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Teaching AI in the college course: introducing the AI prompt development life cycle (PDLC)

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Abstract

This paper discusses how the public emergence of generative AI is compelling those in academia to rethink teaching and learning and to consider the impact AI has on higher education. The decision as to when to use generative AI in a college course, and when not to, is now a significant component in the development of student assessment and activities. Obviously, there are academic activities that require students to engage in original work. In those instances, generative AI is not appropriate, and faculty will need to consider how to avoid the tool. In those instances where generative AI is encouraged, teaching students to use the tools available to them effectively is necessary. For productive generative AI prompts, awareness of the thought process related to developing prompts, and techniques for writing prompts, is essential. This paper introduces the prompt development life cycle (PDLC) which provides a framework to introduce students to the cognitive aspects of writing a prompt and some basic techniques that can enhance their prompt development skills. Activities to assist in developing the PDLC mindset are also included.

Keywords: ChatGPT, generative AI, large language model, LLM, prompt development life cycle, PDLC, prompt engineering

Introduction

Access to generative artificial intelligence (AI), such as ChatGPT, is a disruptor in all areas of education, including higher education. With its ability to complete typical college assignments and make it easier for students to engage in activities that violate academic integrity policies, ChatGPT creates the need for instructors to rethink college assignments and class activities to continue to create effective learning environments for students. Concerns over plagiarism and violations of academic integrity are valid, but the use of generative AI in the workplace has come to stay. As employees, students will be expected to know how to use this tool. Realistically, class assignments and activities will need to include teaching students how to use ChatGPT and faculty will need to distinguish between when the use of ChatGPT is appropriate and when it is not. When the decision is to use ChatGPT, the need to teach students how to develop an effective generative AI prompt will be important to the students' understanding and use of the tool.

This paper considers generative AI and its impact on higher education. It focuses specifically on AI's implications for assignments and assessment, and discusses several ways to use, or not use the tool in developing classroom activities. This paper introduces the Prompt Development Life Cycle (PDLC) model and uses the proposed model to teach students a useful thought process for writing prompts that enhances a student's ability to develop effective prompts.

Background and Literature Review

Generative AI and its Use in Industry

Going viral after its release in late 2022 (Burke et al., 2023), ChatGPT became the fastest growing website to reach 1 million users according to UBS Wealth Management (2023), which it reached in a week, and it was the fastest to reach 100 million users, which took just over two months. ChatGPT is an example of generative AI, which, according to Gartner, Inc.:

“refers to AI techniques that learn a representation of artifacts from data and use it to generate unique artifacts that preserve a likeness to original data...enabling computers to generate brand new, completely original variations of content (including images, video, music, speech and text)...[and] can also improve or alter existing content, create new data elements, and create novel models of real-world objects such as buildings, parts, drugs and materials (Jaffri & Choudhary, 2022, p. 42).”

ChatGPT, specifically, as an example of generative AI, uses GPT, a pretrained large language model (LLM) (Zamfirescu-Periera et al., 2023). Using ChatGPT, however, is not without risks with regard to output or usage purposes. Output risks include wrong answers in the form of confident incorrect answers called “hallucinations,” misinformation or deepfakes, and bias and can involve ethical problems, copyright violations, and fraud, and it can be used for spam or phishing purposes (Burke, et al., 2023).

Even with its associated risks, it did not take long for specific industries to recognize how ChatGPT could prove useful. For example, according to Gartner, Inc. (2023), generative AI is expected to significantly impact industries from architecture and interior design to auto, engineering, manufacturing, defense, aerospace, and medical industries. For example, in the pharmaceutical industry, generative AI is expected to help discover nearly a third of new drugs by 2025 (Burke, et al., 2022).

Other industries will not escape its impact because Gartner, Inc., reports that generative AI also affects business functions from training to marketing and communications where just under a third of all outbound messages are expected to be created with generative AI by 2025 (Burke et al., 2022). In fact, with Microsoft’s plans to introduce generative AI into its Office 365 products, few industries and business functions will be untouched.

