

# Research Methodology

## Unit III: Research Ethics, IPR and Scholarly Publishing

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### Preface

These lecture notes cover the moral and legal dimensions of research. Having learned about research formulation (Unit I) and data collection/analysis (Unit II), we now explore the ethical framework, intellectual property rights, and scholarly publishing practices that govern responsible research conduct. We'll continue using the **Electrical Chakki** (electric grinder) as our running example to demonstrate how these principles apply to real-world research.

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# 1 The Moral and Legal Dimensions of Research

## 1.1 Opening Discussion

**Provocative Question:** Is it ever justifiable to conduct unethical research if it could save millions of lives?

This tension between scientific progress and ethical boundaries defines modern research. Today we explore three pillars: Ethics, Intellectual Property, and Scholarly Communication.

### Electrical Chakki Example: Ethical Dimensions

Even research on something as mundane as an Electrical Chakki raises ethical questions:

- If you test chakkis in people's homes, have you obtained proper consent?
- If a prototype fails and causes injury, who is responsible?
- If you develop a better design, should you patent it or share it freely?
- If you publish your findings, have you properly credited all contributors?
- If your research was funded by a chakki company, could that bias your results?

These questions illustrate why ethics, IPR, and publishing standards are essential for ALL research, regardless of topic.

## 1.2 Historical Context: Why Ethics Matter

[Historical Foundation] The **Nuremberg Code (1947)** and **Helsinki Declaration (1964)** emerged from horrific medical experiments conducted during World War II. Today's ethical guidelines exist so we never repeat those mistakes.



Figure 1: Timeline of Major Ethics Guidelines

## 2 Research Ethics: Foundational Principles

### 2.1 The Four Core Principles of Research Ethics

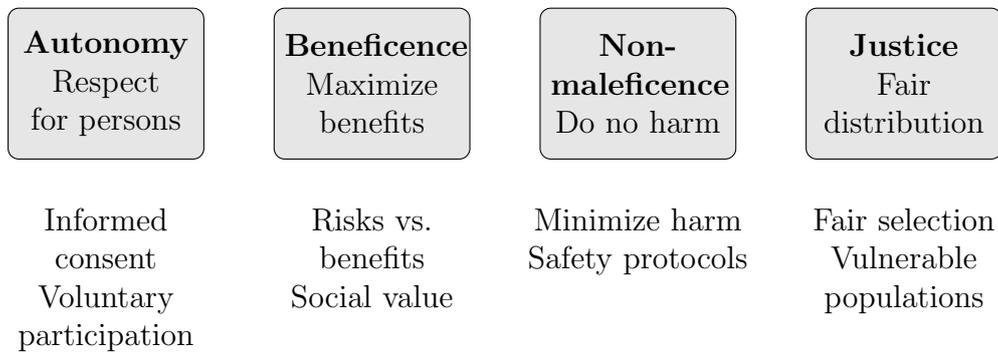


Figure 2: The Four Core Principles of Research Ethics

#### Chakki Example: Applying Ethical Principles

##### **Autonomy:**

- When studying chakki usage in homes, explain the purpose clearly
- Allow participants to withdraw at any time
- Don't pressure families to participate

##### **Beneficence:**

- Your research should benefit society (better, safer chakkis)
- Share findings with participating communities
- Consider how improvements will help users

##### **Non-maleficence:**

- Ensure prototype chakkis are safe before testing
- Don't cause inconvenience or damage to participants' kitchens
- Monitor for any adverse effects during testing

##### **Justice:**

- Don't only study affluent households; include diverse communities
- Ensure benefits reach all segments of society
- Don't exploit vulnerable populations for research

## 2.2 Major Ethical Issues in Contemporary Research

### 2.2.1 Issue 1: Informed Consent

#### Informed Consent

Not just a signed form, but an ongoing process throughout the research study.

#### Must Include:

- Purpose of the research
- Procedures involved
- Potential risks and discomforts
- Expected benefits (if any)
- Alternatives to participation
- Confidentiality provisions
- Voluntary participation with right to withdraw
- Contact information for questions

#### Special Populations:

- **Children:** Parental permission + child assent
- **Mentally impaired:** Legally authorized representatives
- **Prisoners:** Special protections against coercion
- **Economically disadvantaged:** Ensure no undue inducement

#### Chakki Example: Informed Consent Form

##### **EXCERPT FROM CONSENT FORM: "Study on Electrical Chakki Usage Patterns"**

*Purpose:* You are invited to participate in a study understanding how families use electric chakkis, to help design better, more durable products.

*Procedures:* We will:

- Install a small voltage monitor near your chakki for 3 months
- Ask you to complete a weekly 5-minute diary about usage
- Conduct two 30-minute interviews (beginning and end)

*Risks:* Minimal. The voltage monitor is safe and will not affect your electricity. Time commitment may be inconvenient.

*Benefits:* You will receive a free chakki maintenance check and report. Your input will help improve products for all users.

*Confidentiality:* Your name will never appear in any publication. Data will be stored securely with access only to research team.

*Voluntary:* You may withdraw at any time without penalty.

