



BRIDGING THE GENERATIVE AI LITERACY GAP: A GUIDE TO INTRODUCING PROMPT ENGINEERING IN UNIVERSITY COURSES

Meg Coffin Murray*

Kennesaw State University,
Kennesaw, GA USA

mcmurray@kennesaw.edu

* Corresponding author

ABSTRACT

| | |
|--------------|--|
| Aim/Purpose | To address the gap in students' effective use of generative AI tools, this paper presents a framework to introduce university students to the principles and practices of prompt engineering – the art and science of crafting precise and purposeful inputs to guide LLMs in generating accurate and useful outputs. This paper aims to equip students with strategies to interact meaningfully with AI chatbots for academic success. |
| Background | Generative AI tools, like ChatGPT, are widely adopted in educational settings, yet many students lack the skills to harness their full potential. This paper introduces prompt engineering as a critical competency for students to develop both technical proficiency and critical thinking. |
| Methodology | The paper provides a structured framework for teaching prompt engineering in university courses. It draws on existing literature, practical applications, and pedagogical strategies to guide educators in integrating generative AI effectively into their university courses. |
| Contribution | This paper contributes to the body of knowledge by presenting a comprehensive framework for teaching prompt engineering. It highlights prompt engineering's role in enhancing AI literacy and preparing students for technology-driven academic and professional environments. |
| Findings | Prompt engineering enhances students' ability to generate precise and relevant outputs from AI tools by supporting student development of communication strategies tailored to large language models. This guide introduces essential concepts and skills that facilitate effective interaction with AI chatbots. Structured instruction in prompt engineering helps to foster critical thinking, problem-solving, and reflective interaction – key competencies for navigating an AI- |

Editor: Eli Cohen | Received: January 26, 2025 | Revised: March 23, 2025 | Accepted: April 29, 2025

Cite as: Murray, M. C. (2025). Bridging the Generative AI Literacy Gap: A Guide to Introducing Prompt Engineering in University Courses. *Issues in Informing Science and Information Technology*, 22, Article 10. <https://doi.org/10.28945/5516>

(CC BY-NC 4.0) This article is licensed to you under a [Creative Commons Attribution-NonCommercial 4.0 International License](https://creativecommons.org/licenses/by-nc/4.0/). When you copy and redistribute this paper in full or in part, you need to provide proper attribution to it to ensure that others can later locate this work (and to ensure that others do not accuse you of plagiarism). You may (and we encourage you to) adapt, remix, transform, and build upon the material for any non-commercial purposes. This license does not permit you to use this material for commercial purposes.

| | |
|-----------------------------------|---|
| | driven environment. Additionally, integrating prompt engineering into education improves AI literacy, enabling students to tackle complex tasks and apply AI tools effectively across various disciplines. |
| Recommendations for Practitioners | Educators should integrate structured, prompt engineering instruction into their courses, emphasizing its interdisciplinary applications. Scaffolded learning will help students develop competency in applying prompt engineering techniques and strategies. |
| Recommendations for Researchers | Future studies should explore the long-term impact of prompt engineering instruction on academic performance and professional readiness. Additionally, research should examine its effectiveness across diverse disciplines. |
| Impact on Society | Teaching prompt engineering equips students with essential AI literacy skills, fostering responsible and innovative use of AI in academic, professional, and societal contexts. This contributes to a workforce better prepared for the challenges of the AI era. |
| Future Research | Further research should examine the integration of multimodal AI tools alongside prompt engineering to assess how combined approaches can enhance learning outcomes. In addition, studies should investigate the effectiveness of various instructional designs to identify best practices for promoting student engagement and skill development. Exploring discipline-specific and pedagogically meaningful student use cases will also be essential to guiding the thoughtful integration of AI tools across diverse educational contexts. |
| Keywords | generative AI, prompt engineering, AI literacy, large language models, higher education |

INTRODUCTION

The rapid evolution of generative AI, driven by the development of advanced Large Language Models (LLMs) and their integration into AI chatbots, has ushered in a transformative era in technology. These AI systems, powered by sophisticated algorithms and extensive data training, can generate human-like text, create new content, summarize and critique material, and engage in coherent conversations. Despite their potential, fully harnessing these tools remains challenging due to the complexities of accurately guiding AI behavior. Prompt engineering – the process of crafting precise inputs to elicit desired outputs from AI models – offers a solution to this challenge (Federiakin et al., 2024; Knoth et al., 2024).

Since OpenAI's release of ChatGPT in late 2022, Generative AI tools have rapidly integrated into academic environments, fundamentally altering how students approach learning, research, and content (Baidoo-anu & Ansah, 2023; Mai et al., 2024; McDonald et al., 2025). However, research highlights a gap between students' access to these tools and their ability to use them effectively (Knoth et al., 2024). This disparity mirrors broader digital literacy challenges, where exposure to technology does not necessarily equate to proficiency (National Skills Coalition, 2020; Pérez & Murray, 2010). Just as previous generations needed guidance to transition from surface-level internet searching to advanced research skills, today's students require structured instruction in leveraging generative AI effectively. Federiakin et al. (2024) argue that existing frameworks for 21st-century skills should formally recognize prompt engineering as an essential competency.

REVIEW OF THE LITERATURE: PROMPT ENGINEERING IN ACADEMIC CONTEXTS

Research indicates that many students use large language models (LLMs) for a variety of tasks, such as serving as personal tutors, offering personalized learning support, and facilitating interactive activities like brainstorming (Mai et al., 2024; Schei et al., 2024). However, most students currently approach these tools simplistically – primarily as search engines or rapid answer providers (Knoth et al., 2024). The technology’s nascent stage means that few students comprehensively understand or strategically maximize its potential capabilities (Knoth et al., 2024).

This gap underscores the importance of teaching prompt engineering as a foundational skill. By crafting prompts that specify task details, provide contextual information, and request a particular tone or format, students can generate more nuanced, high-quality outputs. Effective, prompt engineering moves students beyond employing basic queries and helps them unlock the transformative potential of generative AI. Educational institutions must, therefore, actively explore methodologies to teach, guide, and assess students’ interactions with AI chatbots, establishing this as a central pedagogical task (Schei et al., 2024).

In their review, Korzynski et al. (2023) emphasize prompt engineering as a key digital competency for modern graduates, presenting it as an interdisciplinary skill that integrates technical proficiency with analytical reasoning. Their conceptual framework outlines strategies such as iterative refinement, scenario-based prompting, and contextual optimization, demonstrating how these approaches enable students to guide AI tools more effectively. This aligns prompt engineering with the broader goals of fostering adaptability and critical thinking in an AI-driven world.

Cain (2023) highlights how training in prompt engineering transforms students and educators from passive recipients of information into active co-creators of knowledge. By understanding the nuances of effective prompting, students gain the agency to guide AI interactions in ways that align with their specific learning objectives. This active engagement fosters a deeper understanding of subject matter and encourages collaborative exploration between students and AI tools.

Lee et al. (2024) found that prompt engineering plays a pivotal role in supporting knowledge creation and knowledge-building processes. Their study demonstrates how students who are trained in crafting precise and purposeful prompts are better equipped to use AI tools for generating insights, synthesizing information, and exploring complex concepts. This ability to construct prompts for higher-order tasks aligns with essential academic skills, such as synthesizing literature, designing research questions, and evaluating evidence.