Furthermore, generative AI appears to be having positive impacts on workplace productivity. For example, an empirical study of the impacts of AI on the economy, conducted by researchers Erik Brynjolfsson, Danielle Li, and Lindsey R. Raymond, found that when supported by AI, customer representative workers were more productive, did more in less time, and customer service improved. The employees whose work became more productive were those with less experience; AI helped them become more proficient at their work in a shorter period of time (Rosalky, 2023). If industry is embracing generative AI, then faculty will need to address AI in the college course.

The Rise of Generative AI and Higher Education

Many early ChatGPT users were no doubt students, a fact which stunned those in higher education. The news of the free open-source generative AI service rattled many in higher education and the first reaction, not surprisingly, was a rather impulsive, negative one, that ChatGPT should be banned from education. From New York to France, ChatGPT was banned from schools and classes (Nolan, 2023). Fears of the negative impact on academic integrity were rampant; the thoughts were that students would no longer write,

or reason, or problem solve, and generative AI would effectively end exam integrity (Susnjak, 2022). Universities have been put on notice that academic integrity policies must include some language involving the use of ChatGPT (Perkins, 2023) and companies are working to develop plagiarism checkers that spot ChatGPT writing (Hern, 2023). While these concerns, of course, have validity, access to generative AI is just another in the line of disruptors to education. Calculators, word processing, and the Internet, created major concerns as they disrupted the traditions of teaching and learning in higher education (Stacey, 2022), and generative AI has placed higher education on the threshold of yet another major change. Bans will not be effective, so those involved in teaching college students must rethink how work will be done due to this disruption.

Now that some months have passed since the launch of ChatGPT, the furor in higher education has settled and the current view is that rather than avoiding generative AI, instructors and students need to learn to work with it. To avoid teaching students about the utilization of ChatGPT is to ignore a major component of their future work experiences. According to Gartner analyst Tony Sheehan, “Tomorrow’s AI-enabled students will graduate to a world where AI enabled research, authoring and decision making are key professional skills” (Sheehan, 2023, p. 6). So, to help students learn, adapting assignments and incorporating ChatGPT as a tool is the future and the way forward. The inclusion of generative AI in the college classroom will also impact assessment for accreditation.

Class Assessment and Accreditation in Colleges of Business

Many students have already put ChatGPT to use in their college studies. A recent survey found that 89% of students acknowledged using ChatGPT for homework (Westfall, 2023). Since students are using AI and will need to know how to use the tool when embarking on their careers, it makes sense for faculty members to promote the constructive use of the tool. Rethinking how assignments and class activities need to be developed with the inclusion of ChatGPT will require consciously choosing when to use, or not use the tool, making it an additional factor to be considered in assignment development.

While generative AI is forcing instructors to reconsider student assessment in their classes, it also has implications for assessment activities for accreditation bodies like the Association to Advance Collegiate Schools of Business (AACSB). The AACSB, for example, has a standard for the Assurance of Learning, the purpose of which is to determine how well students are meeting learning outcomes. According to the standard, assurance of learning represents how a college can “demonstrate that learners achieve learning competencies for the programs in which they participate” (AACSB, 2020, p. 45). The assessment process provides a snapshot of student learning that plays a role in curriculum management at the course and program levels. If the results collected by an assessment instrument, such as embedded test questions or assignments (AACSB, 2020), are generated by AI, then the snapshot will be blurred. Those results will lose relevance and assessment would not be a reliable factor in curriculum management. As one author observed, “if the work that’s turned in wasn’t completed by students, it can’t reveal what they know or can do” (Supiano, 2023, para 9). Clearly, there will be instances in which faculty decide that the use of generative AI is appropriate, and other instances when faculty decide the use of generative AI is not appropriate.

Generative AI In, or Not In, the College Course

Avoiding the Use of Generative AI

There are legitimate concerns regarding the impact of generative AI on student learning and there will be times that avoiding the use of generative AI will be needed to meet learning objectives developed by faculty.

The process of designing an assignment typically starts with identifying what the student is to learn and specifying the outcome or objective associated with the task and then extends to articulating the purpose of the assignment (Carnegie-Mellon University, n.d.). Considering when or if students might use ChatGPT to address the assignment now needs to be one of the design factors. Therefore, the question that an instructor needs to ask is: Do you want students to use ChatGPT or should ChatGPT be avoided? This question will need to be addressed when planning assignments, many of which are classified as common throughout higher education to include writing, problem solving, summarizing, outlining, oral presentations, discussions, software application tasks, and group projects (Friedman, 2017). Instructors will also need to ask themselves how ChatGPT will impact a student's approach to those assignments. Fortunately, there are some options for how to rethink how to teach a course and consider ways to develop activities that avoid or limit the use of generative AI.

