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An educational researcher's guide to ChatGPT: How it works and how to use it

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Abstract

In an era of rapid technological advancements, ChatGPT has emerged as a revolutionary tool in educational research, offering opportunities to enhance research efficiency and foster innovative thinking. This article provides a comprehensive guide to understanding and utilizing ChatGPT effectively in educational research. The operational mechanisms of ChatGPT are explained, along with a discussion of practical applications such as content creation, literature summarization, statistical analysis, and idea generation. A critical discussion of prompt engineering highlights strategies for crafting inputs that optimize AI responses. Examples include paying explicit attention to both the content of the prompt as well as how the prompt is phrased. Advanced features, such as web integration, customized GPTs, and Python-based data analysis, are explored to showcase the expanding possibilities of generative AI in educational contexts. The potential for ChatGPT to streamline workflows is contrasted with ethical considerations, including risks of misinformation, inherent biases, and privacy concerns. Researchers are urged to validate outputs and disclose AI usage transparently to maintain research integrity. While recognizing the challenges, the article underscores ChatGPT's potential to improve educational research by enabling more accessible, efficient, and collaborative practices. Researchers are encouraged to adapt to these evolving tools, embracing their potential while remaining vigilant to ethical considerations and limitations.

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1. Introduction

The illiterate of the 21st century will not be those who cannot read and write, but those who cannot learn, unlearn, and relearn. - Alvin Toffler, author of *Future Shock*.

In an era where technological advancements are redefining the boundaries of possibility, one name continually surfaces: ChatGPT. From news headlines to concerned discussions among academic elites, recent artificial intelligence (AI) breakthroughs are generating significant attention. As educational researchers navigating the ever-shifting currents of pedagogical theory and practice, we recognize the profound implications of integrating new technologies like ChatGPT into our research methodologies. These innovations offer opportunities to alter the way knowledge is generated, disseminated, and applied in the digital age. Alvin Toffler's words urge educational researchers to adapt to the new technology and embrace the potential of AI. However, the capacity for AI to disrupt the very processes it aims to benefit suggests that such change be approached with caution and understanding. Educational researchers wishing to answer Toffler's call must deepen their knowledge of the underlying mechanisms propelling its advancement and familiarize themselves with ways AI can enhance their work. Even those skeptical of AI can benefit from understanding how it functions and is likely to be used by those around them. The landscape of educational research will inevitably be shaped by these advancements, making it crucial for all researchers to stay informed and adaptive.

The objective of this article is to acquaint educational researchers with generative AI. Although there are many generative AI programs in development, we will focus on ChatGPT because of its prominence, ease of access, and simplicity of use. We start by providing researchers with a basic understanding of how to use ChatGPT, followed by an overview of how it functions and its inherent constraints. The next section showcases various applications of ChatGPT, focusing on how to improve research efficiency and efficacy. Next, we explore how to improve the relevance and quality of ChatGPT's outputs through prompt engineering. We follow this with a discussion of how advanced ChatGPT models allow users to use common language to perform a variety of complex tasks. The article concludes by addressing critical considerations associated with employing ChatGPT, ensuring researchers are informed of ethical and practical implications associated with its use.

2. Basics of Using ChatGPT

ChatGPT is an advanced chatbot developed by OpenAI, designed to understand and generate human-like responses. The acronym "GPT" stands for "Generative Pre-trained Transformer," describing both the AI's functionality (generating novel content) and its underlying architecture (a transformer model that has been pre-trained on large datasets). ChatGPT can be accessed in a web browser at https://chatgpt.com, via a mobile application available on iOS and Android, and through desktop applications for macOS and Windows. While traditional (non-AI) chatbots rely on simple, pre-defined rules to generate responses leading to limited and sometimes unnatural interactions, ChatGPT uses sophisticated AI to produce more nuanced and fluid responses. Its ability to dynamically generate text based on the input it receives enables it to perform a wide range of tasks, including answering questions on many topics, assisting with writing and programming, and even engaging in casual banter. Interactions with ChatGPT reveal its strong ability to communicate using common language and can be difficult to distinguish from text-based interactions with humans (Hulman et al., 2023).

