Prompt Engineering
in
Generative AI (gAI)

Vivek S. Dave, Ph.D., M.B.A.
Professor & Chair (Dept. Pharm. Sci.)
St. John Fisher University, Wegmans School of Pharmacy
3690 East Avenue, Room WEGPHR#312, Rochester, NY, 14618
Phone: (585) 385-5297
E-mail: vdave@sjf.edu

Disclaimers & Contextual Notes

- I do not claim to be an "expert" in Artificial Intelligence.
  - I am deeply curious and passionate about the intersection of AI, instructional design, and health professions education.
- AI technologies, especially in the realm of generative models, are evolving at an extraordinarily rapid pace (often daily).
  - The information presented today reflects the state of knowledge as of September 2025.
  - Updates and advancements may have occurred since the preparation of this session.
- Portions of this presentation, including slide structuring, content refinement, and illustration examples, were assisted by generative gAI tools (e.g., ChatGPT, MS Copilot, Google Gemini, heyGen, etc.)
  - All efforts have been made to verify and cross-check information with credible, traceable, and scholarly sources.
- This presentation is designed to foster dialogue, reflection, and faculty development
  - Not to prescribe *one-size-fits-all* solutions.
- Questions, differing views, and collaborative discussion are strongly encouraged
  - This is a shared learning space.

Real A/V Recording

Generated using gAI (ChatGPT + HeyGen)

Outline

Introduction & Context

What is Prompt Engineering?

Why Prompt Engineering Matters

Core Strategies for Effective Prompting

Popular Frameworks for Prompts

Challenges and Considerations

Conclusions

Introduction & Context

Generative AI Revolution

- Launched late 2022
- 100 million users in 2 months
- "supercharged" the potential of gAI in healthcare and education
- Educators - how will these tools shape the training of future professionals?

Why Pharmacy Education?

- Data-intensive and communication-driven field
- AI offers new ways to **augment learning and practice**
- Embracing gAI's possibilities while **managing its pitfalls** is critical for academic leaders, faculty, and students

Introduction & Context
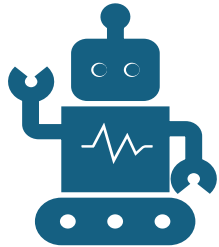
What is Generative AI?

-Systems that produce new content in response to prompts

-Unlike a search engine ('_retrieve_' existing information), gAI _creates_ responses by 'predicting' text based on 'patterns' learned from vast data

-gAI is **interactive and sequential**

• It remembers context from earlier prompt/s

Why Prompts Matter

-Unlike humans, AI models lack true understanding

• They rely entirely on the prompt to infer what the user wants.

-Same model → vastly different outputs (prompt dependent)

-Same prompt → different AI models → different outputs (learning data dependent)

What is Prompt Engineering?

Definition

- *Prompt engineering is the art and science of crafting effective inputs to guide an AI model towards generating the desired output.*

- *Prompt engineering is the process of designing, refining, and optimizing prompts (instructions or questions) to guide an AI model toward the desired output.*

- *It is an emerging discipline at the intersection of language, psychology, and AI*

- *'Figuring out **how to ask AI the right way**'*

An Essential 21ˢᵗ Century Skill

- The *"new essential skill"* for professionals

- In healthcare and education, where precision and clarity are paramount, being able to coax accurate information from an AI is as important as knowing where to look up drug information

Why Prompt Engineering Matters

- **Garbage In, Garbage Out**
  - gAI models will earnestly answer anything
    - Even if the query is vague or flawed
  - Poorly worded questions → irrelevant or incorrect answers
  - Prompt engineering skill
    - Ensures the question we pose is clear, specific, and aligned with what we actually need.
- **Quality, Accuracy, Relevance**
  - A thoughtful prompt → dramatically improved quality, accuracy, and relevance of gAI-generated output
- **Mitigating AI's Quirks**
  - gAI can sometimes "hallucinate" or output biased/inappropriate text if not guided
  - A prompt can be engineered to prevent the AI from confidently making something up.
    - E.g. "*If you don't know the answer, say you are unsure,*"