One area that needs rethinking is that of academic dishonesty, as there are concerns that ChatGPT will allow students to easily cheat on assignments. For example, they can produce essays without putting in much effort and without finding sources (King, 2023). The tool seems to be effective at answering some questions, but not at addressing more complex questions (Taylor, 2023).

At some higher education institutions, professors are opting not to assign take-home, open-book assignments, that they think students are likely to use ChatGPT to complete, and instead in their face-to-face classes they assign in-class assignments, handwritten papers, group work, and oral exams (Schlosser, 2023). Some suggest that the desire to cheat could also be reduced by creating more lower stakes assessments of student work and making the assessments align more closely with the work students will be expected to perform in the workplace (Supiano 2023).

For instructors worried about cheating and the unethical use of ChatGPT, having students complete handwritten assignments could be a way to bypass the use of the AI tool. Plus, in addition to avoiding ChatGPT, requiring students to hand write assignments and exams has been shown to help them to remember the content better and enhance the process of learning (Umejima et al., 2021). Furthermore, a study found that students who hand wrote an assignment in class created pieces of writing that were more original and of higher quality than those who typed their work digitally (Wrigley, 2019). However, instructors may need to overcome biases that have been shown to be connected to handwritten assignments, whereby higher grades have been given to papers based on their appearance rather than their content (Klein & Taub, 2005).

Another way to have students show what they have learned, that can bypass or go beyond ChatGPT, is to have students complete oral presentations or exams. Oral presentations have become very common in higher education to help students share what they have learned with others through an individual or group presentation (Zivkovic, 2014). Presentations can be delivered with or without having follow-up questions asked by the instructor and/or fellow students, with the question option providing more opportunities to gauge what students have truly learned.

Feedback regarding the quality of the presentation and the content can be provided by any of the following, as applicable: the instructor, the student, the student's peers, and service-learning partners. Plus, research findings have indicated that students benefit from a post-presentation conversation with the instructor about the presentation's quality and content (Tsang, 2020). Giving oral exams can be an additional way to find out what students have learned in either a face-to-face or online format, although a large class size may be a drawback to the use of oral exams, and/or to having students complete individual oral presentations and engage in feedback sessions.

Encouraging the Use of Generative AI

Deciding when and when not to use ChatGPT in class must be a conscious decision and the use of AI becomes a factor in the development of assignments. It would be wise for educators and students to be partners in terms of how and when ChatGPT can be used by having conversations with each other and/or online discussions whereby the uses of the tool are openly discussed. By doing so, faculty and students can potentially figure out future learning opportunities in which ChatGPT can be used to assist teaching and learning via more creative capabilities (Taylor, 2023).

As a result of doing so, educators need to offer clear policies regarding the use of ChatGPT and other AI tools in their classes, pay attention to the process a student uses to achieve the learning outcomes, and recognize that the process is actually part of learning (Schlosser, 2023). The open dialogue between an instructor and his/her/their students can then move toward exploring topics directly related to the learning objectives and assessment activities in a particular course. For example, one could ask the following questions of both an instructor and students: What intellectual activities do students need to complete without the assistance of ChatGPT? What intellectual activities could students effectively complete with the assistance of ChatGPT (D'Agostino, 2023)?

In a positive way, ChatGPT, as a form of AI, can potentially support student learning in adaptive and personalized manners (Zawacki-Richter et al., 2019). One way it can potentially be used effectively is in a tutoring capacity and through its use, instructors can facilitate large groups of students, for example, in large online courses. As one student in an online course observed, they can use ChatGPT as their personnel tutor for it will respond to programming questions, noting that if the student does not understand the subject matter very well that its use can direct one to incorrect conclusions (Nelson, 2023). ChatGPT is helpful because it enables students to learn via experimentation and experience (Rudolph et al., 2023).