Interacting with ChatGPT is much easier and less technical than most computer applications. To start using ChatGPT, you write a "prompt." Think of a prompt as a conversation starter or a question you ask someone to get their thoughts on a particular topic. In the context of ChatGPT, your prompt is a text input that you give to the AI, telling it what you're looking for. This could be anything, such as asking a question like "When is it appropriate to use a mixed method design?" or giving an instruction like "Compose an argument in favor of using ChatGPT in the classroom." The key to a successful interaction with ChatGPT lies in how you craft your prompt, which will be covered in-depth in a later section. Once you submit your prompt, ChatGPT will generate and present a response. From here, your interaction may be complete if you get the response, you were looking for, or you can continue the conversation by sending follow-up prompts. Responses to these follow-ups will be based on the context of the entire conversation: ChatGPT remembers what you said before, allowing for human-like back-and-forth interactions. In addition to this text-based conversation, you can also communicate by voice and have a spoken conversation with the AI if you are accessing ChatGPT through the mobile app.

3. How ChatGPT Works

3.1. What ChatGPT Knows

ChatGPT has been trained on an extensive array of written materials, including books, websites, articles, and other forms of text-based content (Johri, 2023). This training involves processing and analyzing these texts to learn language patterns, grammar, facts about the world, and even writing styles. This process is similar to how a human learns language and general knowledge over time through reading and education. ChatGPT represents its memory in a neural network that stores associations between microfeatures of text (Radford, Narasimhan, Salimans, & Sutskever, 2018). Each time it is exposed to new material during learning, the network changes slightly to make it more likely to reproduce trained text. Patterns that consistently appear will be reinforced through this learning, while associations appearing infrequently will be eroded by

exposure to later material. After extensive training, the network will represent the general patterns found in the training material without explicitly recording any of the text. ChatGPT uses this vast reservoir of learned information to generate contextually relevant responses. ChatGPT's knowledge is broad but limited to what it learned during its training and does not include real-time events.

3.2. How ChatGPT Creates Text

ChatGPT takes input provided by the user - whether it's a question, a statement, or even just a word - and then uses its learning to continue it to a natural conclusion (Johri, 2023). This is similar to how one person could use their own experience to finish a sentence started by another. Imagine someone starts a sentence with, "I'm at the store and I forgot…." If this is the extent of the information given, another person might complete the sentence with common guesses like "to get milk" or "my shopping list." However, if the sentence is expanded to include more context, such as "I'm at the store and I forgot to pick up something for my cat's…", the possibilities for completion change. Now, it could be finished with "birthday party" or "new dietary needs." Having more detailed context allows the second person to provide a response that is likely more aligned with the speaker's original intention.

This generative process is not unlike a smartphone's autocomplete feature; however, instead of suggesting one word at a time, ChatGPT works with 'tokens.' Tokens are sequences of characters that serve as the fundamental units of text the model processes. These tokens can be whole words, subunits of words (similar to morphemes in linguistics), or individual characters like punctuation marks. As you type a message on your phone, autocomplete predicts the next word based on the few you already entered. Similarly, ChatGPT predicts the next token based on the previous tokens in the conversation. But unlike the relatively simple predictions made by a phone's autocomplete, ChatGPT's predictions are based on the entire conversation (up to a limit determined by the model being used, but at least thousands of tokens) and an extensive understanding of language. This allows ChatGPT to construct not just words or phrases but entire sentences and paragraphs that are coherent and contextually relevant, much like a knowledgeable person who can continue a conversation given a preliminary topic.

3.3. How ChatGPT Simulates Reasoning

Responses from ChatGPT are typically rational and human-like, giving the illusion that the AI is applying reason or processing information as humans do. However, it does not possess the ability to reason abstractly; as described above, its response is generated as token-by-token predictions based on its training data. Consider a scenario where you ask ChatGPT to write a joke. The AI might come up with something like, 'Why don't scientists trust atoms? Because they make up everything!' While this response may seem clever and suggest an understanding of both humor and basic science, it is actually a reflection of the AI analyzing patterns in joke structures and scientific wordplay found in its training data. ChatGPT does not 'understand' humor in the human sense; it simply reproduces styles and formats it has been trained on (Semrush, 2023). ChatGPT is able to provide useful information by reproducing the knowledge contained in its training material rather than through independent reasoning.

4. Ways Researchers Can Use Generative AI

4.1. Content Creation and Adaptation

The most direct way that ChatGPT can contribute to the research process is through content creation and adaptation. Research articles, a critical form of academic content, can benefit from this technology. Given information about the intended audience and an outline of the desired content, ChatGPT can draft sections of a paper. However, the language generated by ChatGPT is often more dynamic and less precise than what academic journals typically require. Therefore, it is crucial to craft prompts that discourage the use of overly descriptive and sensationalistic language and to carefully review and revise the final output to ensure it meets academic standards.