Core Strategies for Effective Prompting

Clarity and Specificity

- Be clear about what you want
- Vague prompts yield verbose or off-target answers
- E.g. "*Explain diabetes,*" vs. "*Explain Type 2 diabetes to a patient with no medical background, in 3-4 paragraphs (or bulleted list), using simple analogies.*"

Provide Context or Role

- "*You are a clinical pharmacist. Provide counseling to a patient starting lisinopril (an ACE inhibitor) for hypertension.*" vs.
- "*You are a board-certified clinical pharmacist practicing in an ambulatory care setting. A patient has just been prescribed lisinopril, an angiotensin-converting enzyme (ACE) inhibitor, to manage newly diagnosed hypertension. Your task is to provide comprehensive patient counseling in a manner that is clear, professional, empathetic, and tailored for a layperson without a medical background. Use plain, non-technical language suitable for an adult with an average health literacy level. Maintain a respectful, patient-focused, and reassuring tone throughout. Structure your response in short paragraphs or bulleted lists for clarity and readability.*"

# Core Strategies for Effective Prompting (Contd.)

Chain-of-thought prompting

- Rather than one long prompt, do it in steps
- E.g. **Prompt #1**:"*You are interested in writing a humor book on pharmacy faculty having fun. Please suggest a catchy title for this book*" → **Prompt #2**: "You have chosen 'xyz' as the title of your book. *You plan the book to be about 100-150 pages with 6-8 chapters. please suggest an outline of chapters for this book*" → **Prompt #3**: "*For the chapter 1, please provide about 1-2 pages of a highly engaging introduction that will have the readers wanting to read more*", and so on....

Open-Ended vs. Specific Questions

- Decide if you want a 'broad explanation' or a 'focused answer'
- "*How might AI tools like ChatGPT improve student learning of pharmacy calculations*" vs.
- "*A first-year Pharm.D. student is struggling with the concept of 'density & specific gravity' within the 'Pharmacy calculations' course. Please provide an easy-to-understand, step-by-step guide to assist this student's learning. Please supplement your guide with several relevant examples for the student to practice with*. Finally, provide step-by-step solutions to all practice questions"

Core Strategies for Effective Prompting (Contd.)
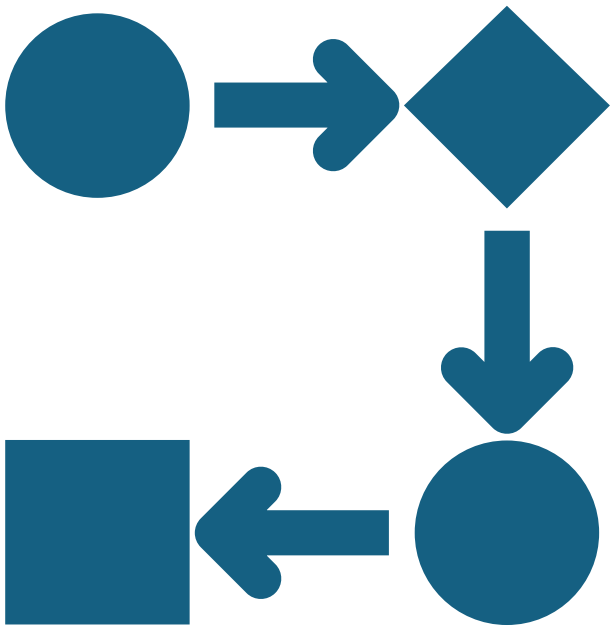
- **Iterate and Refine**
  - You will rarely get the perfect answer on the first try, and that's expected
  - Use follow-up prompts to refine
  - AI can remember what it just told you and adjust accordingly
  - Iterative prompt refinement is a key part of prompt engineering
  - Encourage students (and yourself) to not stop at the first answer
    - Experiment by rephrasing the question or,
    - Asking the AI to elaborate on certain points

Popular Prompting Frameworks

- **C.R.A.F.T.S.**
  - C: Context - What is the situation, background, or purpose?
  - R: Role – Who is the writer or speaker?
  - A: Audience – Who is the output directed to?
  - F: Format – What is the form of the output? (e.g., email, blog post, letter)
  - T: Topic – What is the subject of the response?
  - S: Strong Verb – What is the objective? (e.g., explain, persuade, reflect)