Moreover, Lee et al. (2024) highlight the utility of prompting strategies, such as Chain of Thought (CoT), where students guide AI to break down tasks into smaller, sequential steps. This approach engages students in advanced problem decomposition and analytical thinking, enabling them to craft well-structured prompts for complex tasks. By learning to break down inquiries iteratively, students not only improve the accuracy and relevance of AI outputs but also develop critical thinking and problem-solving skills that extend beyond AI interactions. This process mirrors the structured reasoning required in academic work and fosters the scaffolding necessary for composing questions critical to knowledge creation and building.

More broadly, research emphasizes the importance of a balanced approach to generative AI integration in educational contexts. Effective implementation involves harnessing technological capabilities while maintaining alignment with foundational educational goals. For instance, students who receive structured guidance in using AI tools demonstrate improved critical thinking skills and enhanced information literacy compared to those who either avoid AI or use it without proper instruction (Schei et al., 2024). Their findings emphasize the key is not to restrict AI usage but to teach students how to use it as a cognitive enhancement tool rather than as a substitute for learning.

Similarly, Mai et al. (2024), in a SWOT analysis of research on generative AI in education, noted that as faculty recognize the potential of tools such as ChatGPT, students do as well. However, students independently learning to use these tools can lead to misconceptions or limited proficiency in their use. Incorporating instruction on generative AI and related skills, such as prompt engineering, can help mitigate these issues. Students who grasp the underlying principles of AI systems are more likely to use these tools effectively and make better decisions in their application.

University educators play a pivotal role in shaping the integration of AI chatbots in education, serving as both course designers and mentors who guide students toward their effective use. Incorporating AI chatbots into existing educational frameworks is a critical area of exploration, requiring pedagogical strategies that scaffold learning while enabling students to harness the full potential of this technology (Schei et al., 2024). Consequently, as generative AI becomes more embedded in academic and professional environments, mastering the skill of crafting well-designed prompts has emerged as an essential skill.

This paper addresses a gap in the effective use of generative AI by presenting a framework for introducing university students to the principles and practices of prompt engineering. By employing a structured approach, students can develop a foundational understanding of generative AI, including its core concepts, practical applications, and best practices for interacting with LLMs and AI chatbots. Mastering prompt engineering not only equips students to critically evaluate AI-generated content but also prepares them for an AI-driven future.

GUIDE FOR INTRODUCING PROMPT ENGINEERING

Building on the identified gaps in students' understanding and use of LLMs, this guide provides a structured approach to introducing generative AI and teaching the foundational principles of prompt engineering. While many students are familiar with the term AI and have experimented with AI chatbots, their knowledge of how these systems work and how to effectively interact with them remains limited. This guide offers practical strategies to demystify LLM functionality and teach students how to employ prompt engineering techniques to thoughtfully engage with AI chatbots. The principles of prompt engineering emphasize creating detailed and strategic inputs, leveraging examples, and using an iterative process to refine results. At its core, prompt engineering is an intentional and reflective practice, equipping students with the skills to critically interact with AI tools to foster more accurate and contextually relevant outputs.

OVERVIEW OF AI, GENERATIVE AI, AND LLMs

Generative AI is a subfield of Artificial Intelligence (AI), the overarching field focused on developing intelligent computer systems capable of performing tasks typically requiring human intelligence. Generative AI has emerged as a category of AI referring to models designed to create original content across a variety of formats, including text, images, music, video, and other forms of data. What distinguishes most Generative AI applications is their ability to be 'supervised' through natural language, allowing users to interact with these systems using everyday language.

There are several types of generative AI models, each specializing in different forms of content creation. Text generation models, often implemented as chatbots (e.g., ChatGPT, Gemini, Claude) or Virtual Assistants (Copilot), are based on Large Language Models (LLMs). Image generation models, such as OpenAI's DALL-E and MidJourney, create images based on textual descriptions, while music and audio generation models (like Udio and Suno) compose music tracks from text inputs. Video generation is another emerging area capable of producing video content from textual descriptions.

Notably, many well-known generative AI platforms are now multi-modal, integrating capabilities across text, images, video, and sound. Generative AI for text, driven by LLMs, however, focuses primarily on text-based tasks. While LLMs themselves do not create images, video, or sound, they are often combined with other AI models to enable multi-modal functionality. For instance, when

prompted, a model like ChatGPT will display an image – although the actual image generation is performed by a separate model such as DALL-E. Despite the broad applications of multi-modal generative AI platforms, this paper focuses on LLMs and their capability to generate text-based content.

Large language models (LLMs)

LLMs are AI models designed to generate human-like language. Commonly recognized for their strengths in natural language processing and computer coding assistance, these models perform well in tasks such as essay writing, text analysis, and sentence completion. Additionally, LLMs are adept at generating a wide variety of content, including emails, blog posts, poetry, stories, movie scripts, business plans, and song lyrics. Moreover, they can create, revise, and debug program code, offer tailored recommendations (i.e. travel plans, menus, or movie suggestions), translate languages, answer diverse questions, engage in conversation, and even generate jokes or solve crossword puzzles.

Despite their impressive capabilities, LLMs are not ‘magical’ entities; they are the product of sophisticated algorithms, mathematics, and data. These models are trained on massive datasets, often sourced from the internet for open platforms like ChatGPT. The training process involves billions of variables, known as parameters that the models use to learn patterns and relationships in data. The underlying mathematics incorporates multidimensional calculus, linear algebra, probability and statistics, Fourier analysis, elements of information theory, and occasionally differential equations. As noted by Ananthaswamy (2024) in his recent book, *Why Machines Learn: The Elegant Math Behind Modern AI*, artificial intelligence is far more than just a buzzword or a “mystery box;” it represents the fascinating interplay between high-quality datasets and intricate mathematical algorithms.

LLMs operate by leveraging deep learning techniques and massive neural networks. In essence, they predict the next word in a sequence using a complex probabilistic algorithm that considers the statistical patterns and relationships learned during training. The algorithm assigns probabilities to each word in its vocabulary and selects the word with the highest probability as the next in the sequence. In layman’s terms, LLMs have often been described as a highly sophisticated form of autocomplete.

Simplistically described, an LLM works by taking a user’s input, or prompt, and breaking it down into smaller components called tokens. A token typically represents a word, though compound or multi-syllable words may be split into multiple tokens. Each token is converted (encoded) into a numerical vector that is processed through a transformer model. The transformer model consists of multiple layers of self-attention mechanisms and feed-forward neural networks that identify patterns and relationships within the input to build context. The model then predicts the most likely next word and feeds this prediction back into the system to generate subsequent words, continuing until the response is complete. Finally, the response is decoded into natural language and presented to the user. Figure 1 illustrates the flow of how an LLM functions.