ChatGPT is also skilled at crafting educational materials, formal documents, and academic communications, such as letters of recommendation, tailored to specific criteria (Lin, 2023; Tomlinson, Torrance, & Black, 2023). For example, users can input specific achievements and qualities of an individual, and ChatGPT can draft a recommendation containing persuasive language and a coherent narrative. Recommenders can then refine these drafts to ensure they accurately reflect the candidate's strengths and potential. However, users should be careful about providing personally identifiable information, which we will discuss in our section on privacy concerns below. Furthermore, ChatGPT's ability to adjust its writing tone for different audiences (Lund et al., 2023; Zhu, Jiang, Yang, & Ren, 2023) helps ensure the content resonates with its intended audience. Whether crafting formal academic papers, simplifying information for general public consumption, or creating content for children, ChatGPT can alter its output to match the required tone and complexity. Additionally, the tool's capacity for high-accuracy translations of text into various languages marks a significant advancement for researchers in multilingual environments (Jiao et al., 2023; Ray, 2023). This enhances inclusivity and broadens the reach of educational research to non-English speaking audiences by making materials accessible in languages like Spanish, Chinese, or Arabic.

5. Enhancing Research Efficiency

5.1. Summarizing Research

The integration of ChatGPT into educational research can streamline the literature review process. By providing concise summaries of lengthy academic articles, reports, and books, ChatGPT enables researchers to efficiently sift through large amounts of information, identifying relevant studies more easily (Ray, 2023; Tomlinson et al., 2023). This is particularly useful for topics with extensive research histories. Researchers can provide critical sections of documents to ChatGPT and receive brief, digestible summaries that emphasize key arguments, findings, and methodologies. This accelerates the initial screening process and helps identify research gaps.

ChatGPT can also help summarize researchers' own studies (Macdonald, Adeloye, Sheikh, & Rudan, 2023; Zhu et al., 2023) helping them create clear and engaging presentations of their findings. In the context of writing an article, such summaries can be incorporated into the abstract, an overview for the end of the introduction, or a review of the important findings to start the discussion. These summaries could also be used when submitting presentations or posters to conferences. Outside of academic publishing, ChatGPT can generate summaries tailored for practitioners, policy makers, educators, or the general public, resulting in products such as executive summaries, policy briefs, instructional materials, and public information pamphlets.

5.2. Idea Generation and Refinement

ChatGPT can offer new perspectives on research questions, suggest alternative methodologies, and highlight the potential implications of findings. It can help identify emerging trends and gaps in the literature, providing a broader context for research endeavors. Additionally, ChatGPT can introduce interdisciplinary insights, enhancing research projects with innovative concepts and solutions drawn from other fields. For instance, an educational researcher investigating the impact of socio-economic status on academic achievement could ask ChatGPT for broader implications of their study. Drawing from its extensive knowledge base, ChatGPT might include references to relevant theories from sociology, thereby enriching the analysis with more holistic perspectives.

Furthermore, ChatGPT supports brainstorming sessions through its interactive conversational capabilities. Researchers can use ChatGPT to generate ideas and explore various aspects of a research question. For instance, researchers can prompt ChatGPT to suggest potential variables, theoretical frameworks, and possible outcomes relevant to a research topic. ChatGPT can then help refine these ideas by asking questions, offering counterpoints, and suggesting additional considerations. This iterative process enables researchers to thoroughly explore and expand their initial concepts, leading to more innovative and well-grounded research proposals.

5.3. Dissemination

Finally, ChatGPT can assist researchers in selecting suitable outlets for research. By analyzing the scope, audience, and thematic focus of various academic journals, ChatGPT can recommend the most appropriate venues for their work. This tailored guidance saves time and can increase the chances of publication acceptance. Beyond journal selection, ChatGPT can help wider dissemination efforts. It can assist in drafting conference proposals, pinpointing sessions aligned with research themes, and suggest networking opportunities with field experts. This multifaceted support extends the reach of research findings, potentially improving academic collaboration and visibility. Moreover, ChatGPT can facilitate the crafting of blog posts, website content, and social media updates to further disseminate research findings (Hedau, 2023) so researchers can engage a broader, more diverse audience and enhance public engagement and understanding of their work.

