Student Interaction with Generative AI: An Exploration of an Emergent Information-Search Process

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Abstract

ChatGPT, a generative artificial intelligence, is one of the fastest-adopted tools in history and has quickly become a valued tool in education. This study seeks to understand how generative artificial intelligence has changed the information search process. We collected prompts submitted to ChatGPT and thoughts about ChatGPT responses through a survey of 455 students at a US university. Using thematic analysis, we identified ways that ChatGPT changes the information search process of students by supporting diverse information needs, allowing cycling of prompt adjustments, and promoting easy adoption of results.

Keywords: ChatGPT, Information Search, Education, Generative AI, Conversational Agents

1. Introduction

Advancements in generative artificial intelligence (GAI) technologies—those that can create text, images, synthetic data, etc.—have profoundly advanced human-computer interaction paradigms. One major catalyst for these changes is OpenAI's ChatGPT, a sophisticated conversational AI that leverages natural language processing, deep learning, and neural networks to simulate human-like discourse and creation (Aydın & Karaarslan, 2023). The ability of these large language model (LLM) tools to generate coherent, structured, and insightful responses has garnered global recognition, and it has sparked significant interest in its pedagogical (Lo, 2023) and student-productivity implications (Fauzi et al., 2023) in higher education.

One such use of LLMs (e.g., ChatGPT) is its potential as an information search platform (Haleem et al., 2022; X. Hu et al., 2023). For decades, search engines have been the dominant platform for information search, evolving from curated to algorithmically-generated lists. People query the engine which returns a list of websites likely to contain content related to their query, often being answers to a question. While modern algorithms can quickly find and rank websites, users must still sift through the results to verify their relevance prior to interpreting website content and adapting it to their need.

ChatGPT is different from these search engines in that it offers itself as a conversational AI built upon the collective knowledge of the published world. As such, it can serve as an information-search platform with additional capabilities such as offering contextualized information and direct answers, clarifying ambiguity in users' requests, and providing recommendations. Moreover, due to the anthropomorphic nature of conversational AI, the user experience is quite different from traditional search engines; it involves interaction with something akin to a local 'expert' that can provide advice and engage in an iteratively evolving conversation.

Some have argued that ChatGPT and other LLMs are not yet ready to take over the place that search holds in general use (Gurdeniz & Hosanagar, 2023). They argue that limitations of out-of-date training data, hallucinations (i.e., confident inaccurate responses), lack of transparency, and other issues mean that ChatGPT cannot be used to replace search in its current form. While we acknowledge these limitations, our own and others' observation of student behavior has shown

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that they are willing to ignore or work around those limitations for the benefits generative AI provides (Terry, 2023). Despite its limitations, ChatGPT's natural language understanding, conversational interface, and accessibility have led students to use it in a variety of contexts.

Because of the unique features of LLMs compared to search, we argue that the features of conversational AI, and ChatGPT specifically, might lead to a paradigm shift in users' information search process, especially in higher education. This possibility warrants attention due to the learned nature of search skills that play an important role in information and digital literacy, such as effective information retrieval from tools like Google search (Becker, 2003). If students do not become proficient in LLM use, a knowledge gap could emerge, deepening the digital divide and educational disparities for those who lack access to or are unfamiliar with such tools (Buzzetto-Hollywood et al., 2018). Additionally, educators must understand how students employ LLMs to find information, as this will impact pedagogical strategies. Our research is guided not by a prescriptive desire to tell users what they should or should not do with ChatGPT, but to understand how users are currently using it and how that use differs from search as it has existed since the Google age. This will in turn, inform strategies for increasing information and digital literacy with such tools for students and educators. Therefore, our main research question is:

RQ: What is the information search process for students when interacting with generative AI?

To answer this question, we collected prompts submitted to ChatGPT by university students. We also collected qualitative and quantitative data about the students' perceptions of ChatGPT's reactions to these prompts and their usefulness. We start our discussion with a review of GAI, the information search process, and AI in educational settings.

2. Background

2.1. Generative Artificial Intelligence

GAI is a novel machine learning (ML) application that is highly disruptive in today's landscape. It is a semi-supervised technique for creating content that has two main components: generative adversarial networks (GAN) and generative pre-trained transformers (GPT) (L. Hu, 2022). The GAN generates synthetic data and passes it to the GPT that attempts to discriminate between fake and real data (Baidoo-Anu & Owusu Ansah, 2023). This process between the GAN and GPT continues to cycle until the data are able to pass as real (Jovanovic & Campbell, 2022).