Contact: [Researcher contact information]  
Signature: \_\_\_\_\_ Date: \_\_\_\_\_

## 2.2.2 Issue 2: Privacy and Confidentiality

### Key Distinctions

- **Anonymity:** Researcher cannot identify participants
- **Confidentiality:** Researcher can identify but promises not to disclose

### Challenges:

- Small sample sizes may make participants identifiable
- Unique cases (e.g., only woman in village with solar chakki)
- Data sharing requirements from journals/funders

### Solutions:

- Data de-identification (remove names, addresses)
- Secure encrypted storage
- Limited access to raw data
- Data use agreements for sharing

### Chakki Example: Confidentiality in Practice

**Scenario:** You interviewed a woman whose family has used the same chakki for 40 years—a unique case.

**Risk:** Even without naming her, readers might identify her from details.

### Solution:

- Omit specific village name (use "rural Karnataka")
- Slightly modify non-essential details
- Obtain explicit consent for using unique case
- Allow participant to review how they're described

## 2.2.3 Issue 3: Conflict of Interest

### Conflict of Interest

Situations where professional judgment may be influenced by secondary interests.

### Types of Conflicts:

- **Financial:** Research funding from interested parties (e.g., chakki manufacturer funding your study)

- **Personal:** Relationships that could bias results (studying family member's product)
- **Academic:** Pressure to publish positive results for career advancement
- **Institutional:** Your university owns patent on what you're studying

**Mandatory:** Full disclosure in all publications and presentations.

**Journal Declaration Section:**

*"Conflict of Interest Statement: This research was funded by Bharat Appliances Ltd., manufacturer of the 'GrindMaster' chakki evaluated in this study. The funding source had no role in study design, data collection, analysis, interpretation, or writing of the manuscript. Dr. Sharma holds a patent on voltage stabilization technology (Patent No. IN123456) but this patent was not directly related to the products studied."*

### 2.2.4 Issue 4: Data Manipulation and Fabrication

**Definitions:**

- **Fabrication:** Making up data that never existed
- **Falsification:** Manipulating existing data to get desired results

**The Grey Area:** "Cleaning" data vs. manipulating data

### 2.2.5 Issue 5: Authorship Ethics

**ICMJE Authorship Criteria**

To be an author, one must meet ALL four criteria:

1. Substantial contributions to conception/design OR data acquisition/analysis
2. Drafting or revising critically for important intellectual content
3. Final approval of version to be published
4. Agreement to be accountable for all aspects of the work

**Unethical Authorship Practices:**

- **Ghost authorship:** Contributors not listed (e.g., a technician who did all the measurements)
- **Gift authorship:** People added who didn't contribute (e.g., department head added to all papers)
- **Guest authorship:** Senior authors added automatically (e.g., lab director on every paper)

### Chakki Example: Authorship Scenarios

**Scenario 1:** A graduate student designed the study, collected all chakki data, analyzed results, and wrote the first draft. Her advisor provided guidance and edited the final paper.

**Appropriate authorship:** Both should be authors.

**Scenario 2:** A technician helped install voltage monitors in 50 homes but had no role in design, analysis, or writing.

**Appropriate:** Acknowledge in acknowledgements section, not as author.

**Scenario 3:** A professor secured funding for the chakki research but was never involved in the work.

**Inappropriate:** Adding as "guest author" just because they got money.

## 2.3 Historical Case Study: The Tuskegee Syphilis Study

[The Tuskegee Study (1932-1972)] **What happened:**

- 600 African American men (399 with syphilis, 201 without) were studied
- Told they were being treated for "bad blood"
- Never told their actual diagnosis
- Denied treatment even after penicillin became standard
- Study continued for 40 years

### **Ethical violations:**

- No informed consent (deceived participants)
- Withheld treatment (violation of beneficence)
- Targeted disadvantaged population (violation of justice)
- Continued after effective treatment existed

### **Impact:**

- Led to Belmont Report (1979) and modern IRB system
- Created lasting distrust of medical research in African American communities
- Resulted in strict protections for human subjects

### Discussion Questions

1. Which ethical principles were violated in Tuskegee?
2. What should have been done differently?
3. How does this case impact research today?
4. Could a similar situation happen today? Why or why not?
5. What safeguards prevent such abuses now?

### 3 Ethical Committees: Institutional Review

#### 3.1 Institutional Review Board (IRB) / Ethics Committee

Table 1: IRB Structure and Functions

<b>Composition</b>	Multidisciplinary team: Scientists, ethicists, lawyers, community members
<b>Review Levels</b>	Exempt, Expedited, Full Board Review
<b>Key Documents</b>	Protocol, Consent Forms, Recruitment materials, Data collection instruments
<b>Decision Types</b>	Approved, Modifications Required, Deferred, Disapproved
<b>Ongoing Oversight</b>	Annual reviews, Adverse event monitoring, Protocol modifications

#### Chakki Example: IRB Application

**Study:** "Assessing Electrical Chakki Safety in Rural Households"

**Review Level:** Expedited (minimal risk, involves interviews and observation)

**Key Documents Submitted:**

- Research protocol (15 pages)
- Informed consent form (translated to local language)
- Interview questions
- Observation checklist
- Data management plan
- Safety monitoring procedures
- Researcher training certificates

**IRB Questions:**

- How will you ensure confidentiality in small villages?
- What if you observe unsafe electrical practices?
- Will participants be compensated for their time?
- How will you handle participants who want to withdraw?