6. Statistical and Technical Support

ChatGPT can provide statistical support for educational researchers by facilitating the generation of hypotheses and assisting the selection and programming of analyses (Ray, 2023). It can suggest potential research inquiries based on initial data trends or literature reviews, guiding researchers towards studies that make novel contributions while also being feasible. Provided with research questions and a description of data (either in hand or to be collected), ChatGPT can recommend analytic techniques and provide example programming code for those analyses. ChatGPT can also recommend suitable data visualization techniques, enhancing the presentation and communication of research findings. Finally, ChatGPT can provide plain language explanations of statistics, helping researchers draw valid conclusions from their results.

ChatGPT is also valuable for writing and debugging code (MacDonald, 2023; Sobania, Briesch, Hanna, & Petke, 2023). Large language models like ChatGPT are as fluent in computer languages as they are in human languages. Users can simply describe their needs in plain language, and ChatGPT will generate programming code for data preparation or analysis in programs such as R, Stata, or SPSS. ChatGPT can also review existing programs, explain their components, and assist in revising the code to correct errors or adapt it to new scenarios. Additionally, it can translate code from one programming language to another, enabling researchers to utilize resources across different platforms. ChatGPT's analytical capabilities can benefit all researchers but

are especially helpful for those with limited programming experience, allowing them to conduct statistical analyses without the steep learning curve traditionally associated with programming.

ChatGPT can help clarify academic jargon and explain complex research methodologies (Lin, 2023; Ray, 2023) which is crucial for early-career researchers or those exploring new interdisciplinary fields. This capability enables researchers to navigate unfamiliar academic literatures and apply novel methodologies with greater confidence and accuracy. Similarly, ChatGPT's guidance on the selection and use of educational technology tools can help researchers make informed decisions, whether they are choosing a data visualization software or a virtual learning environment, ensuring that the chosen tools align with their project's objectives.

7. Improving ChatGPT Responses Through Prompt Engineering

In casual use, interacting with ChatGPT requires little concern for the structure of our prompts—simple questions yield straightforward answers. However, when using ChatGPT for more sophisticated tasks, the concept of "prompt engineering" becomes crucial (Mittal, 2023). This term refers to the detailed and thoughtful crafting of prompts to ensure that ChatGPT's responses are not only precise but also deeply aligned with specific goals. Below we discuss both how you should craft your prompts, as well as how you can intentionally design your prompting process to improve ChatGPT's performance.

7.1. What to Include in a ChatGPT Prompt

Understanding the components of a ChatGPT prompt is necessary for researchers aiming to use this technology effectively. Below we describe these components, illustrated with examples pertinent to the field of education. Not all components are needed in every prompt, but each component has a unique role that can help orient ChatGPT to your desired goal.

7.1.1. Task

The task component of a prompt specifies the exact action or outcome you desire from ChatGPT and can also be a question you want answered. Almost every prompt will contain a task, as it sets the direction for the AI's response and specifies what you want it to do. In educational research, this could range from requesting a synthesis of recent studies on a particular teaching method to generating questions for a forthcoming survey on student satisfaction. One example of a task would be, "Summarize the key findings from studies on the effectiveness of flipped classrooms in improving academic outcomes."

7.1.2. Context

Context provides ChatGPT with the background information necessary to tailor its response to your specific needs (Ramlochan, 2023). When summarizing research, for example, this might include details about the educational level (e.g., primary, secondary, or tertiary education), specific populations of interest (e.g., students with learning disabilities), or geographical focus (e.g., urban vs. rural education settings). Providing context ensures the output is relevant and considers important nuances. For example, adding to the previous prompt, you might specify, "Focus on higher education in North America" to narrow the scope of the response.

7.1.3. Role

"Role prompting" involves instructing an AI model to adopt a specific perspective, personality, or professional role when generating its response (Prompt Engineering, 2023). You could ask ChatGPT to deliver its response as if it was a seasoned educator sharing insights on classroom management techniques, a student reflecting on online learning experiences, or a policymaker discussing educational reform. Role prompting encourages the AI to recruit particular information when generating its output while enriching the response with a perspective aligned with your intent. As an example, you might start the prompt discussed above with "As an expert in modern educational techniques, summarize…", guiding ChatGPT to adopt a specific viewpoint that could offer nuanced insights into the application of flipped classrooms in education.