GPT-3 is an implementation of GAI that uses public data to build a 175 billion parameter language model (Brown et al., 2020). ChatGPT is built upon GPT-3 as a front end for a natural language generation (NLG) engine. Users can input text in the form of questions or instructions and receive generated text from the engine. What distinguishes ChatGPT from previous NLG engines is its accuracy, speed, and availability. Because it was released publicly for free and due to its novelty, ChatGPT gained one million users in under a week (Mollman, 2022). It also introduced a new interaction paradigm for GAI, one where users can engage in an iterative and evolving conversation with ChatGPT, which tracks and understands references to previous responses. These new features encourage a user-machine exchange in ways that prior technologies could not support.

2.2. Information search

When searching for answers to problems, individuals gather information from a variety of sources. These sources include other people, online forums, search engines, and other more sophisticated tools including ChatGPT. The information search process has been generally characterized as having six ordered stages: initiation, selection, exploration, formulation, collection, and search closure (Kuhlthau, 1991). An individual progresses through these stages, first recognizing the need, gathering general information, and then personalizing or contextualizing the information and gathering additional information to meet their needs until satisfied that sufficient information has been gathered. Individuals might experience various emotional responses during each stage. Early search stages are often marked by uncertainty that then gives way to clarity, a sense of direction, and ultimately greater interest and confidence during later stages. For a detailed overview of these stages see (Kuhlthau, 1991).

Figure 1 summarizes this general information search process. First, initiation begins with recognizing that additional information might be needed to solve the problem. Selection then involves deciding what topic to pursue and which sources of information might be consulted. Next, exploration consists of gathering information and refining understanding of the topic. During formulation, the information seeker evaluates what has been gathered and formulates a personal construction of the more general information, which in turn reveals further personalized information needed for support. In collection, additional focused information is gathered that satisfies the information needed. Finally, the searcher summarizes and uses the findings of the search process during search closure.

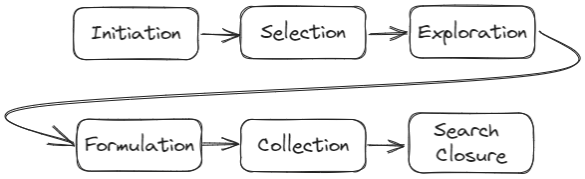

Figure 1. Information search process (Kuhlthau, 1991)

Over time, several technologies, platforms, and tools have changed how humans acquire information. A notable example is internet search engines, like Google, that catalog the resources available on the Internet and produce a list of potential query results. An individual with an informational need formulates and enters a query, and the search engine returns an ordered list of source links. These results are links to the original content and are not altered by the search engine. While targeted searches can be done on specific websites or platforms, by default, search engines include indexed information across the Internet. The information seeker must evaluate the results and contextualize them to the stated problem. This general search process is summarized in Figure 2.

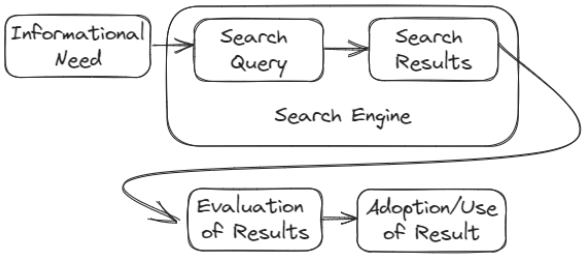

Figure 2. Information search process using search engines

Besides general search engines, platform-specific search facilitates finding information across a variety of domains. Question and answer forums are one common example. Often these forums are topic specific (e.g., parenting questions on Mothering.com or programming questions on StackOverflow) while other sites allow subforums focused on specific topics of interest (e.g., r/IntermittentFasting subreddit on Reddit.com). Researchers have investigated how users seek, filter, and evaluate information in online forums (e.g., Meservy et al., 2014). General search engines may be involved early to identify forums and platforms that contain answers to specific questions. However, platform specific search tools, such as the search tool within StackOverflow, are also frequently used to identify already posted questions that are similar to the user's informational need. Answers in these forums are typically listed together beneath each question and must be evaluated by the user for their usefulness in answering the original question or solving the original problem. This process of evaluating and pruning potential results is referred to as filtering. Ultimately, the user prioritizes and selects a solution that they will adopt, use, or implement. Figure 3 summarizes the online forum search, evaluation, and filtering process.