Through the use of ChatGPT, and other forms of AI, students can assess various tactics and approaches to solving problems and accomplishing goals via game-based learning and other student-centric activities (Sutton & Allen, 2019). Instructors can apply flipped classroom strategies in face-to-face and/or online courses and have their students complete multi-media assignments, make videos, and/or give oral presentations (Zawacki-Richter et al., 2019). Additionally, instructors have the opportunity to spend more time providing feedback and encouraging students to revise their work (King, 2023).

Using the flipped classroom approach for teaching and learning, instead of a traditional lecture format, could be useful in this era of the ever-growing development and use of AI. A traditional face-to-face class format typically has students listen passively to the instructor's lecture and perhaps answer a few questions posed by the instructor. Whereas, in a flipped classroom, students are expected to actively engage in class discussions after they have read materials and answered questions about the readings and/or solve problems prior to class, in preparation for the class session. During a flipped class session, students spend their time participating in instructor-student and student-student discussions and activities that engage the instructor and students in a process of shared learning (Freire, 1968). In a flipped classroom environment,

ChatGPT could be helpful to students when they complete the cognitive work assigned prior to a class session, but in the class, whether an in-person class, a synchronous online class, or even an asynchronous class, the students can address a real or made-up situation related to the course topic(s). Through the flipped classroom approach, students can make decisions about the topic(s) based on evidence they find, make an argument for their choices in class, and create possible solutions, similar to the Harvard case method (Jennings, 1996). The flipped classroom approach places students in active roles and changes the instructor's role from that of the lecturer to one as a discussion facilitator. The strategic use of ChatGPT,

or another AI tool, to prepare students for the classwork, could be very helpful and yet, in the class itself, the students would need to apply what they have studied outside of the class to come up with effective solutions to problems and/or situations based on course content.

Anecdotally, according to one college instructor who is already using ChatGPT in classes, the tool can be very helpful to students who have writer's block (University of Illinois, 2023). The instructor noted that students can be encouraged to use ChatGPT to help them get beyond their writing issues, such as entering a prompt and seeing how ChatGPT answers. Once students get responses from ChatGPT, they can use those answers to provide the basis for their writing assignment by confirming the facts, adding additional relevant information, and rewriting the answer to correspond with the assignment guidelines that the instructor provided. In this manner, students may be able to create a better end product and they can submit the information connected to the process and their progress along with the completed answer/assignment (University of Illinois, 2023).

Additional suggestions for ways that students can use ChatGPT effectively include the following: to summarize articles, videos, and documentaries; to generate ideas for projects and other assignments; to generate practice questions to help one study for exams; to generate content to assist them with their answers to homework and assignments; to use as a grammar and spell checker; to summarize class notes; to help them write applications and meaningful emails (College Vidya, 2023); and to express text creatively (Rudolph et al., 2023).

Since students will be using AI in their workplaces, it will also be important, when using a tool like ChatGPT, to include lessons that discuss the characteristics and limitations (Rudolph et al., 2023) of the generative AI tools available. For example, ChatGPT, Bard, and Bing vary regarding characteristics such as Internet usage and training data constraints. For example, Bard and Bing utilize the Internet while GPT, trained on data through 2021, does not, which constrains ChatGPT's ability to deal with current events (OpenAI, 2023).

Students need to be aware that using ChatGPT may result in inaccuracies and that answers can be factually wrong (Roose, 2023). Generative AI, like ChatGPT has no understanding or intent regarding word choices and can create fabrications and misinformation (D'Agostino, 2023). There are also concerns regarding plagiarism, fake sources (Perkins, 2023), and the release of proprietary information (Greenwood, 2023).

Moreover, given that ChatGPT responds to user prompts, a new category of skill that college graduates will need is that of translating task requirements into productive prompts that increase the likelihood of getting desirable results. While related to assignments designed to teach students information literacy and search skills, novel assignments dealing with prompt development, for example, will be beneficial for students (Chowdhury & Fasso-Wamba, 2023). The question, then, is what model can be used to assist teaching the process of developing efficient and effective prompts.

