rates vary
  - AJP = 50%
  - JBC = 65%
  - NEJM, Science, Nature = 90%

# Major reasons for rejection

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- Confirmatory (not novel)
- Poor experimental design
  - Poor controls
  - Hypothesis not adequately tested
- Inappropriate for journal
- Poorly written

# Tips

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1. Know the journal, its editors, and why you submitted the paper there
2. Pay close attention to spelling, grammar, and punctuation
3. Make sure references are comprehensive and accurate
4. Avoid careless mistakes
5. Read and conform to “Instructions for Authors”

# Publish or perish



"Surely you were aware when you accepted the position, Professor, that it was publish or perish."

# **“The Seven Deadly Sins”**

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1. Data manipulation, falsification
2. Duplicate manuscripts
3. Redundant publication
4. Plagiarism
5. Author conflicts of interest
6. Animal use concerns
7. Humans use concerns



# What constitutes redundant publication?

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Data in conference abstract? **No**

Same data, different journal? **Yes**

Data on website? **Maybe**

Data included in review article? **OK if later**

Expansion of published data set? **Yes**

# What makes a good research paper?

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- Good science
- Good writing
- Publication in good journals

# What constitutes good science?

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Novel – new and not resembling something formerly known or used (can be novel but not important)

Mechanistic – testing a hypothesis - determining the fundamental processes involved in or responsible for an action, reaction, or other natural phenomenon

Descriptive – describes how things are but does not test how things work – hypotheses are not tested.

# What constitutes a good journal?

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Impact factor –

average number of times published papers are cited up to two years after publication.

Immediacy Index –

average number of times published papers are cited during year of publication.

# Journal Citation Report, 2003

Journal	Impact Factor	Immediacy Index
Nature	30.979	06.679
Science	29.162	05.589
Hypertens	05.630	00.838
AJ P Heart	03.658	00.675
Physiol Rev	36.831	03.727
Am J Math	00.962	00.122
Ann Math	01.505	00.564

# Things to consider before writing

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## 1. Time to write the paper?

- has a significant advancement been made?
- is the hypothesis straightforward?
- did the experiments test the hypothesis?
- are the controls appropriate and sufficient?
- can you describe the study in 1 or 2 minutes?
- can the key message be written in 1 or 2 sentences?

*“Those who have the most  
to say usually say it with  
the fewest words”*

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## 2. Tables and figures

- must be clear and concise
- should be self-explanatory

## 3. Read references

- will help in choosing journal
- better insight into possible reviewers

# Things to consider before writing

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## 4. Choose journal

- study “instructions to authors”
- think about possible reviewers
- quality of journal “impact factor”

## 5. Tentative title and summary

## 6. Choose authors



# Authorship

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## GUIDELINES ON AUTHORSHIP

Each author should have participated sufficiently in the work to take public responsibility for the content. This participation must include: (a) conception or design, or analysis and interpretation of data, or both; (b) drafting the article or revising it for critically important intellectual content; and (c) final approval of the version to be published. Participation solely in the collection of data does not ~~justify authorship.~~

~~All elements of an article (a, b, and c above) critical to its main conclusions must be attributable to at least one author.~~

Guidelines on authorship, *International committee of Medical Journal Editors*,  
Reprinted by kind permission of the Editor of the British Medical Journal of Sept  
14, 1985. *J Clin Pathol* 39: 110, 1986

# Writing the manuscript

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The hardest part is getting started.

