

How to Be the Boss of Your AI Assistant

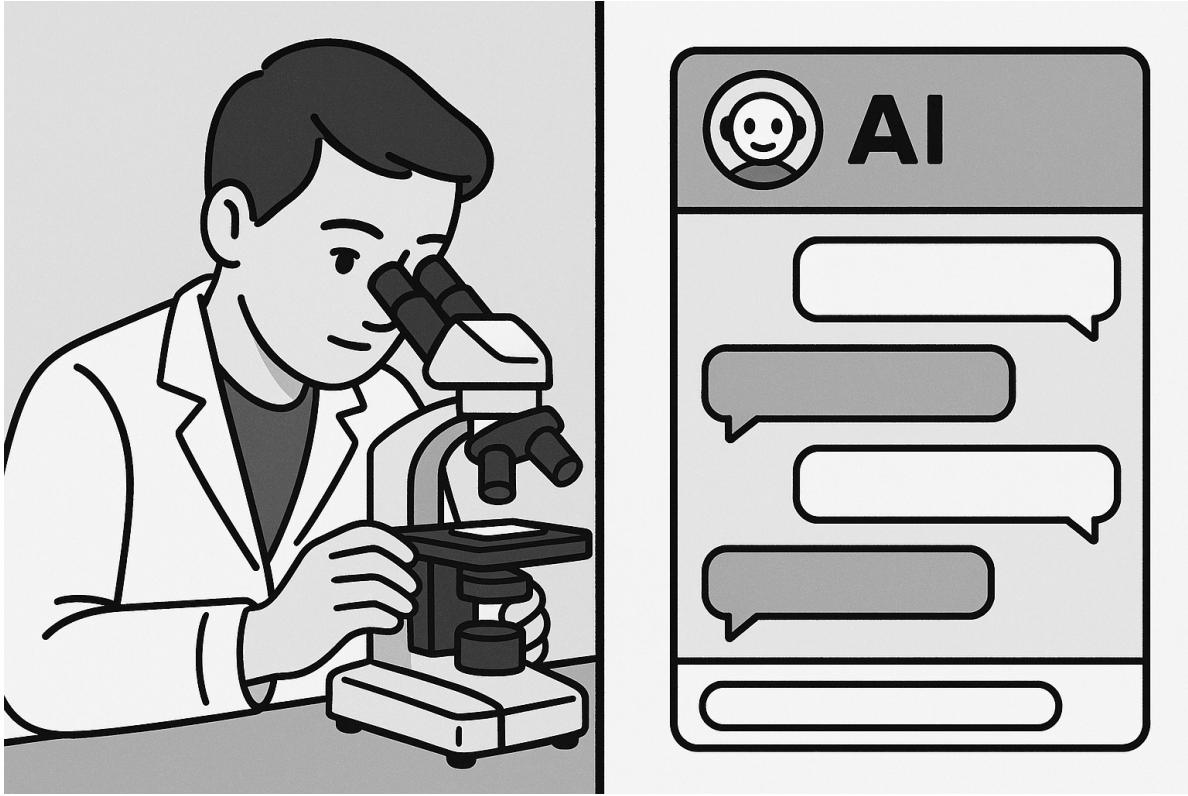
Understanding LLMs & The Research Workflow

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Welcome!

Today's Journey

- Understanding your AI assistant
- Why structure beats magic
- A proven 10-step research workflow
- Live demonstration
- **Your roadmap to AI-powered research**



Welcome students. Today we're learning how to effectively manage AI tools for research. This isn't about fancy prompts - it's about understanding how these tools work.

Quick System Check!

Do you have access to:

- Microsoft Copilot (copilot.microsoft.com)
- Internet connection
- Ability to download files

Can't Access Copilot?

- Try ChatGPT (chat.openai.com) - free tier works
- Claude (claude.ai) - also free
- **Key point:** The principles work with ANY AI assistant

Timing: We'll have troubleshooting breaks at 15 and 35 minutes!

The Problem: The “Everything” Prompt

Have you ever tried this?

- You ask AI to do a huge task all at once...
- “Analyse high-pressure processing for juice shelf life, tell me pros and cons, design an experiment for Vitamin C in orange juice, write the methods, and create expected results table”

What do you get back?

- Shallow, generic summary
- Forgets half your instructions
- Messy, unusable output

Real Example: “Write my entire literature review on plant proteins” → Gets 2 paragraphs of Wikipedia-level content

This happens because you’re giving the AI too much to think about at once. It’s like asking someone to juggle while solving math problems.

The Solution: Think Like a Manager

Not a Magician!