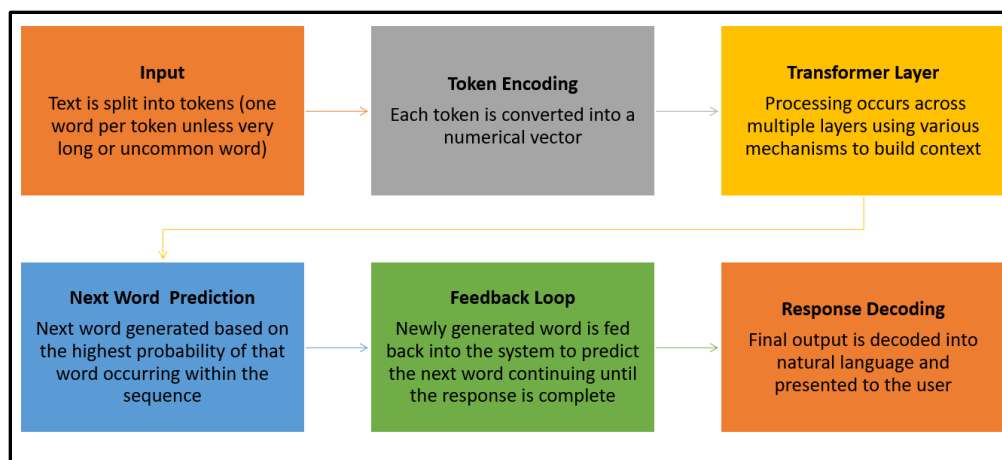


Figure 1. Steps in the Large Language Model (LLM) processing flow

HOW LLMs ARE DEPLOYED

Large language models (LLMs) are deployed in various ways depending on their intended use and the user needs. One of the most well-known deployment methods is through conversational AI chatbots, popularized by OpenAI's release of ChatGPT. These chatbots provide users with an interactive question-and-answer format in a natural language environment.

In addition to AI chatbots, LLMs are supported by interactive platforms – often subscription-based – that offer a range of advanced features. For instance, OpenAI's Playground and Google's AI Studio allow users to experiment with various parameter settings and receive real-time responses making them valuable tools for prototyping and development. These platforms also support the testing of API integration, allowing developers to integrate LLM models into existing software systems or create custom applications tailored to specific needs. For example, many companies integrate LLMs into custom AI chatbots for customer service, product recommendations, or as knowledge-based assistants to streamline information retrieval. Google and Microsoft have now integrated LLM intelligence into their popular search engines. While LLMs are deployed in various ways, this paper focuses exclusively on interacting with LLM-based conversational AI chatbots.

Overview of prominent LLM-based AI chatbots

Over the past two years, several LLM-based AI chatbots have emerged, with frequent enhancements and updates shaping their evolution. Widely used platforms include OpenAI's ChatGPT, Google's Gemini, Microsoft's Copilot, and Anthropic's Claude. Other notable players, such as Perplexity.ai, Meta AI (powered by Llama), and Grok (developed by Elon Musk and xAI), have also gained attention for their unique capabilities. Although these AI chatbots share similar functionalities, their strengths and use cases differ. Most platforms offer free versions with basic access, while paid versions unlock additional features such as higher processing speeds, advanced settings, and integration with developer tools like APIs and playgrounds.

Reviews from sources such as ZDNet (Ortiz, 2024) and performance tests from Tom's Guide (Morrison, 2024) indicate that no single AI chatbot excels at every task. Instead, each model has a different focus and performs better in particular areas depending on the use case. For instance, ChatGPT excels in tasks related to writing and coding, making it a powerful tool for content generation and software development. Microsoft's Copilot, on the other hand, focuses on seamless integration with Office 365 and Teams, making it particularly useful for automating tasks in business environments. Google's Gemini leverages the company's extensive research infrastructure, making it highly effective in general knowledge and search tasks. Claude is known for its emphasis on ethical considerations and its support for academic writing, making it appealing to academicians. Perplexity.ai stands out as an alternative to traditional search engines, providing detailed, well-cited responses, which can be useful for academic research. Meta AI, powered by the open-source Llama model, offers flexibility for developers, while Grok distinguishes itself as a more provocative chatbot, offering in-depth responses on topics that other models might avoid.

Table 1 provides an overview of widely known AI chatbots, including links to their webpage with more information, links to their online AI chatbot, and descriptions of their focus areas and key features. All AI chatbots listed in the table offer online access and mobile apps for Android and iOS, except for Meta AI, which is integrated into other Meta platforms including WhatsApp, Messenger, and Instagram.

Table 1. Well-known LLM-based AI chatbots

| Platform | Link to AI chatbot | Description |
|---|---|--|
| OpenAI ChatGPT openai.com | chatgpt.com | A versatile general-purpose LLM, ChatGPT excels in creative writing, text editing, programming tasks (e.g., code creation, debugging), and conversational fluency. Widely used for professional and casual tasks. ChatGPT has become the household name for AI chatbots. |
| Google Gemini gemini.google.com/faq | gemini.google.com | Known for its seamless integration with Google's suite of apps, Gemini excels at processing long, data-intensive tasks due to access to vast data resources. Its primary limitation is its dependency on Google's ecosystem. |
| Microsoft Copilot adoption.microsoft.com/en-us/copilot/ | copilot.microsoft.com | Embedded in Office 365 and Teams, Copilot streamlines workplace tasks such as summarizing meetings, tracking action items, and editing documents in Word or analyzing data in Excel. Well suited for business environments. |
| Anthropic Claude www.anthropic.com | claude.ai | Focused on ethical AI, prioritizing safety and neutrality through Anthropic's "Constitutional AI" principles to minimize harmful or biased content. Claude excels in summarization, translation, and academic writing but lacks some multi-modal functionality and advanced role-playing capabilities. |
| Perplexity AI www.perplexity.ai/hub/about | perplexity.ai | Positioned as an alternative to search engines, Perplexity AI supports academic research with features like summarizing articles and generating research questions. A standout feature is its "Pages" function, which consolidates search results into a shareable webpage. |
| Meta AI LLaMA www.llama.com/ ai.meta.com | meta.ai (also through Messenger, WhatsApp, and Instagram) | While Meta AI offers a conversational AI chatbot, its key advantage is the open-source LLaMA model. Tools like Llama Stack simplify AI deployment across various environments, aiming to promote transparency and collaboration among developers working on LLM solutions. |
| X Grok x.ai | x.com (must login to X) | Integrated with the X platform, Grok specializes in social media content and real-time event analysis. Its open-source nature allows users to train and customize the model on their own hardware. |

PROMPT ENGINEERING

SETTING THE STAGE

The key to effectively utilizing LLMs lies in mastering prompt engineering—the art and science of crafting well-designed inputs to generate desired outputs. It is the primary method through which users interact with AI systems, such as AI chatbots, by providing structured language inputs that guide the model’s responses. Regardless of the specific AI chatbot being used, the core principles of prompt engineering remain consistent across platforms.

Several strategies and techniques have been proposed to help users develop effective prompts. However, while various methods guide prompt construction, prompt engineering is often considered more of an art than a science. Frameworks have also been developed that assist users to approach the prompt engineering process with the right mindset. One such framework, proposed by Lo (2023), using the acronym CLEAR, is summarized as follows:

- Concise:** Focus on crafting prompts that are clear and precise and avoid unnecessary information. Prompts do not need to be short but should steer clear of superfluous details and distracting words.
- Logical:** Design prompts to be well-structured and coherent, ensuring the flow is logical and easy-to-follow.
- Explicit:** Ensure prompts include explicit specifications about the desired output and provide examples as necessary.
- Adaptability:** Iterate, iterate, iterate. Prompting is an iterative process where input is provided, output is received, and revisions are made until an acceptable response is achieved.
- Reflective:** Engage in continuous evaluation of the model’s performance and the prompting strategies employed to identify areas for improvement and adjust the approach accordingly.