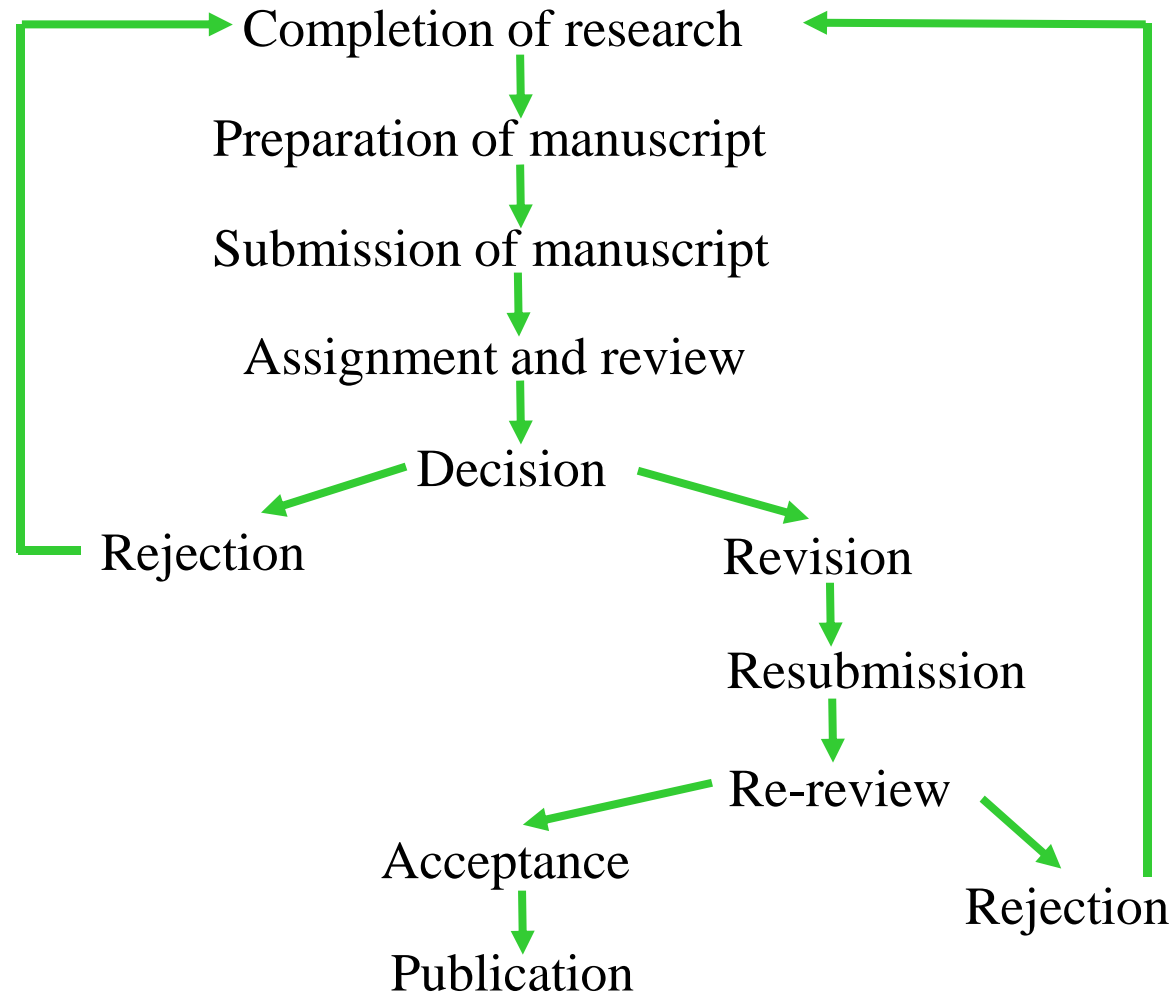
# Submission

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1. Read instructions carefully
2. Fill out all necessary forms  
Copyright transfer  
Conflict of interest
3. Write cover letter (suggest reviewers)
4. Confirm receipt after 6 weeks

# Process of Research

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# Responding to reviewers

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1. Carefully prepare your responses
  - Each comment should be addressed
  - Each change should be stated
  - Be enthusiastic
2. Reviewer may be wrong
3. Be tactful – thank the reviewers
4. Do not respond to reviewers while upset
5. Never call the editor
6. Get help from other authors

*“There is no way to get  
experience except through  
experience.”*

# Thank you and Question?