Hands-on Activity #1

- You want to prepare an instructional activity for a third-year Pharm.D. course in the Pharmacotherapeutics sequence, focusing on infectious diseases, specifically 'Hospital Acquired Pneumonia'.
    - **Step 1**: Using a gAI tool of your choice, input a simple (1-2 sentence) prompt and review the output.
    - **Step 2**: copy/paste the provided prompt created using 'C.R.A.F.T.S.' framework.
    - Compare the outputs from steps 1 & 2

Popular Prompting Frameworks

- Example Prompt using **C.R.A.F.T.S.**

  - ***Context****: You are preparing an instructional activity for a third-year Pharm.D. course in the Pharmacotherapeutics sequence, focusing on infectious diseases. Students have recently completed foundational lectures on antimicrobial agents and are now transitioning to applied, patient-centered care models. The goal is to deepen students' understanding of how to apply antimicrobial stewardship principles in clinical scenarios.*

  - ***Role****: You are a pharmacy educator and infectious disease specialist designing an active learning activity that promotes clinical reasoning, guideline application, and patient safety.*

  - ***Audience****: The activity is intended for third-year Pharm.D. students with baseline knowledge of microbiology, antimicrobial classes, and resistance patterns but limited experience in applying this knowledge to real-world cases.*

  - ***Format****: Design a 60-minute, small-group, case-based classroom exercise using a simulated patient scenario. The session should involve collaborative problem-solving, guided debriefing, and include instructor-facilitated feedback.*

  - ***Topic****: The therapeutic topic is hospital-acquired pneumonia (HAP), with emphasis on empiric therapy selection, de-escalation strategies, duration of treatment, and monitoring for therapeutic effectiveness and adverse events.*

  - ***Strong Verb****: Construct a multifaceted case study and corresponding learning materials that help students evaluate therapeutic choices, justify antibiotic selection based on clinical guidelines (e.g., IDSA/ATS), and formulate safe and effective treatment plans with attention to renal function, culture data, and resistance trends.*

Hands-on Activity #1b

- You want to create practice problems and explanations related to ***dilution and concentration calculations*** for first-year students enrolled in "Pharmacy Calculations" course.
    - **Step 1**: Using a gAI tool of your choice, input a simple (1-2 sentence) prompt and review the output.
    - **Step 2**: copy/paste the provided prompt created using 'C.R.A.F.T.S.' framework.
    - Compare the outputs from steps 1 & 2

Popular Prompting Frameworks

- Example Prompt using **C.R.A.F.T.S.**
  - **Context**: *You are developing lecture materials and formative assessment activities for a first-year Pharmacy Calculations course. Your goal is to design high-quality, realistic practice problems that reinforce key concepts in dilution, concentration, and compounding calculations. You would like to create varied and pedagogically sound problem sets with accompanying explanations.*
  - **Role**: *Act as an experienced pharmacy educator and course coordinator responsible for teaching foundational calculation principles to Pharm.D. students. You ensure that problems align with ACPE competencies and foster accuracy, conceptual understanding, and application to real-world pharmacy scenarios.*
  - **Audience**: *First-year Pharm.D. students enrolled in the Pharmacy Calculations course who have introductory exposure to ratio and proportion, dimensional analysis, and concentration expressions but are still developing fluency and confidence in applying these methods.*
  - **Format**: *Generate a set of 10 structured practice problems that progressively increase in complexity. Each problem should include:*
    - *The full problem statement with all quantities and units clearly defined*
    - *A step-by-step solution using dimensional analysis or appropriate calculation methodology*
    - *The final answer, clearly stated with units*
    - *Two short conceptual reflection questions (e.g., "Why was this calculation method used?" or "How would the result change if…?")*
    - *At the end, include a one-paragraph instructor note explaining how these problems can be used in active learning, small-group, or formative assessment contexts.*
  - **Topic**: *Pharmacy calculation concepts focusing on allegation, dilution, and concentration problems commonly encountered in professional pharmacy practice - including IV admixture preparation, reconstitution of antibiotics, and adjusting concentrations for pediatric dosing.*
  - **Strong Verb**: *Generate realistic, pedagogically sound, and progressively challenging pharmacy calculation problems with clear solutions, reflective questions, and instructor guidance that promote conceptual understanding and professional application.*

Popular Prompting Frameworks

- **R.I.S.E.N.**
  - R: Role – Who is responding?
  - I: Intention – What is the goal or purpose?
  - S: Structure – What format or structure should the response take?
  - E: Evidence – What data, support, or examples must be used?
  - N: Nuance – What complexity, tone, or depth is expected?