## 3.2 The IRB Review Process

## 3.3 Animal Ethics Committees (IACUC)

Animals in research require special ethical consideration. The **3Rs Principle** (Russell & Burch, 1959) guides animal research.

### Animal Research Oversight:

- IACUC (Institutional Animal Care and Use Committee)
- Regular facility inspections
- Veterinary care requirements
- Mandatory researcher training
- Species-specific guidelines
- Justification of animal numbers
- Humane endpoints and euthanasia protocols

### Chakki Example: Animal Research?

While chakki research typically doesn't involve animals, consider:

- If testing chakki noise effects on farm animals
- If studying grains processed for animal feed
- If using animal products in chakki components

Even indirect involvement requires ethical consideration.

## 4 Intellectual Property Rights (IPR)

From ethics we move to legal protections. IPR balances innovation with access.

### 4.1 The Intellectual Property Ecosystem

### 4.2 Patent Law: Protecting Inventions

[Patentability Criteria] For an invention to be patentable, it must meet ALL four criteria:

1. **Novelty:** New worldwide, not disclosed anywhere before filing
2. **Inventive Step:** Not obvious to someone skilled in the field
3. **Industrial Applicability:** Useful, can be made or used
4. **Patentable Subject Matter:** Falls within allowed categories

### Chakki Example: Patent Analysis

#### What CAN be patented in chakki technology:

- A new motor design that reduces power consumption by 40%
- A novel grinding stone material composition
- A safety mechanism that automatically stops the chakki
- A unique cooling system for continuous operation

#### What CANNOT be patented:

- The law of physics explaining why stones grind grain
- The mathematical formula for optimal grinding speed
- The idea of a "smart chakki" without implementation details
- Natural stones in their raw form

### 4.3 What Cannot Be Patented

- Natural phenomena and laws of nature
- Abstract ideas and mathematical formulas
- Diagnostic and therapeutic methods (in many countries)
- Plant and animal varieties (except some countries allow)
- Software per se (though software implementations can be patented)
- Inventions against public order or morality

### 4.4 Patent Process Timeline

#### Chakki Example: Patent Strategy

**Scenario:** You've invented a new chakki that uses 50% less power.

#### Patent Strategy Options:

- **Option 1:** File only in India (low cost, but unprotected elsewhere)
- **Option 2:** File PCT application (buy time to decide countries)
- **Option 3:** File in major markets (India, China, US, EU) (high cost, broad protection)
- **Option 4:** Keep as trade secret (if invention can't be reverse-engineered)

**Recommendation:** File provisional application immediately, use 12 months to assess commercial potential, then pursue PCT if promising.