PROMPT FORMULATION AND PROMPT ELEMENTS

The effectiveness of LLM-based implementations, such as AI chatbots, relies heavily on how well prompts are designed. While there is no single “correct” way to construct prompts, employing strategies and methods can significantly improve the quality and relevance of LLM-generated output. Effective, prompt engineering requires an understanding of the model’s strengths and limitations, as well as leveraging that knowledge to craft input prompts that maximize the LLM’s potential while minimizing inaccurate or irrelevant responses.

A prompt is essentially a question or instruction given to an AI chatbot. Prompts can range from a simple, one-line question to a more detailed, multi-line statement. For instance:

- **Simple Prompt:**
What is an information system?
- **Multi-lined Prompt:**
I am a business professor. Please describe an information system, highlighting its main components, for a 3-page report to a local chamber of commerce. The report should focus on the impact of information systems on small businesses, particularly in inventory control and transaction processing. For example, explain how a point-of-sale (POS) system can streamline inventory tracking and improve transaction accuracy.

When crafting prompts, certain elements are essential for achieving optimal results. Successful interactions with LLMs depend on six key elements: **task** (a clear instruction or question), **context** (rele-

vant background information), **persona** (the intended role or audience), **format** (the desired structure of the output), **tone** (the communication style), and **exemplars** (guiding examples). Table 2 provides detailed descriptions of each element.

Table 2. Description of the six elements of a prompt

| Element | Description |
|----------|---|
| Task | The task defines the core instruction or question for the AI chatbot. Clear tasks often start with action verbs like <i>write</i> , <i>generate</i> , <i>analyze</i> , or <i>summarize</i> , guiding the model toward a specific action. The more precise the task, the better the response. |
| Context | <p>Context ensures accurate and relevant responses by narrowing the scope. For example, specifying that a response is intended for first-year university students versus graduate-level researchers significantly changes the output.</p> <p>Compare the prompt: “<i>Explain quantum computing</i>” to “<i>Provide a concise explanation of quantum computing in layman’s terms to a group of first-year computer science students.</i>” Providing detailed context leads to a more tailored response.</p> |
| Persona | <p>The persona defines the role or identity the AI chatbot assumes. A detailed persona yields better results. For example, rather than simply saying, “I am a professor,” specify, “I am a professor of Information Systems with over 20 years of academic research experience.”</p> <p>A persona also shapes responses to align with the intended role or expertise. An example would be: “<i>You are a cybersecurity analyst specializing in threat detection. Provide an overview of how common cyberattacks are discovered.</i>”</p> |
| Format | <p>The format specifies the structure of the output, such as a paragraph, table, bulleted or numbered list, or code snippet or another style.</p> <p>For example, a requested format might include a report, a timeline, or text in APA style. Specifying format ensures responses meet specific requirements.</p> |
| Tone | <p>Tone sets the emotional or expressive quality of communication. Tones can vary widely. Examples include casual, formal, professional, witty, polite, humorous, friendly, assertive, strong, legal, urgent and instructional. Adjusting tone can dramatically alter the response.</p> <p>One recommendation is to provide the context and ask the AI chatbot to recommend the preferred tone. For example, “<i>I’m writing an email and I want to be taken seriously but do not want to sound conceited. Can you give me a list of 5 tone keywords.</i>”</p> |
| Exemplar | <p>Using examples (exemplars) significantly improves response accuracy and relevance. Providing an example prompt can guide the chatbot’s response to better match your expectations.</p> <p>Examples are provided in one of three ways: zero-shot (no examples), one-shot (a single example), or few-shot (multiple examples).</p> <p>(Note: A detailed explanation of “shot” prompting follows in the next section.)</p> |

Among the identified prompt elements, the task is the only mandatory component. However, context, exemplars, and persona play a critical role in refining the response and producing a more accurate, relevant, and tailored output. Format and tone, though optional, can further enhance the clarity and emotional quality of the response. Figure 2 illustrates the hierarchy of these elements, as well as the suggested order for structuring prompts. Depending on the specific prompt, not all elements may be necessary, nor must the suggested order always be followed. However, the proper combination and thoughtful structuring of these elements can significantly improve the performance and accuracy of AI chatbots. Together, these elements work to guide the LLM toward producing more accurate,

relevant, and contextually appropriate responses. Figure 3 provides an example of a prompt that incorporates all six elements:

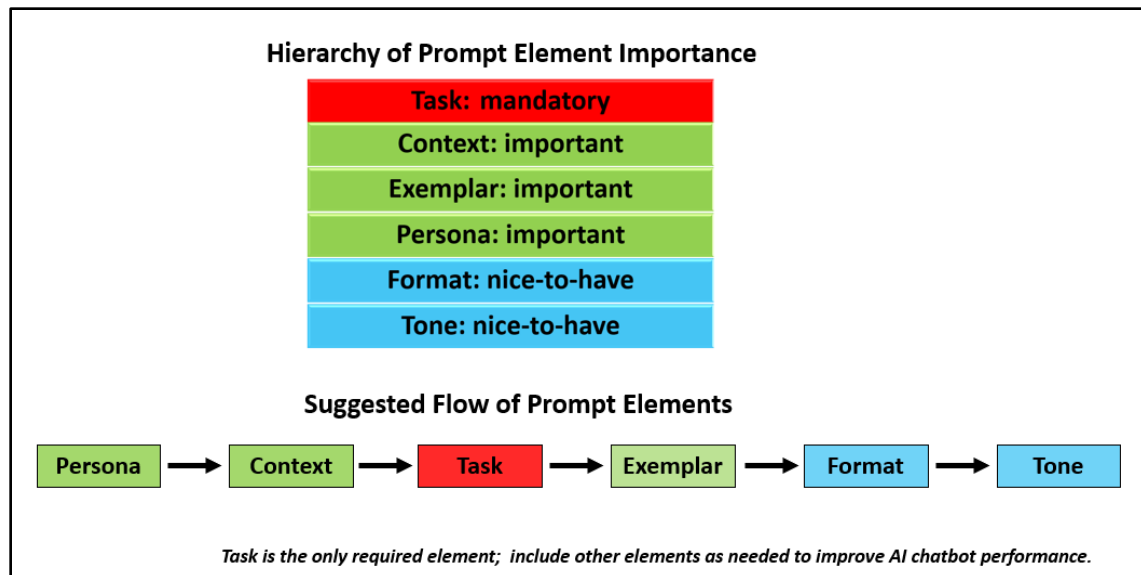


Figure 2. Six elements of a prompt hierarchy and flow

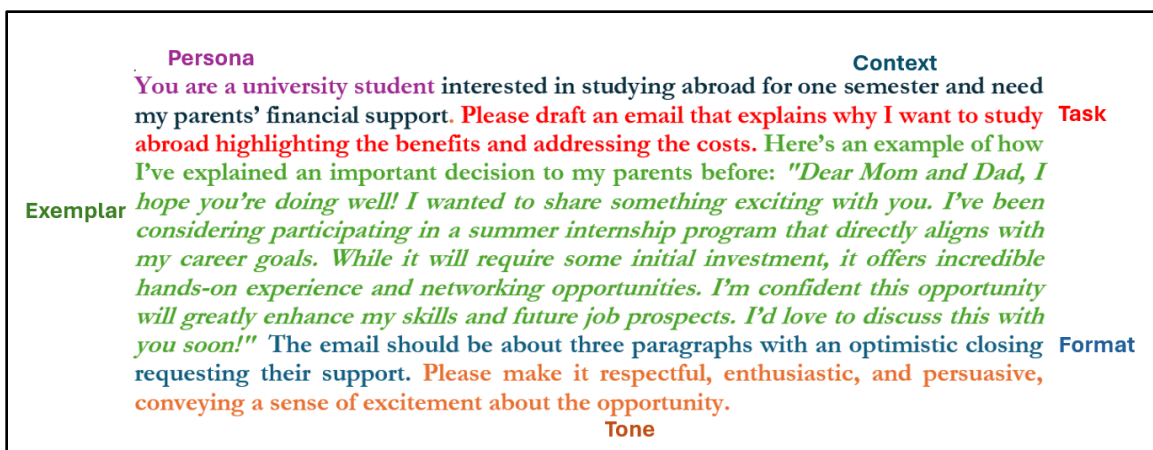


Figure 3. Example prompt containing all six elements

PROMPTING TECHNIQUE: SHOT PROMPTING

In the context of prompt engineering, shot prompting refers to the technique used to provide specific examples or scenarios within a prompt to guide the AI chatbot responses. The concept of shot prompting first gained prominence in academic research through work on large-scale machine learning models and natural language processing (Brown et al., 2020). Providing examples is framed in three levels of example-based prompting: zero-shot (direct questions without examples), one-shot (single example provided), and few-shot (multiple examples provided). Each approach serves different purposes and should be selected based on the complexity of the task at hand.

Zero-shot Prompting

Zero-shot prompting asks the AI chatbot to complete a task without providing examples or context. It is often used for tasks requiring general knowledge or reasoning. As the chatbot relies solely on its

pre-trained knowledge, the quality and accuracy of responses can vary due to the absence of task-specific guidance.

Example of a Zero-shot Prompt (task: Define generative AI):

Zero-shot Prompt:

What is generative AI?

One-shot Prompting

One-shot prompting provides a single example to guide the AI's response. This approach helps the model better understand the desired output, whether it be related to format, content, or task-specific guidance. It is particularly useful for tasks such as language translation, answering straight forward questions, and text formatting.

Example One-shot Prompt (task: Explain generative AI):

One-shot Prompt:

You are an IT professional, and a non-technical person asks you for a clear definition of generative AI. Here's an example of how you might explain another concept:

Example: 'A database is an organized collection of structured information or data, typically stored electronically in a computer system.'

Please now explain generative AI.

Example One-shot Prompt (task: Properly Format a Business Letter):

One-shot Prompt:

I need the following text formatted for a formal business letter.

Example: A formal business letter includes a proper header, salutation, body, closing, and signature block.

Please now format the following as a business letter.

Few-Shot Prompting

Few-shot prompting involves providing the AI with multiple examples to guide its response, making it particularly effective for more complex or nuanced tasks. This approach helps the model recognize patterns or rules across multiple instances. It is useful for tasks such as text classification and generating multi-step solutions. Research shows few-shot prompting tends to yield significant improvement with just a few examples, typically around five, after which additional examples offer diminishing returns (Perez et al., 2021).

Example Few-shot Prompt (task: Classify Components of an LLM):

Few-shot Prompt:

You are an IT professional, and your task is to classify short descriptions into categories, 'model,' 'training data,' or 'algorithms.' Here are a few examples:

- 1. Text: "The foundational structure of an LLM that processes and generates text." Classification: Model*
- 2. Text: "Large, diverse datasets that the model uses to learn language patterns and relationships." Classification: Training Data*
- 3. Text: "The mathematical and computational methods used to train and optimize the model." Classification: Algorithms*

Please now classify this text: "The gradient descent method used to minimize error during training."

Example Few-shot Prompt (task: Construct an Exam Study Schedule Reporting Total Study Hours):

Few-shot Prompt:

I am a university student preparing for exams and need to generate a study schedule that also calculates total weekly study hours for each subject. Here are a few examples of how study plans and calculations are structured:

1. *Study schedule for final exams:*

Math: Monday - 2:00 PM to 4:00 PM

History: Tuesday - 3:00 PM to 5:00 PM

Biology: Wednesday - 10:00 AM to 12:00 PM

2. *Total study hours calculation for each subject:*

Math: 2 hours/day \times 7 days = 14 hours/week

History: 1.5 hours/day \times 7 days = 10.5 hours/week

Biology: 2.5 hours/day \times 7 days = 17.5 hours/week

Now, please organize the following for five courses: Math, English, Biology, Chemistry, and History. Create a weekly study plan that includes two-hour sessions for each subject, ensuring there's no overlap in the schedule. Additionally, calculate the total weekly study hours for each subject.

PROMPTING ENGINEERING STRATEGIES

Crafting effective prompts is critical to ensuring accurate and relevant responses from LLMs. As Elliot (2024) aptly notes, “the use of generative AI can altogether succeed or fail based on the prompt that you enter.” A well-designed prompt provides the clarity and structure necessary to guide the AI, while a poorly constructed prompt can result in inaccurate or irrelevant output. To mitigate this risk, employing prompting strategies has emerged as a vital practice in maximizing the effectiveness of generative AI tools.

Chain of Thought (CoT) Prompting

Several prompting strategies have been proposed to provide structured approaches for crafting prompts that align with the strengths and limitations of LLMs. These strategies are designed to optimize interactions by employing techniques that guide the model to “think” in a logical, step-by-step manner. Among these, one of the most widely recognized and effective techniques is Chain of Thought (CoT) prompting, which addresses LLMs’ inherent lack of true reasoning. By encouraging the model to break down tasks into smaller, sequential steps, CoT prompting has been shown to significantly improve performance on complex, multi-step problems (Wei et al., 2022). CoT prompting not only improves the model’s output but also provides users with greater transparency into the thought process behind the responses. The following section provides an in-depth overview of CoT prompting, including its applications, advantages, and practical examples for implementation.

A classic example of LLMs’ difficulty with reasoning is their struggle to correctly solve math word problems. This often happens when the AI chatbot is asked to provide a final answer without being guided through the intermediate steps required to solve the problem. Figure 4 illustrates this scenario. The left side shows a basic prompt with no guidance, while the right side uses CoT prompting, asking the AI chatbot to approach the problem step-by-step. This is especially important in math problems, as an LLM does not automatically follow the mathematical rule of order of operations.