Introducing the Prompt Development Life Cycle Model

Regardless of the tasks assigned to students, effectively using generative AI requires competence in the development of the prompts that are entered. Prompt engineering is an important new skill (Orr, 2022), and one that appears easy, but requires a great deal of skill (Zamfirescu-Periera et al., 2023). The term "prompt engineering" is often associated with format of prompts, but the definition is far from fixed. The term "prompt engineering" can appear deceptively easy or it can be quite technical (Hou et al, 2022) and has been defined as "the process of creating the prompt function $f_{prompt}(x)$, in which prior work, when faced

with a new task, usually employs a human engineer or algorithm to create a template for the task that the model is expected to perform, mainly by determining the shape of the template” (p. 16). Some steps to effective prompt engineering include the following:

“identifying the contexts in which these LLM’s errors arise, devising prompting strategies to overcome them, and systematically assessing those strategies’ effectiveness” (Zamfirescu-Periera et al., 2023, p. 1). The better people become at developing prompts, the better their outputs since “people can improve LLM outputs by [adding] textual instructions and examples of their desired interactions—to LLM inputs. Prompts directly bias the model towards generating the desired outputs (Zamfirescu-Periera et al., 2023, p. 1). “

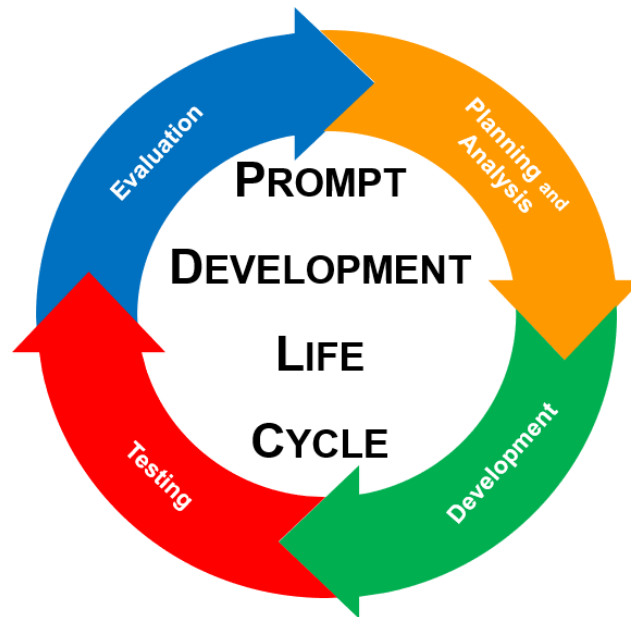
Few studies involve prompt engineering by end-users, though one study, using chiefly graduate students and other professors and professionals involved the participants trying to improve the initial prompt output, showing steps to create a recipe such that the GPT-3 “chatbot” would respond like an episode of a particular chef instructing another person (Zamfirescu-Periera et al., 2023).

Observing their prompts, researchers noted that participants struggled with generating and evaluating prompts and tended to over-generalize prompt failure and success based on single observations and based their prompts on interactions humans would have with each other. However, even before students input a prompt to a generative AI like ChatGPT, they need to learn the process of planning and analyzing a prompt, and then developing a prompt prior to testing, and then evaluating results, as it is a thinking process. In this sense, prompts go through a development life cycle much like a systems development life cycle (SDLC), in which various models represent the methodologies used to develop information systems.

SDLC models have been described since the 1970s (Maryani et al., 2022), with the earliest model, the Waterfall Model moving through stages of requirements definition, a stage covering planning and analysis, followed by design, testing and maintenance stages with other non-iterative models such as the ADDIE (analyze, design, develop, implement, and evaluate) Model involving an explicit evaluation phase (Branch, 2009).

Later models involved a more iterative approach with some models like the Spiral Model also involving an evaluation phase. Some models like the Big Bang Model lack the planning phase with little “formal preparation and analysis (p. 158)” and are considered “dangerous (p. 158)” and high risk with a likely low success rate. The system is developed (Maryani, et al., 2022).

However, the big bang methodology of the SDLC may be less appealing to universities that place more emphasis on “critical analysis and logical thinking (p. 9)” with “strong analytic, communication, quantitative and information skills (p. 9)” a generally agreed-upon goal of undergraduate student learning (Meacham & Gaff, 2006). Like the SDLC, creating productive prompts also occurs as a life cycle model, the prompt development life cycle model (see Figure 1).