Big Idea: Break complex research into small, logical steps

The Golden Rule - One Task, One Prompt

Give your AI assistant one clear job at a time

Let’s explore why this simple rule is so powerful...

Quick Start Essentials

The Most Important Prompt Template:

You are an AI research scientist specializing in [YOUR FIELD].

Task: [ONE SPECIFIC TASK]

Requirements:

- [SPECIFIC REQUIREMENT 1]
- [SPECIFIC REQUIREMENT 2]
- [SPECIFIC REQUIREMENT 3]

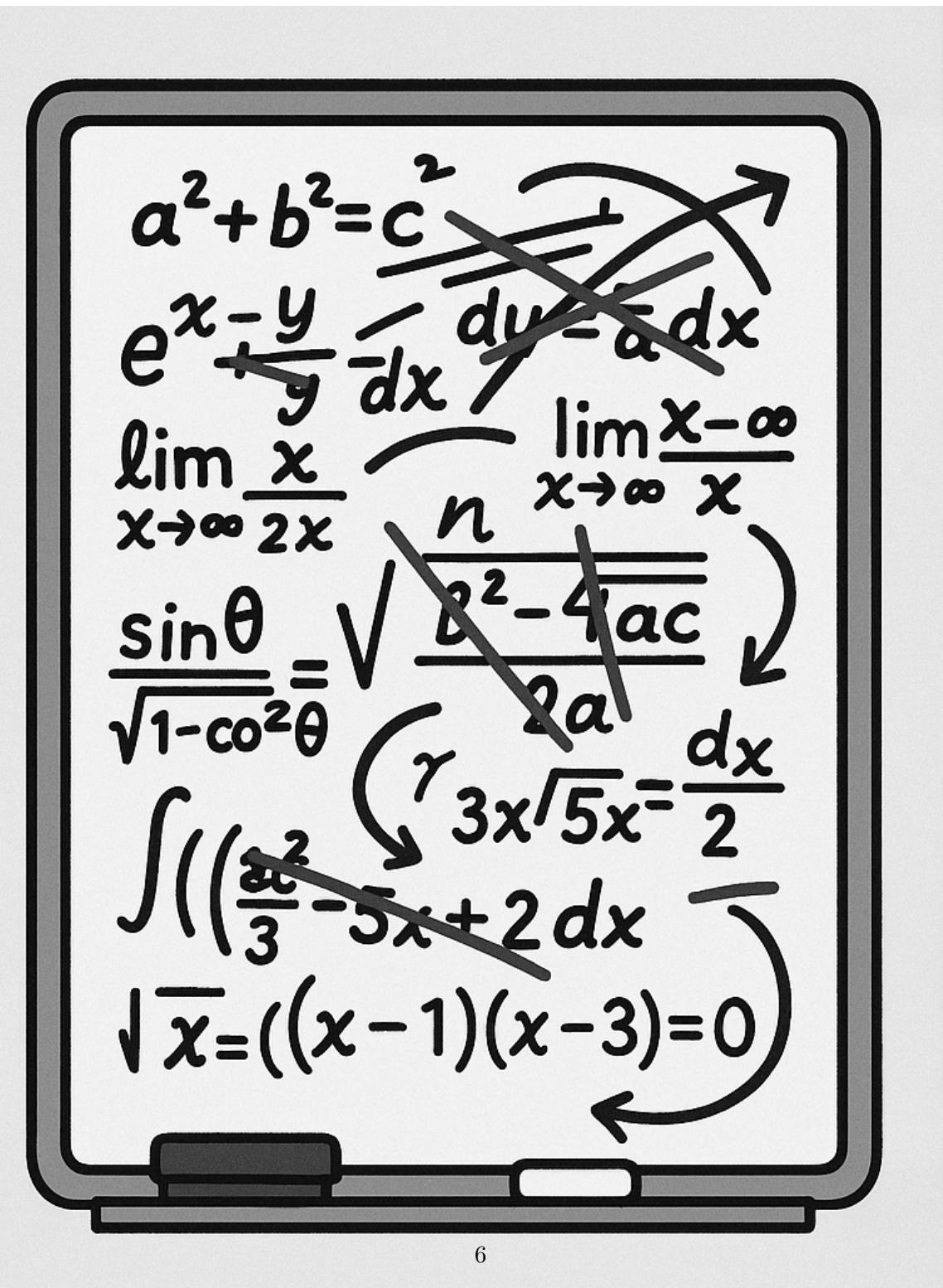
Format: [HOW YOU WANT THE OUTPUT]

Context: [BACKGROUND INFO IF NEEDED]

Save this! 80% of your AI interactions will use this basic structure

Reason 1: Limited “Working Memory”

The “Everything” Prompt



The Step-by-Step Approach

Solve:

$$x^2 - 4x + 3 = 0$$

1. $(x-1)(x-3) = 0$

2. $x - 1 = 0$

3. $x = 1$

4. $x = 3$

$$x^2 - 4x + 3 = 0$$

One problem, full space = Detailed, accurate results

Takeaway: A single, focused task gets the AI's full attention

LLMs have a context window - think of it as their working memory. When you fill it with multiple complex tasks, each gets less attention and processing power.