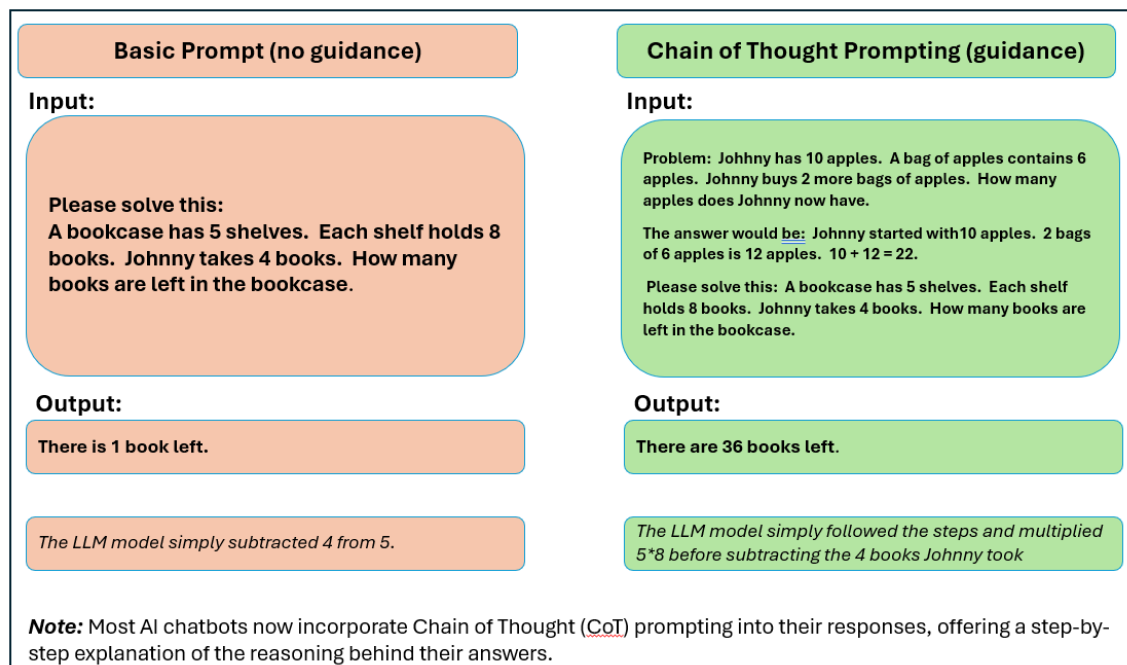


Figure 4. Example of Chain of Thought prompting

Ultimately, CoT prompting enhances the AI chatbot's ability to handle more complex tasks by promoting deeper reasoning and logical progression. CoT prompting has become so integral that most AI chatbots now implement this approach by default, providing not only the response but also the reasoning behind it. However, user enhancements – such as refining or repeating CoT prompts – can further improve the quality and accuracy of responses. For example, another way to initiate CoT prompting is to simply use a prompt like, 'Please think through this task step-by-step,' or 'Please use Chain of Thought' followed by the task instruction. Using the previous example of developing a study schedule for exams, it might look like:

CoT Example (task: Create Study Schedule):

CoT Prompt:

Please think through this task step-by-step: Organize a weekly study schedule for five subjects (Math, English, Biology, Chemistry, and History) so that each subject gets two two-hour sessions per week, with no overlaps in the schedule.

AI Chatbot Response:

Step-by-Step Reasoning:

Step 1: Determine the total number of study sessions needed.

Each subject requires two two-hour sessions per week, and there are five subjects.
Therefore:

Total sessions = 5 subjects \times 2 sessions = 10 sessions per week.

Step 2: Define the available study time in a week.

Assume study blocks from Monday to Friday, 9:00 AM to 5:00 PM, with two study slots per day (e.g., morning and afternoon).

This provides:

10 slots available (2 slots/day \times 5 days).

Step 3: Allocate one session per subject each day.

Assign each subject to a specific day and time, ensuring no overlaps. Spread the sessions across the week to balance the workload.

Step 4: Create the study schedule.

Monday:

Math (9:00 AM - 11:00 AM)

English (1:00 PM - 3:00 PM)

Tuesday:

Biology (9:00 AM - 11:00 AM)

Chemistry (1:00 PM - 3:00 PM)

Wednesday:

History (9:00 AM - 11:00 AM)

Math (1:00 PM - 3:00 PM)

Thursday:

English (9:00 AM - 11:00 AM)

Biology (1:00 PM - 3:00 PM)

Friday:

Chemistry (9:00 AM - 11:00 AM)

History (1:00 PM - 3:00 PM)

Step 5: Verify the schedule.

Each subject has two two-hour sessions per week.

No overlaps in the schedule.

Balanced workload across the week.

TalkToModel Prompts

Many prompting strategies have been developed and documented, offering diverse approaches for interacting with AI systems. However, a few strategies stand out as particularly useful for students. These strategies are based on the “TalkToModel” approach, which engages the AI chatbot in an interactive dialogue, encouraging it to reflect on its reasoning and responses (Slack et al., 2023). Notable examples include the Reread (Re2) strategy, flipped interaction or role-reversal prompts, and a third approach that simply asks the AI chatbot to recommend prompts to guide the interaction.

These strategies are based on a “TalkToModel” that engages the AI chatbot in an interactive dialog of reflection of the AI chatbot to explain its reasoning and responses. (Slack et al., 2023). Two such strategies include the Reread or Re2 and flipped interaction or role reversal prompting strategies.

Reread (Re2) Prompt Strategy. The Re2 prompting strategy involves processing the task twice by instructing the AI chatbot to reread or reevaluate its response. This method encourages the AI to critically assess its output, identify potential errors, and evaluate the accuracy and relevance of the response.

A typical Re2 prompt might look like:

Generate a response to [question/task]. Then reread your response and:

Check for logical consistency.

Identify any potential gaps or missing information.

Verify the accuracy of any claims or facts.

Suggest improvements or refinements to enhance clarity and quality.”

Flipped Interaction Prompt Strategy. The flipped interaction or role-reversal strategy involves shifting the dynamic by having the AI chatbot ask the user questions instead of the other way

around, fostering a more interactive and collaborative dialogue (Eliot, 2024). This approach encourages deeper engagement and helps the AI chatbot gather the necessary context before generating a solution.

A typical Flipped Interaction prompt might look like:

"Instead of me asking you questions, I want you to ask me a series of questions. Your goal is to gather all the necessary information before providing a solution. Please ask as many questions as you need to fully clarify [the problem]."

Prompt Suggestion Prompting. A final suggestion is the Example Suggestion Prompting or Prompt Suggestion Prompting strategy, which involves asking the AI chatbot to generate potential prompts or questions related to a specific topic or goal. This approach is particularly helpful for users who are uncertain about how to structure their prompts or what to ask. By leveraging this strategy, users can guide interactions toward more targeted and relevant responses.

A typical Prompt Suggestion might look like:

"I need to analyze a case study on ethics in AI. What are some prompts I could use to evaluate ethical decision-making when deciding to use Generative AI in university-level education?"