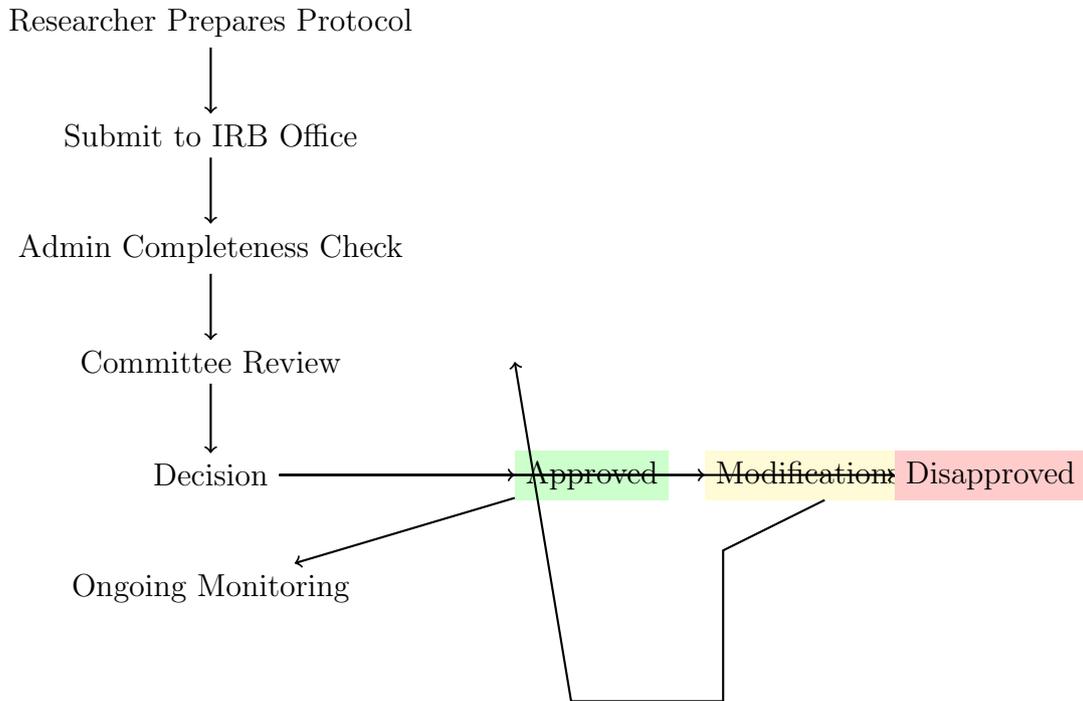


Figure 3: The IRB Review Process

Table 2: Patent Process Timeline and Costs

Stage	Timeline	Description	Cost (Approx.)
Prior Art Search	2-4 weeks	Check if invention is novel	\$1,000-\$3,000
Provisional Application	1 year protection	Establishes filing date, lower cost	\$70-\$280
PCT Application	30 months	International filing option	\$3,000-\$5,000
National Phase	Country specific	Enter individual countries	\$5,000-\$20,000/country
Examination/Grant	3-7 years	Patent office review process	Additional \$2,000-\$10,000
Maintenance	20 years total	Keep patent in force	Annual fees increasing

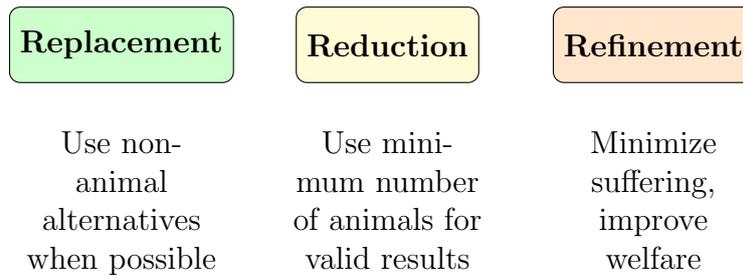


Figure 4: The 3Rs of Animal Research Ethics

## 4.5 Copyright: Protecting Expression

### Chakki Example: Copyright

#### What is copyrightable in chakki research:

- Your research paper about chakki performance
- The photographs you took of chakki components
- The user manual you wrote
- The software code for a smart chakki app
- The diagrams and illustrations in your thesis

#### What is NOT copyrightable:

- The idea of a more efficient chakki
- Facts about chakki failure rates
- The mathematical formula for efficiency
- The functional aspects of the design (these need patents)

**Note:** Copyright is automatic. You own it as soon as you create the work.

## 4.6 Fair Use Doctrine (Educational Context)

### Fair Use Factors

Four factors determine if use of copyrighted material is fair:

1. **Purpose and character** of use (commercial vs. educational, transformative)
2. **Nature** of the copyrighted work (factual vs. creative)
3. **Amount and substantiality** of portion used
4. **Effect** on potential market for the work

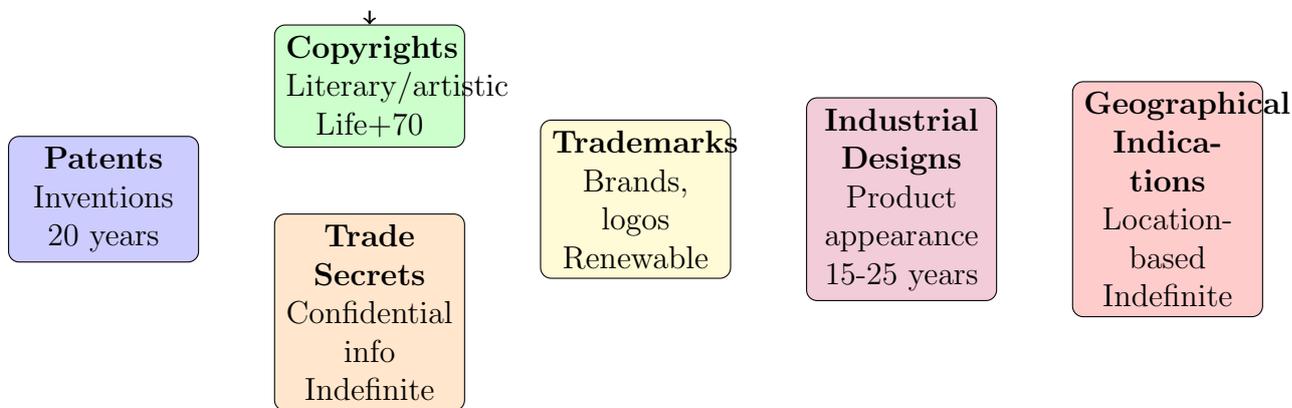


Figure 5: The Intellectual Property Ecosystem

Table 3: Copyright vs. Patent Comparison

Aspect	Copyright	Patent
<b>What's Protected</b>	Expression of ideas (not ideas themselves)	Inventions and processes
<b>Registration</b>	Automatic upon creation (optional registration)	Required, not automatic
<b>Duration</b>	Life of author + 70 years (varies by country)	20 years from filing date
<b>Cost</b>	Minimal (registration fees if chosen)	Substantial (filing, prosecution, maintenance)
<b>Example</b>	Research paper, software code, diagrams	New drug, machine, chemical process
<b>Chakki Example</b>	User manual, design drawings, website content	New grinding mechanism, motor design

### Class Activity: Fair Use Analysis

**Scenario:** You want to use 5 minutes from a documentary about traditional grinding methods in your class presentation.