7.1.4. Style

Specifying the style of the response helps ensure the output aligns with your goal. You can specify the manner of a response, such as requesting that the language be formal, informal, attuned to a particular educational level, or replicating a particular individual's writing style. You can also request that the response be structured in a particular format such as a bulleted list, an outline, or a table. If you are generating content, you can specify a particular publishing format such as a script, a poem, an academic abstract, or a policy brief. Continuing the example, you might add "Present the findings in an enumerated list, with the most important findings presented first. Use language that would be understandable to someone with a 4-year college degree" to your prompt to identify the desired format and writing style of the response.

7.1.5. Examples

Providing examples can guide ChatGPT towards the desired type of response (Logan IV et al., 2021). This is particularly useful when creating content or when the task might be interpreted in multiple ways. As a final addition to our example, you could say "Incorporate findings from studies or reports on flipped classrooms like Escueta, Quan, Nickow, and Oreopoulos (2021) which observed short-term gains in mathematics but no effects in economics." This sets a precedent for the kind of research you want included in the summary and how you would like them evaluated.

In addition, when using ChatGPT to categorize or transform information, it can often be easier to provide a list of examples instead of trying to define the rules behind what you want it to do. This is particularly helpful when the rules for the categorization or transformation are complex or difficult to verbalize. For example, if you want ChatGPT to categorize a set of student responses as creative or uncreative, your prompt could include a list of 6 example responses with labels identifying whether each should be classified as creative or uncreative to act as references for ChatGPT's own judgments.

7.2. How to Phrase a ChatGPT Prompt

The effectiveness of a prompt is determined by several characteristics: *clarity*, *specificity*, *conciseness*, and *language* (Do, 2023). Understanding and applying these characteristics can significantly enhance the quality of ChatGPT's outputs.

7.2.1. Clarity

Clarity in a prompt ensures that the request is easily understandable, minimizing the potential for ambiguity. The language of your prompts should be straightforward so that ChatGPT can process and respond to the query without confusion. In educational research, where topics can range from pedagogical strategies to policy analysis, clarity helps in obtaining focused responses. For example, a prompt with a clear task might be, "Summarize the findings from empirical studies on the impact of digital gamification by presenting lists of the positive and negative impacts." This prompt is direct and leaves little room for misinterpretation.

7.2.2. Specificity

Specificity in prompts involves providing detailed instructions or questions that offer clear guidance on what is expected from ChatGPT's response. An important reason to make your prompts specific is to ensure the AI focuses on information relevant to the research question and that the result is directly related to the task at hand. A prompt with a specific context might say, "Describe strategies for integrating project-based learning in urban high school science classes, focusing on student collaboration and critical thinking." This prompt not only specifies the educational strategy of interest (project-based learning) but also narrows the context and desired outcomes, guiding ChatGPT to produce a tailored and in-depth response.

7.2.3. Conciseness

Prompts including unnecessary words or phrases, concern diverse topics, or involve multiple questions can confuse the AI, resulting in responses that are fragmented, superficial, or incomplete (Timothy, 2023). Making your prompt as simple as possible while retaining the essence of your request will typically lead to more relevant and informative responses. For example, a researcher inquiring about the impact of remote learning on math scores during the pandemic might use the concise prompt: "Summarize the effect of remote learning on high school math scores during the COVID-19 pandemic." In contrast, a less concise version might be: "I'm interested in various impacts of the COVID-19 pandemic on high school education, including remote learning, student mental health, access to technology, and teacher preparedness. How have these factors collectively and individually influenced math scores among high school students?" This second version, while detailed, risks diluting the AI's focus due to its breadth.

7.2.4. Language

The language used in a prompt influences ChatGPT's response style, tone, and complexity. ChatGPT tends to mirror the prompt's linguistic style, adapting its output to match (Sejnowski, 2023). This characteristic is particularly useful in educational research, where the required output can vary widely, from academic literature reviews to policy briefs to summaries for social media. By adjusting the language of the prompt to reflect the desired output, researchers can guide ChatGPT to produce responses in a scholarly tone, a more accessible language for broader audiences, or technical jargon specific to an educational sub-discipline. For example, although the prompt "Describe effective teaching strategies for high school biology, focusing on the implementation of 'inquiry-based learning' as evidenced by students constructing a 'phylogenetic tree' to understand evolutionary relationships" is conceptually similar to the prompt "Describe effective teaching strategies for high school biology, such as asking students to explore how different animals are related through fun projects like creating family trees," the examples in the first prompt use more jargon and would likely lead to a more academic and technical response relative to the second prompt.