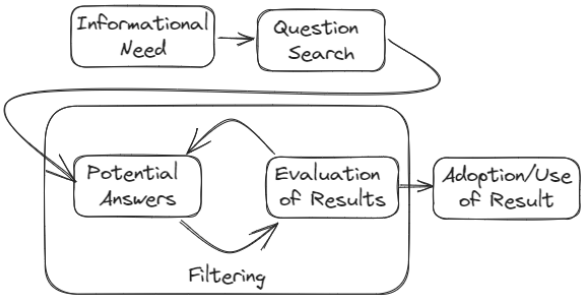

Figure 3. Online forum search, evaluation, and filtering process

In this research, we found that the information search process users followed when interacting with generative AI systems like ChatGPT might not fully adhere to the processes outlined in existing models of information search. Here, we evaluate the prompts that students used as they interacted with ChatGPT as well as their comments on what they found useful and not useful in their experiences. These assessments led us to create a new model of information search that applies to text-based generative AI systems.

3. Methodology

This research study employed a cross-sectional survey design to gauge the perspectives, attitudes, and experiences of students in primarily business-oriented academic disciplines at a private university in the United States. The survey was conducted in April 2023. Our sample consisted of 455 students with ages ranging from 17 to 37 (M=22.7). Students represented a variety of majors, with the largest groups from information systems (231, 51%), accounting (66, 15%) and pre-business (67, 15%). There were 64 (14%) other business majors collectively, and we also surveyed 27 non-business majors (6%).

Students were asked about their experience with ChatGPT during the January-April semester. This was the first full semester for which ChatGPT was publicly available. We primarily asked questions to understand how students were using ChatGPT and which classes were most helped by ChatGPT. An example question included, "How often did you use ChatGPT for course-

related questions this semester?" Seventy of the 455 students surveyed said that they had never used ChatGPT, and three reported that they did not remember if they had used ChatGPT.

Our survey did not directly ask students about informational needs or the questions or problems they had. Rather, participants reported specific prompts they used throughout the semester in support of their coursework. Participants identified prompts where ChatGPT gave helpful answers and other prompts that resulted in unhelpful answers. In total, we had 338 useful prompts submitted and 184 identified as not useful. In addition, students were asked to submit as many prompts as they were willing to share related to their coursework. In total, we received 2,902 prompts from students who used ChatGPT during the semester.

The authors engaged in a three-stage research process: 1) initial evaluation of prompts, 2) formulation of an information search process model describing the use of ChatGPT, and 3) organization of the qualitative feedback based on the proposed model. Prompts were parsed from the survey software into an Excel spreadsheet, with additional columns in the spreadsheet for labeling and categorizing.

In the first stage, we evaluated a sampling of prompts to gain a deeper understanding of the information-search process and inform the subsequent stages of our research process. This initial evaluation provided insights into the types of prompts used by participants and their satisfaction with using ChatGPT. During this evaluation, some of the general patterns of use appeared to align with processes in the aforementioned information search models (e.g., Kuhlthau, 1991; Meservy et al., 2014).

Next, building upon the findings from the initial prompt evaluation and existing information search models (see Figure 2 and Figure 3), we formulated an information search process model specific to LLMs (Figure 4). This model aims to capture the unique characteristics and dynamics of the information-search process when using ChatGPT as a GAI tool, informed by the prompts and comments gathered in the survey.

In the final stage, the qualitative feedback we collected in the survey was organized and analyzed using the new information search process model specific to ChatGPT. In this stage, we employed open coding, systematically examining and categorizing collected data into common codes or categories. This process resulted in 9 distinct codes as described in Section 4.2. Our research team then conducted thematic analysis (Braun & Clarke, 2012), grouping the open codes into four major themes: *retrieval*, *generation*, *revision*, and *evaluation*. We also identified and aligned prompts and explanations of prompts with the stages and elements outlined in the proposed framework. This process allowed for a richer understanding of the patterns, themes, and nuances present in participants' experiences and interactions with ChatGPT. We were particularly interested in how our participants found ChatGPT useful and not useful, and how it was used as a tool for their school-related information search.

Based on our analysis, we present our adapted model of information search, followed by discussion of the steps in our model with quotes supporting each step's function when using ChatGPT.