Hands-on Activity #2

- You are a clinical pharmacy specialist with expertise in cardiology and want to design a module on heart failure pharmacotherapy for Pharm.D. students.

    - **Step 1**: Using a gAI tool of your choice, input a simple (1-2 sentence) prompt and review the output.

    - **Step 2**: copy/paste the provided prompt created using 'R.I.S.E.N.' framework.

    - Compare the outputs from steps 1 & 2

Popular Prompting Frameworks

- Example Prompt Using **R.I.S.E.N.**
  - **Role**: *You are a clinical pharmacy specialist with expertise in cardiology, responding to a request from a pharmacy educator who is designing a module on heart failure pharmacotherapy for Pharm.D. students.*
  - **Intention**: *The goal is to provide a detailed, evidence-based comparison of guideline-directed medical therapies (GDMT) for Heart Failure with reduced Ejection Fraction (HFrEF), highlighting key teaching points, clinical pearls, and common pitfalls students should recognize.*
  - **Structure**: *Your response should be organized as:*
    - *Concise overview of HFrEF treatment goals*
    - *Comparison table of drug classes (e.g., beta-blockers, ARNIs, SGLT2 inhibitors) covering mechanisms, dosing, and landmark trials*
    - *Case-based example illustrating a patient's therapeutic journey*
    - *Teaching tips for addressing student misconceptions (e.g., "Why is hydralazine/nitrate combination still used?")*
  - **Evidence**: *Support recommendations with:*
    - *2022 AHA/ACC/HFSA Heart Failure Guidelines*
    - *Landmark trials (e.g., PARADIGM-HF, DAPA-HF)*
    - *Real-world data on adherence challenges (e.g., cost/access barriers to ARNIs)*
  - **Nuance**: *Balance depth (e.g., nuanced titration strategies) with accessibility for learners. Use a collaborative tone (e.g., "A common debate in practice is...") and highlight gray areas (e.g., when to prioritize SGLT2 inhibitors over ARNIs in specific populations).*

Popular Prompting Frameworks

- **C.R.E.A.T.E.**
  - C: Clarify – Define the goal clearly.
  - R: Reflect – Encourage connection to prior knowledge or experience.
  - E: Explore – Involve exploration or ideation.
  - A: Apply – Require real-world application or synthesis.
  - T: Transform – Promote original or divergent thinking.
  - E: Evaluate – Include self-assessment or critical thinking.

Hands-on Activity #3

- You are a pharmacy educator and want to design a one-hour workshop for Pharm.D. students to critically evaluate antibiotic prescribing in hospital-acquired pneumonia (HAP) cases.

  - **Step 1**: Using a gAI tool of your choice, input a simple (1-2 sentence) prompt and review the output.

  - **Step 2**: copy/paste the provided prompt created using 'C.R.E.A.T.E.' framework.