**Analyze using the four factors:**

1. Purpose? (Educational, non-profit → favors fair use)
2. Nature? (Documentary is factual → favors fair use)
3. Amount? (5 minutes from 60-minute film, key segment? → borderline)
4. Market effect? (Unlikely to affect sales → favors fair use)

**Conclusion:** Likely fair use, but always attribute the source.

## 4.7 Royalty and Commercialization

### 4.7.1 Commercialization Pathways

1. **University Technology Transfer:** License patent to existing industry
2. **Startup Creation:** Form new company as university spin-off
3. **Joint Ventures:** University-industry partnership for development
4. **Open Source:** Free access with conditions (e.g., attribution required)
5. **Consulting:** Direct application of expertise without IP transfer

### 4.7.2 Royalty Structures

## 4.8 Trade Related Aspects of Intellectual Property (TRIPS)

[TRIPS Agreement] TRIPS is the WTO agreement that sets minimum IP standards globally. It came into effect in 1995.

**TRIPS Key Provisions:**

- Minimum 20-year patent protection for all technologies
- Copyright protection: Life + 50 years minimum
- Enforcement mechanisms and dispute resolution
- Flexibility for public health (compulsory licensing)
- Technology transfer obligations for developed countries
- Most-favored-nation treatment (non-discrimination among WTO members)

### Chakki Example: TRIPS Impact

**Before TRIPS (pre-1995):**

- India only allowed patents on processes, not products

- Local companies could reverse-engineer and produce differently
- Lower prices, but less incentive for innovation

**After TRIPS (post-1995):**

- India now grants product patents on inventions
- A foreign company could patent a new chakki design in India
- Local manufacturers need license or risk infringement
- Higher prices possible, but more foreign investment

**Balancing:** TRIPS includes flexibilities for public interest and essential needs.

## 5 Scholarly Publishing

Research isn't complete until it's communicated. Publishing is how knowledge enters the scientific record.

### 5.1 IMRAD Structure: The Universal Research Paper Format

#### 5.2 Crafting Each Section

##### 5.2.1 1. Introduction: The Funnel Approach

**Introduction Structure:**

1. Start with broad context and importance of the field
2. Narrow to specific problem area
3. Review relevant literature (what's known)
4. Identify research gap (what's unknown)
5. State your research question/objective
6. End with hypothesis (if applicable)

#### Chakki Example: Introduction

**Chakki Research Paper: "Voltage Fluctuation Effects on Electric Chakki Motor Lifespan"**

**Broad Context:** "Electric chakkis are essential kitchen appliances in over 200 million Indian households, consuming approximately 15 TWh annually."

**Specific Problem:** "Despite their widespread use, premature motor failure remains a significant problem, with average lifespan of only 3.2 years versus designed 8 years."

**Literature Review:** "Previous research has examined motor durability under ideal conditions (Sharma et al., 2020) and manufacturing quality variations (Patel,

Table 4: Common Royalty Structures

Structure	Description	Chakki Example
Lump Sum	One-time payment	Company pays 10 lakh once for rights
Running Royalty	Percentage of sales	5% of every chakki sold
Minimum Guarantee + Royalty	Guaranteed minimum + percentage	5 lakh/year + 3% of sales
Equity	Ownership stake	10% ownership in startup company
Milestone Payments	Payments upon achieving goals	2 lakh when prototype ready, 5 lakh when product launched

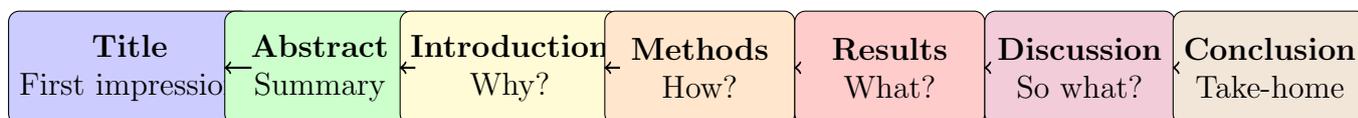


Figure 6: IMRAD Structure: The Universal Research Paper Format

Table 5: IMRAD Sections: Purpose and Key Elements

Section	Purpose	Key Elements
Introduction	Why this study?	Broad context, specific problem, research gap, research question, objectives/hypotheses
Methods	How was it done?	Study design, participants, procedures, materials, analysis, ethical approval statement
Results	What was found?	Data, figures, tables, statistical results, negative findings (just the facts)
Discussion	What does it mean?	Main findings, comparison with literature, explanations, limitations, future research
Abstract	Summary	250-300 words covering all sections

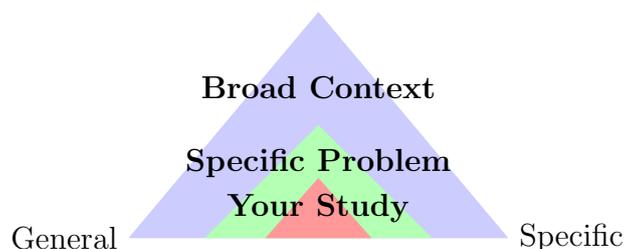


Figure 7: Introduction: Funnel from Broad to Specific

2021). However...”