HALLUCINATIONS: A MOST CRITICAL CHALLENGE

One of the biggest challenges with generative AI is its tendency to produce false information that appears truthful, a phenomenon known as AI hallucinations (Alkaissi & McFarlane, 2023). These systems can generate fabricated responses with a false sense of confidence, making it essential to approach AI-generated content critically. An example of an AI chatbot hallucination is shown in Figure 5. In response to a prompt regarding APA formatting of book titles used in a sentence, the chatbot incorrectly provided the format for an in-text citation instead. According to APA guidelines, book titles in the body of the text should be italicized and written in title case, with all major words and proper nouns capitalized. This example highlights the need to verify AI-generated content, even when it appears authoritative.

Prompt: *How do you format a book title used in the body of a text following APA guidelines.*

Chatbot Response:

In APA format, when a book title is used within the text, it should be italicized, and only the first word of the title, the first word after a colon (if any), and any proper nouns should be capitalized.

For example:

- **The book *Thinking, fast and slow* offers insights into cognitive biases.**
- If there is a subtitle, the same rules apply to it:**
- **Smith's *The rise of modern computing: A historical overview* explores the evolution of technology.**

So, the key points are to italicize the title and use sentence case.

Figure 5. Example of an AI chatbot hallucination

While the example provided depicted a simple task, hallucinations are far more common when responding to complex or ambiguous prompts. A study reported by Metz (2023) found that ChatGPT

fabricated information in about 3% of its responses, while Google’s chatbot did so in 27% of cases. To address this issue, students must develop strategies to effectively manage and reduce hallucinations.

Key recommendations for reducing hallucinations include constructing prompts that are clear, specific, and free of ambiguity while avoiding tricky or humorous wording. Prompts should also include all necessary elements, such as context and task details, to provide the AI with proper guidance. Additionally, students should verify factual claims, implement appropriate oversight depending on the importance of the task, and cross-reference AI outputs with authoritative sources to ensure accuracy.

For complex problems, students can employ Chain of Thought (CoT) prompting by breaking tasks into smaller steps, requesting explicit reasoning processes, verifying intermediate outputs, and critically evaluating final responses. Furthermore, using focused prompting strategies, such as the self-reflection prompting techniques outlined in this paper, can significantly reduce the risk of generating inaccurate or factually false AI responses.

ETHICAL, RESPONSIBLE, AND INCLUSIVE USE OF PROMPT ENGINEERING

As generative AI tools become increasingly embedded in higher education, instruction in prompt engineering must be rooted in the principles of responsible use (Francis et al., 2025). Students should learn not only how to craft effective prompts, but also how to engage with AI systems ethically, critically, and with an awareness of potential risks. This includes fostering transparency, appropriate attribution of AI-generated content, and a clear understanding of academic integrity guidelines.

Data privacy is a critical concern in the use of generative AI, particularly as many platforms retain user interactions that may contain sensitive or personally identifiable information. Instruction in prompt engineering should address privacy risks and emphasize best practices, including the avoidance of names, grades, institutional data, or proprietary content in prompts. Students should be made aware that disclosing personal or academic information may lead to unintended data retention, third-party access, or breaches of institutional policy, and students should be encouraged to engage with AI systems in ways that intentionally protect privacy and uphold confidentiality.

Another key dimension of responsible use is understanding the potential for bias in AI-generated outputs. Because large language models are trained on vast datasets, they can reproduce or amplify societal biases. Teaching students to evaluate AI responses for fairness and accuracy is essential to fostering ethical awareness. Prompt engineering provides a practical context for helping students recognize these limitations and develop skill in the critical evaluation of AI-generated content.

Additionally, prompt engineering must account for the linguistic and cultural diversity of learners. While this guide focuses on English-language usage, AI chatbots support multiple languages and are used in varied global contexts. However, prompting strategies may need to be adapted based on linguistic structures or cultural norms. For example, differences in grammar or idiomatic usage can affect clarity, and analogies or references employed should be culturally relevant to ensure model comprehension. Moreover, since LLMs perform most reliably in English, users working in other languages may need to craft simpler or more explicit prompts to achieve desired results.

Some ways educators might promote inclusive instruction is by providing localized examples, developing language-specific templates, and encouraging experimentation across languages. These strategies help students understand LLM performance variations and support more equitable access to generative AI tools.

Together, these considerations – responsible use and cultural inclusivity – underscore that prompt engineering is not merely a technical skill, but a multidimensional competency. To prepare students for thoughtful and effective use of generative AI, instruction in prompt engineering should integrate

ethical awareness, cultural sensitivity, and inclusive practices. Students should be guided toward becoming reflective users of generative AI – capable not only of crafting effective prompts but also of critically assessing AI-generated outputs, identifying potential limitations and biases, and making informed decisions about responsible use. These foundational competencies are essential for engaging with generative AI technologies in ways that are ethically grounded and appropriate across diverse academic, professional, and cultural contexts.

CONCLUSION

Generative AI is rapidly transforming the landscape of higher education, sparking both opportunities and challenges. Some have called this the “year of reckoning” for universities as they navigate the integration of generative AI into academic settings (Palmer, 2024). Institutions are tasked with balancing the potential of AI to enhance cognitive learning with the risk of over-reliance on these tools (Francis et al., 2025; Schei et al., 2024). To successfully incorporate generative AI into higher education, institutions must establish clear guidelines that address appropriate use cases, citation and attribution practices, verification procedures, and ethical considerations (Bobula, 2024; Francis et al., 2025).

Integrating generative AI into higher education presents transformative potential accompanied by many considerations. The rapid evolution of AI technology demands flexible teaching approaches that emphasize foundational principles while addressing ethical considerations and identifying appropriate use cases. Even as generative AI has been viewed as a catalyst for transforming assessment and evaluation practices, it will require frameworks that evaluate both technical proficiency and critical thinking while tackling issues like plagiarism and intellectual dishonesty (McDonald et al., 2025). Additionally, students must be educated on the ethical dimensions of AI, including bias, verification, and responsible use (Bobula, 2024). However, the current focus has shifted towards analyzing how AI tools are used and students’ ability to effectively integrate AI-generated content effectively into their work (McDonald et al., 2025).

For students, the ability to effectively use generative AI requires the development of specific competencies. These include prompt crafting and refinement, output evaluation and verification, ethical use, attribution, and the integration of AI-generated content with traditional research methods. Of these, prompt engineering emerges as one of the most critical skill sets, applicable across disciplines, including liberal arts and STEM fields (Westfall, 2025).

At its core, prompt engineering involves crafting precise, purposeful inputs to guide LLMs in generating accurate and useful outputs. As AI systems continue to evolve, the foundational principles of prompt engineering will remain an essential competency. Teaching students how to master prompt engineering not only ensures more effective interactions with these advanced tools but also deepens their understanding of how AI functions and its limitations.

As generative AI continues to redefine the classroom experience, higher education must prepare students to thrive in this evolving landscape. By teaching prompt engineering alongside traditional research and critical thinking skills, universities can empower students to use AI responsibly, creatively, and effectively in their academic and professional pursuits. Future research should explore discipline-specific and pedagogically meaningful student use cases to better inform the integration of AI tools into diverse educational contexts.