Technical Detail: Context Windows

What's really happening?

- LLMs have **finite context windows** (8k-200k tokens)
- Token ~0.75 words
- Each task competes for this limited space

Example:

- LLM Context window: ~8,000 tokens
- Complex research prompt: ~500 tokens
- Response space needed: ~1,500 tokens per task
- **Result:** Only 3-4 tasks fit properly!

Think of it like RAM: Too many programs = computer slows down. Too many tasks = AI quality drops.

This is why breaking tasks down isn't just helpful - it's technically necessary for quality outputs.

Reason 2: Guiding the AI's “Thinking”

LLMs Create Answers Piece by Piece

- Each word depends on previous words
- Complex prompts = mental shortcuts
- Structured prompts = logical reasoning

Cooking Analogy

Bad: “Make beef wellington”

Chef might skip steps or use wrong ingredients

Good: 1. “First, sear the beef” 2. “Next, prepare duxelles” 3. “Then, wrap in pastry”

By giving step-by-step instructions, you force the AI to build a logical argument, leading to much stronger outputs.

Reason 3: Easy Error Detection & Fixing

With a Giant Prompt

- Problem: Weak experimental method
- Solution: Re-run EVERYTHING
- Time lost: 10-15 minutes
- Quality: Hope for the best

With Our Workflow

- Problem: Weak experimental method
- Solution: Fix just that step
- Time lost: 2 minutes
- Quality: Keep what works

Benefit: Iterative refinement = Higher quality + Less frustration

Reason 4: More and Better Ideas

Diversity vs. Convergence

Single Prompt Approach

“Give me the best hypothesis for oat milk fermentation” → **One idea, possibly mediocre**

Our Multi-Step Approach

1. **Generate:** “Give me 5 hypotheses” → **Diversity**
2. **Evaluate:** “Score each for feasibility” → **Analysis**
3. **Select:** “Recommend the top 3” → **Quality**

Result: Multiple perspectives + Critical evaluation = Stronger research

Good AI Outputs Look Like This:

Structure & Detail - Organized sections - Specific numbers/examples - Academic language
- Proper formatting

Actionable Content - Clear next steps - Testable hypotheses - Realistic timelines - Measurable outcomes

Bad AI Outputs Look Like This:

Vague & Generic - “Consider various factors...” - “This is an important topic...” - “Results may vary...”

Incomplete - Missing key sections - No specific examples - Unclear methodology

The 10-Step Research Workflow

From Idea to Manuscript

Discovery Phase (Steps 1-5) ~60 minutes
1. **Idea Generation** - Brainstorm hypotheses (8 min)
2. **Parallel Exploration** - Diversify ideas (12 min)
3. **Preliminary Testing** - Feasibility checks (10 min)
4. **Optimization** - Find best parameters (15 min)
5. **Full Execution** - Main study design (15 min)

The 10-Step Research Workflow (cont'd)

From Idea to Manuscript

Communication Phase (Steps 6-10) ~40 minutes

6. **Component Analysis** - What matters most? (8 min)

7. **Visualization** - Create figures & charts (*10 min*)
8. **Writing** - Draft manuscript (*12 min*)
9. **Review** - Peer review simulation (*5 min*)
10. **Iteration** - Continuous improvement (*5 min*)

Total time: ~100 minutes for a complete research project from idea to first draft!

This mirrors the **actual scientific method** - we're just using AI as our assistant!

Step 1: Idea Generation

The Power of Structured Brainstorming

Prompt Template:

You are an AI research scientist specializing in Food Science. Given the following research area, generate 5 distinct and innovative scientific hypotheses suitable for a Masters-level research paper.

For each hypothesis, include:

- A clear Title
- 3-5 Keywords
- A short Abstract (under 200 words)
- An explanation of its Novelty and Significance

Research Area: [YOUR TOPIC HERE]

Pro tip: Replace “Food Science” with your specific field for better results!

Notice how specific this prompt is. We’re not just asking for “ideas” - we’re asking for structured, academic hypotheses.