**Research Gap:** ”No studies have systematically examined how real-world voltage fluctuations—common in rural areas with 30% voltage variation—affect motor lifespan.”

**Research Question:** ”This study investigates the relationship between voltage fluctuation frequency and chakki motor failure rates.”

**Hypothesis:** ”We hypothesize that households experiencing  $\geq 20$  voltage drops per month will have significantly shorter motor lifespans.”

## 5.2.2 2. Methods: The Recipe Book

### Key Requirements:

- Enough detail for replication
- Clear subsections
- Ethical approval statement MANDATORY

### Typical Methods Subsections:

- Study design (e.g., prospective cohort, randomized trial)
- Participants/sample (inclusion/exclusion criteria, sampling method)
- Materials/apparatus (detailed specifications)
- Procedures (step-by-step what was done)
- Statistical analysis (tests used, software, significance level)
- Ethical considerations (IRB approval, consent)

### Chakki Example: Methods Section

**Study Design:** ”A prospective cohort study with 6-month follow-up.”

**Participants:** ”384 households were randomly selected from 5 villages in Karnataka. Inclusion criteria: owned electric chakki for  $\geq 1$  year, agreed to monitoring.”

**Materials:** ”Voltage fluctuations were measured using Fluke 1750 Power Quality Loggers ( $\pm 0.5\%$  accuracy). Chakki motors were inspected monthly using standardized checklist.”

**Procedures:** ”Loggers recorded voltage every minute for 180 days. Households maintained daily usage diaries. Motor failures were documented with timestamp and failure mode.”

**Statistical Analysis:** ”Independent t-tests compared failure rates between high-fluctuation ( $\geq 20$  events/month) and low-fluctuation groups. Cox proportional hazards models examined predictors of time-to-failure.”

**Ethical Approval:** ”The study was approved by the Institutional Ethics Committee (IEC/2026/084). All participants provided written informed consent.”

### 5.2.3 3. Results: Just the Facts

#### Key Principles:

- No interpretation here (save for Discussion)
- Use tables and figures effectively
- Report ALL results, even negative ones
- Complete statistical reporting

#### Statistical Reporting Standards:

- Means, standard deviations for continuous data
- Frequencies, percentages for categorical data
- Test statistics with degrees of freedom (e.g.,  $t(98) = 2.34$ )
- Exact p-values (not just  $p < 0.05$ )
- Effect sizes (Cohen's d, eta-squared, etc.)
- Confidence intervals

#### Chakki Example: Results Section

**Participant Flow:** "Of 400 enrolled households, 384 (96%) completed the 6-month follow-up. Attrition was due to relocation ( $n=12$ ) and equipment damage ( $n=4$ )."

**Descriptive Results:** "Mean household chakki usage was 47.3 minutes/day (SD = 23.1). Rural households used chakkis significantly longer (54.2 min) than urban (40.1 min,  $p = 0.003$ )."

**Main Findings:** "Households with high voltage fluctuations ( $>20$  events/month,  $n=124$ ) had significantly higher failure rates (23.4%) compared to low-fluctuation households (8.1%,  $n=260$ ).  $\chi^2(1) = 16.84$ ,  $p < 0.001$ ,  $\eta^2 = 0.21$  (small effect)."

**Table 1: Failure Rates by Voltage Fluctuation Category**

Group	N	Failures (%)	Mean Time to Failure (days)
High Fluctuation ( $>20$ /month)	124	29 (23.4%)	98.3 (SD 34.2)
Low Fluctuation ( $\leq 20$ /month)	260	21 (8.1%)	156.7 (SD 41.5)

**Negative Finding:** "No significant difference in failure rates was found between stone and steel grinding plates ( $p = 0.234$ )."

### 5.2.4 4. Discussion: Making Meaning

#### Discussion Structure:

1. Start with main findings (answer research question)
2. Compare with existing literature
3. Explain unexpected results

4. Address limitations
5. Suggest future research
6. End with conclusion/implications

**Main Finding:** "This study demonstrates that households experiencing frequent voltage fluctuations have nearly three times higher chakki failure rates compared to those with stable power supply."

**Comparison with Literature:** "These findings align with laboratory studies showing motor vulnerability to voltage variations (Kumar et al., 2022), but provide the first real-world evidence from actual households."

**Explain Unexpected Results:** "Contrary to expectations, stone plates did not differ from steel in failure rates. This may reflect that modern composite stones are more durable than traditional ones."

**Limitations:** "This study was limited to 6 months; longer follow-up might reveal different patterns. Voltage monitoring was continuous but could not capture instantaneous spikes. The sample was from one district, limiting generalizability."