**Figure 1: The Prompt Development Life Cycle (PDLC) Model
Phases of the PDLC Model and Corresponding Class Activities**

The prompt development life cycle (PDLC) model is a tool that will educate students as to processes involved in prompt writing and will support more effective methods of utilizing generative AI tools to achieve desired outputs. The model includes the following phases: planning and analysis, development, testing, and evaluation. The iterative nature of PDLC reinforces the thought process of writing a prompt with each phase building on the earlier phase. One may work through the phases multiple times before writing a prompt that meets the desired result.

Several aspects included in the prompt development life cycle phases are consistent with other prompt writing guides, such as assuring that the context of the prompt and desired output is clearly identified (OpenAI, 2023) and checking that the output is accurate and unbiased (Wallbank, 2023; DAR.AI, n.d.). However, other prompting guidelines stress techniques such as zero-shot, one-shot, few-shot and chain-of-thought techniques, while the PDLC model focuses on those techniques as part of a larger process. The phases of the PDLC model are defined as follows:

- **Planning and Analysis:** Identifying the subject and its context, phrases or keywords that describe the subject, desired output including format, and available tools.
- **Development:** Creating or refining the prompt using the information from the planning and analysis phase.
- **Testing:** Running the prompt and maintaining the prompt and output.
- **Evaluation:** Checking that the output is on-point and then critiquing the output for accuracy and for bias

The PDLC model can be used to educate students as to processes involved in prompt writing and to support more effective methods of utilizing generative AI tools. Introducing the PDLC model in an introductory information systems (IS) course is beneficial to both IS students, who will have additional opportunities to use prompt writing in later coursework, and non-IS students, for whom this might be their only opportunity to practice prompt writing in class. Those who choose to pursue a more in-depth study of prompt

development can also apply the phases in the PDLC model as they learn to create prompts using more sophisticated techniques. Moreover, including a prompt-writing activity in a course also addresses the AACSB requirement for “technological agility” in business curriculum and which, allows “learners to be agile with current technologies and possess technological agility” (AACSB, 2020, p. 27). The framework of the PDLC model provides a method by which to introduce and enhance prompt-writing processes and skills. Each phase of the PDLC model enables students to become familiar with the stages associated with prompt development that will improve the chances of obtaining the desired output.

In the tables below, some suggested activities for teaching with the PDLC are identified (see Tables 1, 2, 3, 4). Generally, each exercise walks students through all four phases of the PDLC model, though exercises do have an area of emphasis, as noted in the table heading. Of course, students may have already written prompts and used generative AI for school or recreation, but it is still important to encourage students to consider the “thinking” aspects of prompt writing. Looking at the basic thought process while developing prompts, as encouraged by the PDLC, will increase any student’s skill level. In the planning and analysis phase, students will think about the information they are trying to gather, the tools available to them, and the words that will result in a prompt that will best achieve the desired result (see Table 1).

Also included is the introduction to some prompt writing techniques: “zero shot,” “one shot,” “few shot,” and “role prompting” prompt-writing (Learn Prompting, n.d.) which will, for beginners, be used to refine wording for more productive prompts. The word “shot” refers to an example within a prompt, which can be helpful in assuring the output meets the desired requirements (course, “few shot” on menu). One shot includes one example, few shot, of course, includes more than one example (Learn Prompting, n.d.). “Role prompting” helps provide output suited to a particular attribute of a person or style, such as adding a profession to the prompt (DAR.AI, n.d.).

Table 1: Emphasis on the Planning and Analysis Phase

Generative AI Options: Tools Divide the class into groups.
Planning and Analysis: Have each group discuss how they ask generative AI to provide information about one of the following: career fairs coming up in the area over next three months, current employment trends in IS/IT, or about whether another university has a student CIS Club. Write down words they will use in the prompt.
Development: Based on those responses, write the prompt limiting the output to 200 words.
Test: Run the prompt. Save the prompt and output. Use ChatGPT, Bard, and Bing
Evaluation: Have groups report to the class on the information they obtained. How do the outputs compare? Were there difficulties in getting the information? Did it meet the requirements of their prompt?
Search Engine v. Generative AI: Tools
Divide the class into groups. Instruct students to gather some information about business plan examples. Have the students use a search engine to gather information and skim and make a few notes about the first three hits.
Planning and Analysis: Have student groups decide the answers to the following: What information do they think generative AI could provide? What words would I use to write instructions asking for that information?
Development: Based on those responses, write the prompt limiting the output to 200 words.
Test: Run the prompt. Save the prompt and output.
Evaluation: Skim the output to check that the information is on point. Compare the search engine hits and the generative AI hits. How do the results differ? Which provides the most on-point information?