4. Model of information search: Adapted for generative AI

We found that the use of ChatGPT as an information search tool differs from the more general search processes involving search engines or question-and-answer forums. In our model, a user searching for answers to a question or problem formulates a prompt to be posed to ChatGPT. Prompts can vary widely in their complexity. Simplistic prompts might come in the form of direct questions. More sophisticated prompts might provide background information to help ChatGPT contextualize the request in light of additional information (Wang et al., 2023). The process of carefully crafting prompts with precise vocabulary, wording, and context is referred to as *prompt engineering*. Based on the prompt, ChatGPT and other similar LLMs construct a single response that is customized, contextualized, and personalized to the prompt provided. Thus, this information search process differs from those used with search engines or online question-and-answer forums. A single answer is returned and evaluated by the user rather than a list of content that must be further filtered and evaluated. Additionally, ChatGPT's answer is contextualized and adapted to the user's prompt rather than remaining a more generic response to the general question.

Another way the information search process changes with the use of ChatGPT is that the tool often provides further analysis, explanation, or justification for the solution provided (Ayoub et al., 2023) leading to potentially easier adoption of specific answers. Further, information seekers using ChatGPT can more easily cycle back to the conversation to refine their prompts or pose new ones related to the existing conversation (Wang et al., 2023). These differences affect the evaluation of results in the information search process.

ChatGPT excels at information searching for language modeling, text classification, and question answering (Hassani & Silva, 2023) and has the potential to combine vision and language models (Yang et al., 2023). However, unlike search engines or online question-and-answer forums, ChatGPT has been criticized for providing incorrect answers (i.e.,

"hallucinations"). These hallucinations happen more frequently in LLMs because a language model's main purpose is to generate text, not to provide accurate information (Qin et al., 2023). This feature has led to student skepticism of results (Shoufan, 2023) and can lead to ethical concerns when people use AI for information search (c.f., Ebrahimi & Hassanein, 2021) especially as students are more likely to accept answers (Shoufan, 2023). ChatGPT has also introduced a unique skill–prompt engineering–that, when learned, can lead to superior results (Sun et al., 2023). These factors might lead to the result evaluation becoming an even more important aspect of the search process (Ebrahimi et al., 2022) as well as altering information search stopping behavior (Browne et al., 2007; Browne & Pitts, 2004; Ilani et al., 2023; Pennington & Kelton, 2016). We now discuss each of the stages in our model.

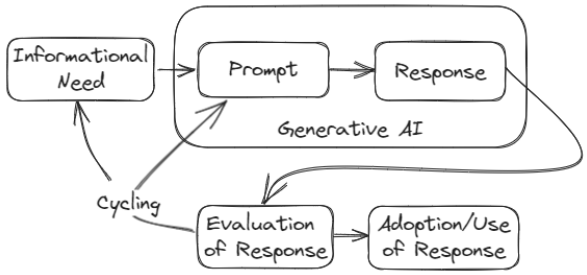

Figure 4. Information search process using Generative AI

4.1. Informational need

The first stage of our adapted information search model is analogous to previous models in that the user recognizes a need for information and has some mental formulation of that need. However, because ChatGPT does not simply retrieve existing content, but can also generate new content, the range and type of information that users might seek is expanded. For example, rather than retrieving ideas on how to write about a specific topic (like that which could be done with Google), a user might frame their informational needs as seeking to generate new content on a topic instead. Based on the open coding of prompts into themes, we propose four types of informational needs when using generative AI tools: *retrieval, generation, revision,* and *evaluation*. *Retrieval* is the need to access specific, pre-existing information, a need that existing search tools also meet. *Generation*, *revision*, and *evaluation* are all unique to generative AI and are similar in that they involve some production or calculation of content that might not yet exist. *Generation* is the creation of new content. *Revision* is the altering of existing content, often in specific ways. In *evaluation*, the user provides criteria for the tool to examine and judge information according to specified parameters. Examples of prompts that fit these types of information needs and the tasks that go along with them are provided in the following section.

4.2. Prompts

Information search, and the formulation of queries for search has developed with each new iteration of supporting technologies. Informational needs are abstract and serve as the trigger of the search process. Prompts are syntactic representations of the need. As such, prompts are specific to the technology or tool used during the search process and often are refined during the search process to meet the need. Early models of information search tactics centered around the strategies searchers used to monitor searches, understand the structure of searched data, formulate searches, and create appropriate search terms (Bates, 1979). These skills develop with use and as searchers develop familiarity with their tools, they can better access the desired information quickly and precisely (Kai-Wah Chu & Law, 2007).