**Future Research:** "Future studies should test voltage stabilizer interventions, examine seasonal variations, and include more diverse geographic regions."

**Implications:** "These results suggest that voltage stabilizers could substantially reduce chakki failures, particularly in rural areas. Policymakers should consider power quality improvements or subsidized stabilizers."

## 5.3 Citation and Acknowledgement

Academic writing is a conversation. Citations acknowledge others' work and place your research in context.

### 5.3.1 Major Citation Systems

### 5.3.2 Acknowledgements Section

#### Who to Acknowledge:

- Funding sources (grants, fellowships)
- Technical assistance (lab technicians, data collectors)
- Colleagues who provided intellectual input
- Reviewers (if journal allows)
- Non-author contributors (e.g., survey translators)
- Participants (anonymously)

#### Who NOT to Acknowledge:

- Routine departmental support

- Family members (unless they substantially contributed)
- People who simply encouraged you
- Casual conversations
- General inspiration without specific contribution

### Chakki Example: Acknowledgements

#### Acknowledgements Section:

”The authors thank the 384 households who participated in this study and patiently maintained usage diaries. We acknowledge Mr. Rajesh Kumar for technical assistance with voltage logger installation and Dr. Anjali Sharma for statistical consultation. This research was funded by the Department of Science and Technology (Grant No. DST/2026/0842). The funding source had no role in study design, analysis, or interpretation.”

**Note:** Specific names used only with their permission.

## 5.4 Plagiarism: The Unforgivable Sin

Plagiarism destroys academic careers. Let’s understand it fully.

### 5.4.1 Types of Plagiarism

Type	Description	Example
Direct	Copy-paste without credit	Taking paragraphs verbatim from a source
Paraphrasing	Changing words, same structure	”The rapid development of AI” → ”The quick growth of artificial intelligence”
Mosaic	Mixing copied phrases	Patchwriting from multiple sources
Self-plagiarism	Reusing own work	Submitting same paper to two journals
Idea	Stealing concepts	Using someone’s theory without citation
Citation	Fake citations	Citing articles you haven’t read

### Chakki Example: Plagiarism Scenarios

**Original Text:** ”The electric chakki revolutionized Indian kitchens by reducing grinding time from hours to minutes while maintaining traditional texture.”

**Unacceptable (Direct Plagiarism):** ”The electric chakki revolutionized Indian kitchens by reducing grinding time from hours to minutes while maintaining traditional texture.” [No citation]

**Unacceptable (Paraphrasing Plagiarism):** ”Indian kitchens were transformed by the electric grinder, which cut grinding duration from hours to mere minutes while preserving traditional consistency.” [No citation]

**Acceptable (Proper Citation):** ”The electric chakki dramatically changed food preparation in Indian households (Sharma, 2019).” [With citation]

**Acceptable (Quoting):** ”As Sharma (2019) noted, ’The electric chakki revolutionized Indian kitchens by reducing grinding time from hours to minutes while maintaining traditional texture’ (p. 45).” [Quotation marks + citation]

## 5.4.2 Plagiarism Detection and Prevention

### Detection Tools:

- Turnitin (most common in academia)
- iThenticate (for journal submissions)
- Grammarly (includes plagiarism check)
- Google search (for quick checks)

**Acceptable Similarity:** Typically 15-20% depending on journal

### Best Practices to Avoid Plagiarism:

1. Take notes in your own words, not copying
2. Cite as you write (don't plan to "add citations later")
3. Use quotation marks for direct quotes
4. Paraphrase properly (both words AND structure)
5. Keep a bibliography as you go
6. Track all sources meticulously
7. Run plagiarism check before submission

### Interactive Exercise: Plagiarism Identification

**Original:** "The rapid development of artificial intelligence has raised significant ethical concerns about privacy, employment, and human autonomy."

**Student Version:** "The quick growth of AI has created important ethical questions regarding privacy, jobs, and human independence."

**Question:** Is this plagiarism?

**Analysis:**

- Words changed (rapid→quick, development→growth, raised→created, concerns→questions)
- Structure identical (Subject + verb + object + list)
- Core idea unchanged
- No citation

**Conclusion:** YES, this is plagiarism (paraphrasing plagiarism). Even though words changed, the structure and idea are copied without attribution.

## 5.5 Reproducibility and Accountability

### 5.5.1 The Reproducibility Crisis

### 5.5.2 Causes of Non-reproducibility

1. **Methodological:** Poor study design, small sample sizes, lack of blinding
2. **Statistical:** p-hacking, selective reporting, multiple comparisons without correction
3. **Publication bias:** Preference for positive results over null findings
4. **Career pressure:** "Publish or perish" culture incentivizes quantity over quality
5. **Inadequate reporting:** Methods sections lack detail for replication
6. **Data hoarding:** Raw data not available for verification

### 5.5.3 Solutions: The Open Science Movement

1. **Preregistration:** Register study design, hypotheses, and analysis plan before collecting data
2. **Open Data:** Share raw data (with appropriate privacy protections)
3. **Open Materials:** Share protocols, code, and materials
4. **Open Access:** Make publications freely available
5. **Registered Reports:** Peer review before results are known
6. **Replication studies:** Value and publish replication attempts

### 5.5.4 Accountability Mechanisms

- **Retraction Watch:** Database tracking retracted papers
- **ORCID:** Unique researcher identifiers to track publications
- **Data availability statements:** Required by many journals
- **Conflict of interest declarations:** Mandatory disclosure
- **Author contributions sections:** Specify who did what
- **Post-publication peer review:** Comments and critiques

#### Chakki Example: Open Science Practices

##### Chakki Study with Open Science:

**Preregistration:** "This study was preregistered on the Open Science Framework (osf.io/xyz123) on January 15, 2026, including hypotheses and analysis plan."