Step 2-3: Exploration & Feasibility

Step 2: Parallel Exploration (*12 min*)

- Open multiple chat sessions
- Generate non-overlapping ideas
- Score and rank all options
- **Output:** 10-15 diverse hypotheses

Step 3: Preliminary Testing (10 min)

- Select top hypothesis
- Design minimal experiment
- Generate expected data
- **Output:** Feasibility confirmed

Key insight: Step 2 prevents tunnel vision - you see ALL possibilities before committing!

Steps 4-6: The Research Core

Building Your Study

Step 4: Optimization (15 min) - Test variable combinations - Define success criteria - Find the “sweet spot”

Step 5: Full Execution (15 min) - Detailed methodology - Comprehensive data tables - Statistical measures

Step 6: Component Analysis (8 min) - What ingredients matter? - Ablation studies - Understanding mechanisms

Steps 7-10: Communication & Refinement

Step 7: Visualization (10 min) - Generate scientific figures - Write clear captions - Visual storytelling

Step 8: Manuscript Writing (12 min) - Complete paper draft - All sections included - Proper citations

Step 9: Peer Review (5 min) - Critical evaluation - Scoring rubric - Actionable feedback

Step 10: Iteration (5 min) - Address weaknesses - Refine sections - Achieve excellence

When AI Goes Wrong: Real Examples

Hallucination Alert!

Made-up Citations: > “According to Smith et al. (2023), fermentation at 45°C increases yield by 23%”

Reality: Paper doesn’t exist!

Plausible but Wrong Data: > “Oat milk contains 15g protein per 100ml”

Reality: Usually 1-3g per 100ml

What You Should Do:

1. Always verify numerical claims
2. Check citations before using them
3. Cross-reference with reliable sources
4. Use AI for structure, not facts

Remember: AI is confident even when wrong!

Ethical Guidelines: Using AI in Academic Work

The Right Way to Cite AI Assistance

In your methods section: > “Hypothesis generation and experimental design were developed with assistance from Microsoft Copilot (Microsoft Corporation, 2024). All outputs were verified against peer-reviewed literature.”

What Requires Citation:

- Idea generation
- Statistical analysis suggestions
- Writing structure
- Data interpretation ideas

What Doesn't:

- Grammar checking
- Simple calculations
- Basic formatting

Bottom line: When in doubt, cite it. Transparency builds trust.

Live Demo Time!

Your Choice: Which Research Should We Explore?

Option A: Fermentation Study - Oat milk fermentation - pH, cell counts, viscosity - 3 treatments over 48 hours

Option B: Shelf Life Analysis - Yogurt alternatives - Microbial & sensory data - 4 products over 30 days

Option C: Sensory Panel - Plant-based cheese - 50 panelists - Texture, flavor, preference

Option D: Process Optimization - Protein extraction yields - Temperature vs pH effects - Response surface data

Vote Now!

Scan QR code or shout out your choice!

Quick Demo: Bad vs. Good Prompting

Let's try both approaches... (*10 minutes total*)

First: The “Everything” Prompt (*3 min*)

Watch what happens when we ask for too much at once

“Analyze [winning dataset], create graphs, write conclusions, and suggest future research”

Then: Our Structured Approach (7 min)

See the difference when we break it down

Steps 1 → 3 → 7 in sequence

Pay attention to: Response quality, detail level, and actionability

Troubleshooting Common Issues

When Things Don't Work

Problem: AI gives generic responses - **Solution:** Add more specific requirements to your prompt

Problem: Getting confused by long conversations - **Solution:** Start a new chat session

Problem: AI refuses to help - **Solution:** Rephrase more academically, avoid trigger words

Universal fix: When stuck, start fresh with a clearer, more specific prompt

Understanding AI Limitations

Critical Things to Know

Hallucinations - AI can “make up” information - Fake citations are common - Always verify sources - May invent plausible-sounding data

Other Limitations - Knowledge cutoff dates - Can’t access real databases - No actual lab work - Context window limits

Golden Rule for Research

Never trust, always verify! Use AI for ideation and structure, but validate all facts, citations, and data.