  - Compare the outputs from steps 1 & 2

Popular Prompting Frameworks
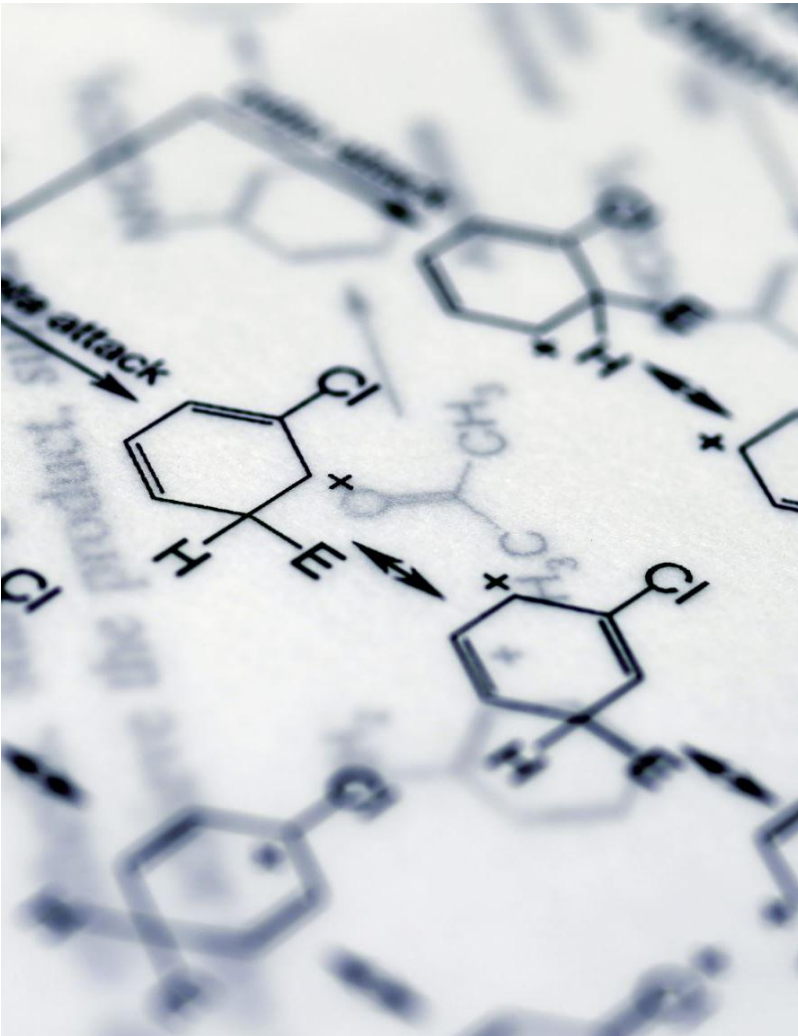
- Example Prompt Using **C.R.E.A.T.E.**
  - ***Clarify***: *Design a 60-minute workshop for PharmD students to critically evaluate antibiotic prescribing in hospital-acquired pneumonia (HAP) cases. The goal is to reinforce antimicrobial stewardship principles, including spectrum selection, de-escalation, and duration of therapy, while aligning with IDSA/ATS guidelines.*
  - ***Reflect***: *Begin by asking learners to recall prior knowledge (e.g., "What are key risk factors for multidrug-resistant pathogens in HAP?"). Have them reflect on past clinical or classroom cases where inappropriate antibiotic use led to resistance or adverse outcomes.*
  - ***Explore***: *Facilitate small-group exploration of:*
    - *Case vignettes with real-world prescribing errors (e.g., overly broad empiric coverage, missed de-escalation opportunities).*
    - *Interactive debate on controversial scenarios (e.g., "Would you use piperacillin-tazobactam vs. cefepime in this ICU patient with renal dysfunction?").*
  - ***Apply***: *Task students with creating a stewardship intervention for a hypothetical hospital:*
    - *Develop a 1-page guideline summary for empiric HAP therapy.*
    - *Role-play a pharmacist-provider conversation advocating for de-escalation.*
  - ***Transform***: *Challenge learners to think beyond guidelines:*
    - *"How would you adapt stewardship strategies in a resource-limited setting?"*
    - *"Design an infographic to teach nurses about early culture stewardship."*
  - ***Evaluate***: *Conclude with a self-assessment (e.g., "Rate your confidence in HAP stewardship on a 1–5 scale") and group critique of one another's guideline summaries.*

Popular Prompting Frameworks

- **S.P.A.R.K.**
  - S: Situation – What is the scenario or background?
  - P: Purpose – Why are we generating this content?
  - A: Audience – Who is it intended for?
  - R: Requirements – What are the must-have elements?
  - K: Knowledge – What prior knowledge or context is needed?