Words, words, words: Word choice
Divide the class into groups. Provide students with a general topic, such as starting your own business
Planning and Analysis: Ask students to make a handwritten list of five words that could be used to write a prompt seeking that information. Then, have the students use an online thesaurus and write down one other word for each word they selected. Then, have each team write a prompt using some of the words they selected and some of the words gathered from the thesaurus.
Development: Have each group write a prompt using some of the words they selected and one using some of the words gathered from the thesaurus limiting the output to 200 words.
Testing: Run both prompts. Save the prompt and output.
Evaluation: Skim the output to check that the information is on point. Review the results. Discuss the similarities and differences in the output. Did the wording make a difference in the output?
Take a shot or two
Provide the students with the following information: The following people are attending a CIS conference. Katie Smith, is presenting a paper on generative AI and teaching in Conference room 102 at 9:00am; Joan Wilson and Tom Wilson are presenting a paper on trends in CIS in Conference Room 104 at 9:00am; Lucy Reed’s paper is on videogame coding in Conf. Room 102 at 10:15am; John Reed’s paper is on advances in data privacy in Conf. Room 103 at 10:15am; Karen Light’s paper is on database and SQL in Conf. Room 101 at 8:00am; Ted Branch’s paper is on networking in Conf. Room 101 at 10:00am; Russ Macy’s paper is on data analytics in Conf. Room 102 at 11:00am; Jill Timmons’ paper is on software development trends in Conf. Room 104 at 8:00am, and Jane Williams’ paper is on faculty utilization of information systems in Conf. Room 104 at 9:00am.
Planning and Analysis: For the first round, ask students to think about how to phrase a prompt that will put the information in a list. What will you ask generative AI to do? For the second round, how could you add an example to the prompt so that the list was in a format listing person by name, then paper topic then room then time? Write out an example of that format. (For example, Example: Name/Paper title/Conference Room/Time)
Development: On the first run, just use the “make a list” prompt. On the second run, add an example of the format to the initial prompt.
Testing: Run the prompt. Save output. Run the second prompt. Save output.
Evaluation: Skim the output to check that the information is on point. Was a list generated using the first prompt? Has adding an example of a desired format changed the output? Does the prompt need additional examples to create the list you want? Do you need to go back to P&A and think about adding another example? How could you generate an additional example that would put names in alphabetical order?

After considering the concepts in the planning and analysis phase, students develop a prompt. The Development Phase involves initial iteration of a prompt or adjustments to it after reviewing outputs (see Table 2).

Table 2: Emphasis on the Development Phase

Introducing...
Ask students to write down a few notes about themselves in a Word file, specifically noting name, major, hometown, software used at school or work, hobbies or interests, and a favorite vacation.
Planning and Analysis: What words do you need to use to ask ChatGPT to introduce yourself to the class? How do you write that and include the information in your file?
Development: Write the prompt, using the information you wrote, and adding the words needed to generate an introduction as the output.
Testing: Run the prompt and save the prompt and output.
Evaluation: Skim the output to check that it is on-point. What do the students think of the results? How is the output similar to or different from what the student would have written or would have said in class? (Instructors can have the students read or post their ChatGPT introductions in class.)
Write a prompt, any prompt.
Ask the students to write a prompt.
Planning and Analysis: Have the students hand write some ideas about information they would like to get from ChatGPT, something that is interesting to them, their choice, but they to be specific as to the information they want. How will you write the prompt to generate that information?
Development: Write the prompt. After running and saving the output from the first prompt, have the students ask generative AI to write a prompt on the topic selected. Limit outputs to 200 words.
Testing: Run the prompt and save prompt and output. Run the second prompt and save output.
Evaluation: Skim the output to check that the information is on point. Are the prompts very similar or different? Did the differences impact the output?
Who are you? Role Prompting
Tell students they will write a prompt to find out the legal status of a click wrap agreement on an internet site.
Planning and Analysis: What words will need to be included in the prompt? How will you put together the prompt request?
Development: Write the prompt. Then, when students have completed the first run, have the students use the same prompt but include the following sentence first: "You are a US lawyer." Limit the output to 200 words.
Testing: Run the prompt and save prompt and output. Run the second prompt and save prompt and output.
Evaluation: Skim the output to check that the information is on point. How did adding a role change the output? What specific differences are there?