REFERENCES

- Alkaissi, H., & McFarlane, S. I. (2023). Artificial hallucinations in ChatGPT: Implications in scientific writing. *Cureus*, 15(2), e35179. <https://doi.org/10.7759/cureus.35179>
- Ananthaswamy, A. (2024). *Why machines learn: The elegant math behind modern AI*. E. P. Dutton.
- Baidoo-anu, D., & Ansah, L. O. (2023). Education in the era of generative artificial intelligence (AI): Understanding the potential benefits of ChatGPT in promoting teaching and learning. *Journal of AI*, 7(1), 52-62. <https://doi.org/10.61969/jai.1337500>
- Bobula, M. (2024). Generative artificial intelligence (AI) in higher education: A comprehensive review of challenges, opportunities, and implications. *Journal of Learning Development in Higher Education*, 30(1), 112-127. <https://doi.org/10.47408/jldhe.vi30.1137>
- Brown, T., Mann, B., Ryder, N., Subbiah, M., Kaplan, J., Dhariwal, P., Neelakantan, A., Shyam, P., Sastry, G., Askell, A., Agarwal, A., Hervert-Voss, A., Krueger, G., Henighan, T., Child, R., Ramesh, A., Ziegler, D., Wu, J., Winter, C., ... Amodei, D. (2020). Language models are few-shot learners. *Advances in Neural Information Processing Systems*, 33, 1877-1901. <https://doi.org/10.48550/arXiv.2005.14165>
- Cain, W. (2023). Prompting change: Exploring prompt engineering in large language model AI and its potential to transform education. *TechTrends*, 68, 47-57. <https://doi.org/10.1007/s11528-023-00896-0>
- Eliot, L. (2024, May 9). The best prompt engineering techniques for getting the most out of generative AI. *Forbes.com*. <https://www.forbes.com/sites/lanceeliot/2024/05/09/the-best-prompt-engineering-techniques-for-getting-the-most-out-of-generative-ai/>
- Federiakina, D., Molerov, D., Zlatkin-Troitschanskaia, O., & Maur, A. (2024). Prompt engineering as a new 21st-century skill. *Frontiers in Education*, 9, 1366434. <https://doi.org/10.3389/feduc.2024.1366434>
- Francis, N. J., Jones, S., & Smith, D. P. (2025). Generative AI in higher education: Balancing innovation and integrity. *British Journal of Biomedical Science*, 81, 14048. <https://doi.org/10.3389/bjbs.2024.14048>
- Knoth, N., Tolzin, A., Janson, A., & Leimeister, J. M. (2024). AI literacy and its implications for prompt engineering strategies. *Computers and Education: Artificial Intelligence*, 6, 100225. <https://doi.org/10.1016/j.caeai.2024.100225>
- Korzynski, P., Mazurek, G., Krzykowska, P., & Kurasinski, A. (2023). Artificial intelligence prompt engineering as a new digital competence: Analysis of generative AI technologies such as ChatGPT. *Entrepreneurial Business and Economics Review*, 11, 25-37. <https://doi.org/10.15678/eber.2023.110302>
- Lee, A. V. Y., Teo, C. L., & Tan, S. C. (2024). Prompt engineering for knowledge creation: Using chain-of-thought to support students' improvable ideas. *AI*, 5(3), 1446-1461. <https://doi.org/10.3390/ai5030069>
- Lo, L. S. (2023). The CLEAR path: A framework for enhancing information literacy through prompt engineering. *Journal of Academic Librarianship*, 49(4), 102720. <https://doi.org/10.1016/j.acalib.2023.102720>
- Mai, D. T. T., Da, C. V., & Hanh, N. V. (2024). The use of ChatGPT in teaching and learning: A systematic review through SWOT analysis approach. *Frontiers in Education*, 9, 1366434. <https://doi.org/10.3389/feduc.2024.1328769>
- McDonald, N., Johri, A., Ali, A., & Collier, A. H. (2025). Generative artificial intelligence in higher education: Evidence from an analysis of institutional policies and guidelines. *Computers in Human Behavior: Artificial Humans*, 3, 100121. <https://doi.org/10.1016/j.chbah.2025.100121>
- Metz, C. (2023). Chatbots may 'hallucinate' more often than many realize. *New York Times*. <https://www.nytimes.com/2023/11/06/technology/chatbots-hallucination-rates.html>
- Morrison, R. (2024). I tested Gemini vs ChatGPT vs Claude vs Meta Llama – which AI chatbot wins? *Tom's Guide*. <https://www.tomsguide.com/ai/i-tested-gemini-vs-chatgpt-vs-claude-vs-meta-llama-which-ai-chat-bot-wins#section-winner-chatgpt-claude-gemini-and-llama>
- National Skills Coalition. (2020). *The new landscape of digital literacy*. <https://nationalskillscoalition.org/resource/publications/the-new-landscape-of-digital-literacy/>

- Ortiz, S. (2024). I've tested dozens of AI chatbots since ChatGPT's stunning debut. Here's my top pick. ZDNET. <https://www.zdnet.com/article/best-ai-chatbot/>
- Palmer, K. (2024). How will AI influence higher ed in 2025? *Inside Higher Education*. <https://www.insidehighered.com/news/tech-innovation/artificial-intelligence/2024/12/19/how-will-ai-influence-higher-ed-2025>
- Perez, E., Kiela, D., & Cho, K. (2021). True few-shot learning with language models. *Advances in Neural Information Processing Systems*, 34, 11054-11070. <https://doi.org/10.48550/arXiv.2105.11447>
- Pérez, J., & Murray, M. C. (2010). Generativity: The new frontier for information and communication technology literacy. *Interdisciplinary Journal of Information, Knowledge, and Management*, 5, 127-137. <https://doi.org/10.28945/1161>
- Schei, O. M., Møgelvang, A., & Ludvigsen, K. (2024). Perceptions and use of AI chatbots among students in higher education: A scoping review of empirical studies. *Education Sciences*, 14(8), 922. <https://doi.org/10.3390/educsci14080922>
- Slack, D., Krishna, S., Lakkaraju, H., & Singh, S. (2023). Explaining machine learning models with interactive natural language conversations using TalkToModel. *Nature Machine Intelligence*, 5(8), 873-883. <https://doi.org/10.1038/s42256-023-00692-8>
- Wei, J., Wang, X., Schuurmans, D., Bosma, M., Xia, F., Chi, E., Quoc, V. L., & Zhou, D. (2022). Chain-of-thought prompting elicits reasoning in large language models. *Advances in Neural Information Processing Systems*, 35, 24824-24837. <https://doi.org/10.48550/arXiv.2201.11903>
- Westfall, C. (2025, January 23). Incorporating AI agents into your workforce: 5 future of work ideas. *Forbes.com*. <https://www.forbes.com/sites/chriswestfall/2025/01/23/incorporating-ai-agents-into-your-workforce-5-future-of-work-ideas/>

AUTHOR



Meg Coffin Murray is a Professor of Information Systems in the Coles College of Business at Kennesaw State University. She holds a PhD in Information Systems and has over 40 years of experience in academe and industry. Dr Murray specializes in the development and implementation of emerging technologies to meet educational, business, and societal needs. Her work involves devising strategies to assess, remediate, and amplify skills needed to leverage IT in innovation, a primary driver of economic growth. Her current focus is on the emerging role of artificial intelligence including generative AI and machine learning in both higher education and business.