Hands-on Activity #4

- You are a pharmacy educator and want to prepare a lecture on anticoagulant therapies focusing on the key differences between warfarin and direct oral anticoagulants (DOACs)
  - **Step 1**: Using a gAI tool of your choice, input a simple (1-2 sentence) prompt and review the output.
  - **Step 2**: copy/paste the provided prompt created using 'S.P.A.R.K.' framework.
  - Compare the outputs from steps 1 & 2

Popular Prompting Frameworks

- Example Prompt Using S.P.A.R.K.
  - *Situation: As a pharmacy educator preparing a lecture on anticoagulant therapies, you need to develop an engaging and informative session for students who will soon begin clinical rotations. With the increasing use of direct oral anticoagulants (DOACs) in practice, it's essential to ensure learners understand key differences between warfarin and DOACs, including dosing, monitoring, and patient counseling points.*
  - *Purpose: The goal is to create a case-based learning activity that reinforces critical decision-making skills, helps students compare and contrast anticoagulants, and prepares them to confidently manage patients on these medications in real-world settings.*
  - *Audience: The content is intended for third-year PharmD students who have completed foundational pharmacology coursework but have limited clinical experience with anticoagulation therapy.*
  - *Requirements: The activity must include:*
    - *A patient case (e.g., atrial fibrillation vs. DVT treatment)*
    - *Comparison tables (warfarin vs. DOACs: dosing, monitoring, reversal agents)*
    - *Interactive elements (e.g., polling questions, small-group discussions)*
    - *Common counseling points (e.g., dietary restrictions, signs of bleeding)*
  - *Knowledge: Students should already be familiar with:*
    - *Basic coagulation pathways*
    - *Pharmacokinetics of warfarin and DOACs*
    - *INR monitoring principles*
    - *General principles of medication safety*

gAI Prompting Frameworks (summary)

Framework	Meaning	Best Use Case	Key Features
A.I.D.E.	Ask - Inform - Define - Evaluate	Ethical and critical evaluation of AI use	Promotes responsible AI use through well-structured task framing.
C.O.T.	Chain of Thought	Logic and reasoning tasks	Encourages the AI to explain step-by-step reasoning before concluding to improve accuracy.
C.R.A.F.T.S.	Context - Role - Audience - Format - Topic - Strong Verb	Creative and expository student prompts	Guides student outputs using structured elements like audience and format.
C.R.E.A.T.E.	Clarify - Reflect - Explore - Apply - Transform - Evaluate	Innovation and applied learning	Encourages connection, synthesis, transformation, and evaluation of knowledge.
D.A.R.E.	Defend - Argue - Refute - Evaluate	Argumentative writing	Encourages structured debates with defense, refutation, and critical evaluation.
I.+ E. (FSP)	Instruction + Example (Few-Shot Prompting)	Replicating tone or format	Uses explicit examples to guide AI output in similar style or structure.
L.E.A.P.	Look - Engage - Act - Present	Inquiry-based and experiential learning	Fosters observation, reflection, creation, and peer engagement.
M.E.C.E.	Mutually Exclusive, Collectively Exhaustive	Categorization and diagnostics	Organizes outputs into non-overlapping, exhaustive categories for clarity.
P.E.E.L.	Point - Evidence - Explanation - Link	Persuasive writing	Supports structured argument construction, commonly used in education.
P.R.O.M.P.T.	Purpose - Role - Organization - Mechanics - Product - Tone	Clear, multi-use prompts	Structures prompts with purpose, mechanics, product, and tone for targeted responses.
R.A.F.T.	Role - Audience - Format - Topic	Educational writing	Supports audience-aware communication, especially in academic contexts.
R.I.S.E.N.	Role - Intention - Structure - Evidence - Nuance	Reflective and ethical thinking	Promotes critical thinking and structured analysis of complex issues.
R.T.C.	Role - Task - Context	General-purpose prompting	Assigns a role, defines a task, and provides necessary background for clarity and focus.
S.C.O.R.E.	Situation - Challenge - Opportunity - Resolution - Evaluation	Strategic analysis	Breaks down a situation into analytical categories for evaluation and decision-making.
S.O.A.R.	Summarize - Organize - Analyze - Recommend	Analytical synthesis and recommendations	Guides prompts through summarization, organization, analysis, and action.
S.P.A.R.K.	Situation - Purpose - Audience - Requirements - Knowledge	Creative or scenario-based student work	Guides learners through audience-awareness, scenario, and content needs.
T.R.I.C.	Task - Role - Input - Constraints	Controlled outputs	Adds structured parameters such as tone, format, and content boundaries.