**Data Availability:** "De-identified data and analysis code are available at [repository link]. Voltage logger data cannot be shared due to privacy but summary

statistics are provided.”

**Materials:** ”Survey instruments, interview protocols, and observation checklists are available as supplementary materials.”

**Author Contributions:** ”RS conceived the study, collected data, and drafted manuscript. AK performed statistical analysis. PM supervised fieldwork and edited manuscript. All authors approved final version.”

## 6 Class Activity: Ethical Dilemma Resolution

[The Dual-Use Dilemma] **Scenario:** You discover a method for rapid, efficient influenza virus sequencing that could revolutionize vaccine development. However, the same method could potentially be used to create dangerous engineered strains.

### Questions for Discussion:

1. Should you publish your findings?
2. What ethical principles apply?
3. What safeguards could be implemented?
4. Who should decide—you, your institution, government?
5. How does this compare to other dual-use research?

### Chakki Example: Dual-Use Parallel

**Chakki Technology Parallel:** You develop a motor controller that can run efficiently on variable power. Same technology could:

- **Beneficial use:** Help rural households with unstable power
- **Potential misuse:** Could be adapted for weapons systems (drones, etc.)

### Discussion Questions Applied:

1. Do you publish the controller design openly?
2. Do you patent and control licensing?
3. Do you keep it as trade secret?
4. What responsibility do you have for how it’s used?

## 7 Summary and Key Takeaways

- **Research ethics** protects participants and maintains public trust—always obtain informed consent, ensure confidentiality, and disclose conflicts
- **IRB/IACUC approval** is mandatory for all research involving humans or animals
- **Four core principles:** Autonomy, beneficence, non-maleficence, justice

- **IPR balances** innovation with access through patents, copyrights, trademarks, and trade secrets
- **Patentability requires** novelty, inventive step, industrial applicability
- **TRIPS** sets global IP standards with flexibilities for public interest
- **IMRAD structure** is the universal format for research papers
- **Proper citation** acknowledges intellectual debts and avoids plagiarism
- **Plagiarism** has severe consequences—understand its many forms
- **Reproducibility crisis** requires open science practices
- **Accountability mechanisms** include data sharing, preregistration, and transparency

**Thought for the Day**

”Ethics is not incidental to scientific research but fundamental to it. Good science requires good ethics.”

— Ruth Ellen Bulger

**Chakki Connection:**

From informed consent when studying village households to patenting a better motor design to publishing findings ethically—every aspect of chakki research touches the principles we’ve learned today.

# Assignment for Next Class

## Homework Assignment

### Part A: Ethics Analysis

1. Find a published paper in your field (use Google Scholar)
2. Analyze it for:
  - Ethical approval statement
  - Conflict of interest declaration
  - Author contributions section
  - Data availability statement
3. Write a brief critique: Is ethical practice adequately documented?

### Part B: Patent Search

1. Use Google Patents ([patents.google.com](https://patents.google.com))
2. Find a patent in your field of interest
3. Analyze:
  - What is the patent number?
  - What does it claim (independent claims)?
  - Who are the inventors/assignees?
  - When was it filed? When does it expire?
  - Has it been cited by others?

### Part C: Plagiarism Check

1. Take a paragraph you've written
2. Run it through a free plagiarism checker
3. Reflect: Are there any issues? How could you improve?

**Reading:** "Singapore Statement on Research Integrity" for next class discussion

**Next Week:** Research Proposal Development and Grant Writing

Table 6: Reproducibility Rates Across Fields

<b>Field</b>	<b>Reproducible</b>	<b>Study Year</b>
Psychology	36%	2015 (Open Science Collaboration)
Cancer Biology	11%	2012 (Begley & Ellis)
Economics	39% (61% failed)	2015 (Chang & Li)
Preclinical Research	20-25%	Multiple studies

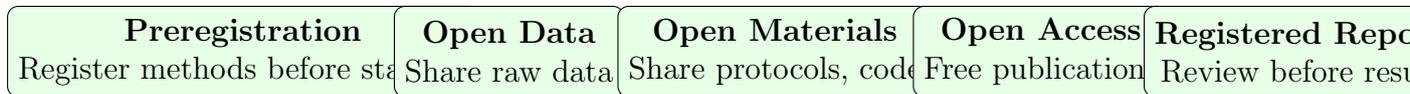


Figure 8: Open Science Solutions to Reproducibility Crisis