Key Takeaways

1. **One Task, One Prompt** - Your golden rule
2. **Structure = Success** - Guide the AI step-by-step
3. **Iterate & Refine** - Fix what needs fixing
4. **Think Like a Manager** - You're the boss!
5. **Always Verify** - AI assists, you validate

Next Session Preview

- Hands-on practice with all 10 steps
- Building your own AI research agent
- Advanced techniques and shortcuts
- **Bring a research topic you're curious about!**

Your Mission (Should You Choose to Accept)

Before Next Session:

1. **Think** of a research topic you're interested in
2. **Try** the idea generation prompt on your own
3. **Note** what works and what doesn't
4. **Bookmark** copilot.microsoft.com or your preferred AI tool

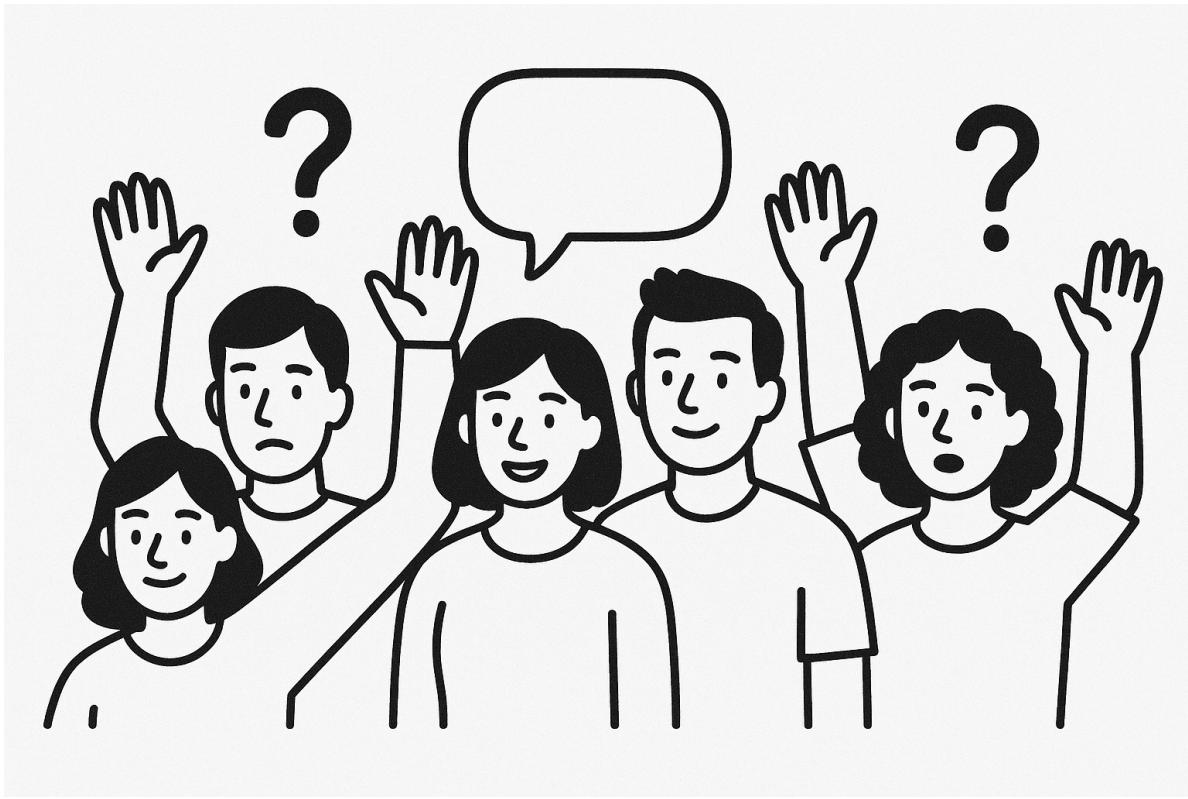
Remember

You're not learning to use AI - you're learning to **manage** AI

Questions?

Let's Discuss!

- Concerns about the workflow?
- Technical questions?
- Want to see another demo?
- Ethical considerations?



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Bonus Slide: The Complete Workflow

Your Research Assistant Checklist

Step	Task	Time	Output
1	Idea Generation	8 min	5 hypotheses table
2	Parallel Exploration	12 min	10-15 total ideas
3	Feasibility Testing	10 min	Experimental plan + data
4	Optimization	15 min	Best parameters
5	Full Study	15 min	Complete methodology
6	Component Analysis	8 min	Key factors identified
7	Visualization	10 min	Figures + captions
8	Writing	12 min	Full paper draft
9	Review	5 min	Feedback report
10	Iteration	5 min	Refined manuscript

This is a reference slide students can photograph or refer back to.

Resources & Links

Everything You Need

- **Presentation slides:** [GitHub link will be here]
- **All datasets:** [GitHub data folder link]
- **Audio version:** [NotebookLM podcast link]
- **Video explainer:** [NotebookLM video link]
- **Quick reference:** [Prompt templates document]

Created with assistance from Claude (Anthropic)