Challenges and Considerations

- **Accuracy & Hallucinations**
  - gAI does not know truth – it generates plausible text
  - It may confidently present **incorrect** information
  - In pharmacy, accuracy is paramount
    - A wrong dose or interaction in an AI-generated answer could be dangerous
    - Partially tackle this by phrasing prompts to encourage accuracy
      - e.g., "*Cite the source*" or "*If unsure, say you do not know*"
    - Always double-checking critical information against trusted references.
  - gAI should **supplement, not replace**, evidence-based resources.
  - Knowing the AI's limitations is crucial to set realistic expectations

Challenges and Considerations (contd.)

- **Bias and Fairness**
  - gAI models learn from vast data that may contain cultural or gender biases.
    - Prompts could elicit biased responses (e.g., stereotypes in a patient scenario)
  - It's important to be aware of this and counteract it.
    - E.g. when generating case studies or patient advice, include a variety of patient contexts in prompts to ensure diversity (different ages, ethnic backgrounds, etc.)
    - So that the AI doesn't always assume a default

Challenges and Considerations (Contd.)

- **Academic Integrity**
  - A major concern in education is students misusing gAI
    - Plagiarism, cheating on assignments, etc.
    - If a student simply asks ChatGPT to write an essay and submits it, that violates academic integrity.
  - It's vital to address this head-on
  - Many strategies to protect academic integrity involve education rather than just detection
    - The best mitigation includes **training students and faculty** about **ethical AI use** and setting **clear guidelines**
  - By incorporating prompt engineering exercises in class, educators can turn this into a learning opportunity
    - Showing students how gAI can help with brainstorming or refining work
    - Also showing where relying on gAI is inappropriate

Challenges and Considerations (Contd.)

- **Privacy and Data Security**
  - There's a risk of privacy breaches, if we input sensitive data (like patient or student information) into the public versions of gAI tools
  - Institutions should guide on **what not to share with gAI**
    - Unless using approved, secure platforms
  - De-identify patient/student before using them in a prompt
    - Or use an institutional version of the gAI that complies with privacy regulations
  - In pharmacy context, think of HIPAA and FERPA
    - Users must be careful not to inadvertently expose protected information *via* prompts

Challenges and Considerations (Contd.)

- **gAI Literacy and Misinformation**
  - Both students and educators need a **baseline understanding** of how gAI works and its limits
  - There's a r**isk of over-reliance** or trust in gAI outputs
  - Ongoing training is needed to ensure users critically appraise gAI outputs
  - Prompt engineering includes asking the model to provide justification or references, **but the human must verify them**
  - By treating gAI as a *collaborator* **that still requires oversight**, we can avoid the trap of misinformation
  - Any gAI-generated content for students, patients, or clinical decisions should be reviewed by a qualified professional

Conclusions

- Generative AI, spearheaded by ChatGPT's debut, represents a paradigm shift in how we generate and interact with information.

- For pharmacy education, it offers transformative opportunities: from richer learning experiences to streamlined administrative tasks, **if we wield it wisely.**

- **Prompt engineering** is the key to unlocking these benefits, by **bridging the gap between human intention and gAI output.**

- **Administrators** can explore gAI for efficient operations, **professors** can integrate gAI for interactive teaching and content creation, **students** can personalize their learning, and **alumni in practice** can leverage gAI for patient education and professional writing.

Conclusions (contd.)

- To fully realize the promise of generative AI, we must address its challenges.
    - Teaching prompt engineering and AI literacy as part of the curriculum
    - Establishing ethical guidelines and policies
    - Encouraging a mindset of critical evaluation

- The AI tools will continue to evolve
    - Future AI may require less prompt finesse as they become more "intelligent," but in truth, **defining objectives clearly will always matter**
    - Prompt engineering is here to stay, even if its form changes.
    - Staying current will be a part of professional development.

- By investing time to craft good prompts and maintain ethical guardrails, we can amplify innovation in pharmacy education while safeguarding the quality and integrity of our work.

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Questions?

Post Session Feedback