Students indicated in their comments and shared prompts that they used ChatGPT for a wide variety of tasks. Our open coding identified 9 major categories of ChatGPT use: (1) writing code, (2) fixing and debugging code, (3) writing content, papers, and/or paragraphs, (4) revising writing, (5) explaining or summarizing concepts, (6) study support (e.g., study guide creation), (7) advice and recommendations, (8) math and calculations, and (9) idea generation. The research team examined examples from each of these open use categories and determined that they fell into the four major themes of informational need previously discussed: information retrieval, content generation, content revision, and evaluation.

Retrieval prompts frequently mirrored what might be seen in a search engine query. Explaining or summarizing (5) and study support (6) fell into this category. Students indicated that ChatGPT was, in some ways, more capable than Google search: "I have found that it can collect and gather information on a topic so much quicker than I could ever find on my own." Some examples of prompts identified as useful include:

- "Can you give me a simple definition of a genotype?"
- "What is the size of the market of neck pillows in the US?"

The generation of content differentiates GAI from traditional information search. In the prompts analyzed, we found students requesting two types of results: 1) ideas and insights representing fleeting content that students then build on or that make them think differently about a topic, and 2) prose and functional

code that represent the traditional output of knowledge work. Writing code (1) and writing content (3) fell into this category, along with idea generation (9). The prompts and responses differ markedly from information retrieval that typically returns a list of potential answers or answer sources. Content generation examples included:

- "Ideas to grow email subscription rates"
- "Write me python code using a csv to predict someones [sic] gender"

Another distinguishing capability for GAI is the ability to review, revise, and rewrite content (4). We also included code revision and debugging (2) in this category. While previous tools like Grammarly can be used to identify improvements for language use in writing, ChatGPT and other GAI models can use their language models to provide responses customized to the exact content a user is working with. Students appreciate this customizability in the context of writing: "...passing my writing through it was a super easy way to make it sound more professional." It can also serve as a code debugging tool, identifying sources of errors and frequently providing steps to fix those errors. Example prompts included:

- "How can I edit [this code] so it loops through each column in the dataframe and compares it to depth on a heatmap?"
- "Reword this, elaborate on it, and make it sound more professional for a webpage…"

The final category utilized some of ChatGPT's unique capabilities to evaluate messages from the user. This evaluation included performing math calculations (8), something for which ChatGPT's early models were not well suited. It also included using ChatGPT to evaluate user messages (7). Some examples of these prompts include:

- "Can you tell me if this is a good executive summary:"
- "Based on this- what option would you recommend?"

From our examination of ChatGPT prompts, it is clear that skill level varied in the searchers. Skill, along with tool familiarity, had a large influence on the effectiveness of prompts to generate the desired response. Despite ChatGPT's natural language interface, the ability to generate effective prompts takes experience, and that experience yields better results (Zuccon & Koopman, 2023).

We asked students to characterize some of their prompts as eliciting/not eliciting useful responses. As part of our qualitative analysis, we compared similar prompts identified as useful and not useful to understand what drives the effectiveness.

Effective prompts generally included sufficient context to allow ChatGPT to infer the informational need of the searcher. For code generation, effective prompts clearly articulated the programming language and the necessary format (e.g., a function, script, or method) along with the desired functionality.

Ineffective prompts were characterized by a lack of context or specificity, leading ChatGPT to give answers irrelevant to the question asked. One such example was "What is the best product for food?" This prompt is vague with no clear context or boundary conditions that would lead to an actionable or informative response.

4.3. ChatGPT responses

Many students noted the unique capabilities of ChatGPT to provide different answers to similar or identical prompts compared with a Google search. The way ChatGPT provides a specific answer to an information retrieval prompt, rather than pulling up a variety of websites about the prompt, makes the process simpler for students. The ability to quickly read synthesized and summarized information is more time efficient for students than using a Google search and then navigating to other websites. One student said, "it was useful because I could learn in one place instead of making dozens of google searches on different websites."

ChatGPT also provides custom-tailored responses to content generation prompts, revision prompts, and evaluation prompts, whereas Google's capabilities are limited to finding websites containing keywords relevant to the given prompt. A search will retrieve websites that have all of these keywords, but ChatGPT consolidates this response into a single interface.