Testing occurs whenever a student runs a prompt in the exercises discussed here, but the activity in the table below places an emphasis on distinguishing outputs (see Table 3).

Evaluation, the last phase in the PDLC, involves deciding if the output meets prompt requirements. Then, students critique the factual accuracy of the output and whether the results can be "trusted" (Wallbank, 2023). Students also review the output, and consider any biases (Wallbank, 2023) and whether the prompt needs to be refined in any way, which requires another iteration of the PDLC (see Table 4).

Approximately 60 CIS students completed the Student Introduction activity (see "Introducing" in Table 2 above). Students were to paste the information in the prompt input box and use the PDLC stages to refine their prompt until it was acceptable without further human editing. Anecdotally, most students were thrilled with the output while some were frustrated and others were concerned about AI's impact on society. Most students reworked their initial prompts while a few interacted in a more chat-like manner.

Table 3: Emphasis on the Testing Phase

Testing 1,2, 3
Provide the students with the following two prompts: What are the current software trends for firms doing accounting audits? And then the next prompt: What are the latest software trends used by accounting audit firms for full automation of the auditing process?
Planning and Analysis: Do the students understand the prompts? How are the prompts different? How are the words different? Will the outputs differ? How?
Development: Not this time.
Testing: Run the prompt and save the prompt and output. Run the second prompt and save the output.
Evaluation: Skim the output to check that the information is on point. Compare the two outputs. In three minutes, make a list of the differences between each output (Instructor will time three minutes. Have the student who has the most differences discuss results with the class and call on others to add their insights).

Table 4: Emphasis on the Evaluation Phase

Can you trust the output?
Provide the students with a prompt: How can I incorporate my business in NC?.
Planning and Analysis: Have students review the prompt to ensure they understand the question.
Development: Not needed such students have been provided the prompt.
Testing: Run the prompt. Save the input and output.
Evaluation: Skim the output to check that the information is on point. Compare the output with the information available at Nolo Press (https://www.nolo.com/legal-encyclopedia/how-form-corporation-north-carolina.html) Is the information generative AI provided accurate? Comprehensive?
Check the source
Provide the students with a prompt: Write a 200-word essay on contracts and include three references with URLs.
Planning and Analysis: Have students review the prompt to ensure they understand the question.
Development: Not needed such students have been provided the prompt.
Testing: Run the prompt. Save the input and output.
Evaluation: Skim the output to check that the information is on point. Check each reference. Can you get to the source provided? Does it look like a valid source?
Is there bias?
Provide the students with a prompt: In 200 words, is the federal minimum wage good for US businesses?
Planning and Analysis: Have students review the prompt to ensure they understand the question.
Development: Not needed such students have been provided the prompt.
On the second run, use this prompt: Are there people who have a different point of view than that in your answer?
Testing: Run the prompt. Save the output. Run the second prompt. Save the output.
Evaluation: Skim the output to check that the information is on point. Has generative AI provided a good answer? After the second run, how has the output changed? Are there varied points of view?

Future Research

While generative AI has compelled instructors to rethink how they teach so that students can learn, the reality is clear. Generative AI is part of the education environment. For courses and programs, decisions must be made in connection with each assignment and assessment as to whether generative AI needs to be avoided or encouraged and how it is to be used effectively to enhance learning. When generative AI is an option for students' work, helping students learn to use the tools more effectively is of fundamental importance. That means exposing students to methods and techniques that help them get the results they

seek. Developing exercises related to thinking about, writing, testing, and evaluating prompts, is just the beginning. Once instructors review student performance when engaging in these exercises, more effective student assignments can be developed. Future research needs to focus on data collection and student feedback regarding prompting activities and areas where students need more help. The PDLC model is a first step.

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