4.4. Evaluation of responses

Evaluation of responses can differ from other information search processes in that typical signals of credibility are absent (Wells et al., 2011) such as the approval of a trusted organization or community votes. This can complicate the actions needed to verify information as one student noted, "[it] was wildly unhelpful because it gave me a lot of info, all of which was inaccurate. It even gave me fake quotes with page numbers and everything." Thus, evaluation might often be met with more skepticism than other sources. In the context of programming, many students noted that ChatGPT gave them exactly what they needed, but they still needed to test the code before understanding whether it was a correct response.

4.5. Cycling

After evaluating a response from ChatGPT, a user may iterate through the process before finally adopting or using a response, which we call cycling. *Cycling* is the set of actions taken in the GAI information seeking process where students engage in a series of prompt iterations to 1) refine their queries, 2) deepen their understanding through contextual follow-up questions, or 3) redirect their inquiries when necessary. We describe these cycling types below.

4.5.1. Refinement cycling. A common practice observed among students was the strategic refinement of their queries to obtain more precise and desired responses from ChatGPT. One student described this process, “It's hard to find things that were not useful because even if I didn't get the desired answer, I was able to refine the search." Through iterative adjustments, students could narrow the gap between their initial prompt and the intended response. Another student said, “I asked it to write some code for me, and it did not give me what I was asking for. I had to explain the error, and reword my instructions for it to fix it.” This type of cycling closely resembles the prompt refinement commonly encountered in traditional search engines, where users iteratively modify their queries to enhance search results.

4.5.2. Contextual cycling. Another approach to cycling leverages ChatGPT's contextual understanding to help explore subject matter. Through ongoing conversations, students can pose follow-up questions to clarify uncertainties, uncover nuanced aspects of a topic, and even correct ChatGPT. For example, one student found that ChatGPT’s response to their query did not align with their desired outcome. Expressing frustration, the student clarified their requirement to ChatGPT with this prompt: “Okay, that definitely didn't work! I mean, I got my program to run, but what you had me do was try to turn my Iqueryables into forms, that is NOT what I need. I need my forms to FILTER my IQueryables!!!” Recognizing the discrepancy, ChatGPT corrected its response based on the student's feedback, illustrating how contextual cycling allows for adjustments and improvements in the AI's understanding and guidance.

In another case, a student described the usefulness of contextual cycling to learning. The student talked about how they had been exposed to a concept several times in class but had not really understood it. However, the student's experience with ChatGPT was different: “I'm a very shy person, but I felt like I could ask all the follow up questions I needed to understand when I was having a conversation with ChatGPT." By building upon prior interactions, students can engage in a dynamic exchange that resembles a dialogue rather than a one-sided search for information.

4.5.3. Reset cycling. Reset cycling represents the final type of cycling, where students recognize the need to reset their prompt and initiate a new inquiry. This form of cycling arises when students realize they have followed an erroneous path or reached a dead-end in their information-seeking process and need to change their target (Hider, 2006). One student explains the challenges they encountered: "There have been many times where I would ask it something and then I would use what it gave me, only to get an error. When I told it the error, it would tell me to go back and do what I had already done... just an infinite error loop." In such cases, a reset is necessary to break out of the loop and create a new prompt that is more likely to succeed.

Reset cycling shows a willingness to reevaluate and reassess one's approach, demonstrating a metacognitive awareness of the information seeking and learning process. By abandoning a misguided prompt and starting over, students also embrace adaptability.

The three cycling processes we observed provide insight into student use of ChatGPT. By refining prompts, engaging in contextual interactions, and resetting when needed, students interacted with ChatGPT to seek better answers and understanding. These cycling processes not only promote more personalized information seeking and learning but also cultivate critical thinking skills, metacognitive awareness, and adaptability—essential skills in today's educational landscape.

4.6 Adoption/Use of ChatGPT responses

The final step of the search process involves adopting the response, using the newly acquired information to address the original information need, and terminating the search. Because ChatGPT works within the context of user prompts, users can immediately incorporate its answer into their workflow, eliminating the need to modify examples to fit their scenario. Participants reported less busywork, fewer monotonous routines, and faster task performance.

- “I started using ChatGPT and I started spending half [the] time on assignments. I got a better understanding of what was going on…”
- “It was like my 24/7 TA, I could also get busy work done way more quicker.[sic]”

However, some participants also reported the inaccuracy of results, which could impede adoption, though responses could still benefit the user by helping them understand something about their problem.

- “[T]he responses it gave me were very rarely totally correct they did point me in the right direction and helped me to get out of my rut…”

- "Codes don't always work: With functions that are hard to achieve, ChatGPT will give you something related to it but doesn't exactly work that way."

4.7 Discussion of traditional vs. GAI information search

In summary, while the GAI information search process has some similarities in structure to more traditional information search processes, there are several key differences, summarized in Table 1.

Our research has several contributions for practitioners, especially educators. We assert that just as educators have increased the information and digital literacy of their students by training them how to make effective internet searches (Becker, 2003), teaching the effective use of GAI tools such as ChatGPT for educational purposes will become increasingly important. Students will need to understand how these tools respond to prompts, and how to iteratively refine these prompts to meet their information needs. Simultaneously, students should be acquainted with the limitations inherent in the GAI information search process, and be able to contrast that with traditional search methods. They must recognize the challenge of assessing the quality of ChatGPT answers, including the possibility of encountering fabricated information. Offering examples to students about the technology's potential applications is likely to enhance student understanding of its effective use, with educators playing a pivotal role in disseminating such insights.

Additionally, our research has implications for information search theories. Because key steps in the search process are altered (as shown in Table 1), many of the implications of past models likely will not apply. We provide some examples of how future work can test these differences in the following section.

Traditional Search	Generative AI Search	Key Difference
Informational need		Traditional allows retrieval only. GAI adds generation, revision, and evaluation.
Query or search formulation	*Prompt formulation*	GAI allows specific contexts in prompts, requests for generation.
Filtering	*ChatGPT response, cycling*	GAI provides a single answer, rather than many. If the single answer is not satisfactory, cycling occurs.
Evaluation		GAI lacks traditional information quality signals and may hallucinate info.
Adoption/Use		GAI can be easier to adopt because results are tailored to the user's context.

Table 1. Key differences in search processes

5. Limitations and future directions

While we believe our model is generalizable to a variety of contexts, our dataset was gathered at a single university during the first full semester that ChatGPT was generally available. Most students were business majors with many information systems majors. While students were enrolled across a wide variety of classes, these might not fully represent the informational needs of all students within the university or across universities. There are also likely other uses of ChatGPT that have not been addressed in our sample, including non-educational uses.

ChatGPT will continue to evolve, possibly affecting perceptions of its capabilities and the quality of its results. This aspect might also impact the prompt engineering skills and the need for various cycling types required for informational needs. Although the information search framework for GAIs is expected to be stable and generalizable, this paper offers a view of the tool's current use in the search process. Limitations and issues with the tool might vary over time.

Future research should more deeply investigate each of the steps in the process model. For example, understanding the cognitive processing and emotional reactions of individuals as they progress through the information search process would likely reveal how and why individuals employ certain actions in pursuit of their information needs and where the friction exists in finding useful information. Further work could focus on prompt engineering and the level of specificity and sophistication needed to get useful information for different types of inquiries across domains. A variety of learning-based research questions could also be investigated including whether students improve at developing prompts with more practice and how they can add the right level of contextualization to get the information they are seeking. In addition, future research should weigh the benefits of GAI for learners against societal costs such as the climate impact of the power consumption for training models and generating responses and shifts in the labor market that might arise from these tools.

We suggest that investigating issues related to how users interact with GAI models, like ChatGPT, would

be beneficial. The model's conversational nature and its ability to provide contextualized, personalized information offer research opportunities such as understanding the anthropomorphization of the tool. Examining how users develop and evolve trust in ChatGPT and its results is another intriguing avenue. Broader concepts might include investigating when to use ChatGPT compared to other tools, preferences over human-generated content, and examining several non-education, possibly more hedonic applications.

6. Conclusion

Generative AIs like ChatGPT fundamentally alter the information search process. By generating new responses instead of retrieving existing content, GAI requires users to develop skills in formulating prompts, evaluating the responses, and integrating responses into their workflows. This paper provides an initial examination into the information search process using actual prompts that students used during the semester immediately after ChatGPT became widely available. The information search process with GAIs, though similar to past processes that are augmented by tools such as internet search, has important differences that alter how users find or generate and evaluate information.

Our examination of student use of ChatGPT shows that search with GAI consists of five phases: (1) identification of an information need, (2) prompt generation, (3) response creation, (4) response evaluation, and (5) response adoption. In addition, our model includes cycling, a process of iteration where evaluation of responses results in looping back to step 1 or 2 to restart or refine the process. This model, developed from student data, can serve as a general model to understand how people use generative AI to resolve their information needs.

7. References

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