7.3. Managing Your Prompting Process

Maximizing the utility of ChatGPT requires strategic management of the prompting process. This section explores strategies for managing interactions with ChatGPT, enabling educational researchers to harness its full potential.

7.3.1. Splitting Up Tasks

One effective strategy is to break down complex research tasks into smaller, more manageable questions (Khot et al., 2022). This approach allows researchers to guide ChatGPT in generating context-specific information that can be built upon in subsequent queries. For instance, if you were exploring the impact of technology on student engagement, you could start by asking ChatGPT to outline general trends in educational technology. Following this, you could use the insights gained from the first response as a foundation for more focused questions, such as the specific impact of mobile learning apps on student engagement in mathematics. The context ChatGPT creates as part of the first response will automatically be used when generating responses to the second prompt as long as the two are part of the same conversation. The additional information provided in ChatGPT's response to the first question can help it provide more detailed, accurate, and relevant responses to the second. This step-by-step approach facilitates a deeper exploration of the topic, enabling researchers to gather comprehensive insights into various facets of their question.

7.3.2. Human Revision of AI Output

Human intervention plays a vital role in the prompting process. Researchers should critically evaluate and edit ChatGPT's outputs to ensure they align with academic standards and research objectives. This might involve rephrasing responses for clarity, integrating multiple responses into a cohesive narrative, or validating the information against existing literature. Such editing not only improves the quality of the final output but also enables researchers to tailor the information to fit their specific research context, making it a more valuable resource. ChatGPT can be used as part of a feedback loop to iteratively refine prompts (Horsey, 2023). Researchers start by asking ChatGPT an initial question. After reviewing ChatGPT's output, researchers might find areas requiring further clarification or detail. Researchers can use follow-up prompts to direct ChatGPT to produce more targeted responses better meeting their goals. While this could be accomplished by editing and re-submitting the original prompt, it is usually more efficient to continue the existing conversation by asking ChatGPT to make a change to its last result. For example, if you initially ask ChatGPT to provide an overview of the effects of homework on student outcomes, it may initially provide a response focusing on elementary education. In this case, you could submit the prompt "Please focus on effects in high school" and the AI, taking the original question into account, will provide you with a review of the effects of homework on high school student outcomes.

7.3.3. Tracking and Analyzing Prompts

An often-overlooked aspect of managing the prompting process is tracking and analyzing the effectiveness of different prompts. By keeping a record of the prompts used and the quality of responses generated, researchers can identify what elicits the most useful information from ChatGPT. This continuous learning process allows researchers to refine their prompting strategies over time, enhancing the efficiency and effectiveness of their interactions with ChatGPT. Researchers are encouraged to maintain a document containing copies of prompts used for common tasks, such as generating and formatting literature reviews or producing text appropriate for academic journals. This practice will facilitate incremental improvements to their prompts over time.

8. ChatGPT Advanced Features

The ability to interpret and create text is only the beginning of what can be done with generative AI. Advanced ChatGPT models (including ChatGPT 4 and ChatGPT 4o) pair its linguistic capabilities with other tools, giving users the ability to use common language to guide powerful computer applications. With the May 2024 release, all users of ChatGPT can use these advanced models (OpenAI, 2024d) although those paying for a ChatGPT subscription have greater access. In this section, we review these advanced capabilities and how they might benefit educational researchers.

8.1. Web Searching

Advanced ChatGPT models can craft and execute internet searches, using their linguistic abilities to determine search terms and interpret results. This allows ChatGPT to access obscure information that may not be well-represented in the training data, such as niche academic studies or specific historical documents. Additionally, it can access content generated after the model's training period, which is crucial for staying updated on current events and newly published research. Of particular interest to researchers is the ability to identify specific sources or citations, ensuring that the information provided is credible and verifiable. This is

particularly important given ChatGPT's proclivity for fabricating references when using its generative AI (MacDonald, 2023).

8.2. File Upload/Download

Advanced ChatGPT models allow you to upload a wide variety of files, including PDFs, Word documents, Excel spreadsheets, and images, that can be referenced in your prompts and subjected to analysis (OpenAI, 2024a, 2024c). It can also create files of these different types in response to your requests. Together, these additional capabilities broaden ChatGPT's versatility, enabling a more comprehensive approach to both analyzing and generating content.

8.3. Customized GPTs

"GPTs" refer to custom versions of ChatGPT designed for specific purposes. Each GPT is configured with a name, a set of instructions, and optional features that enhance its functionality, such as including external documents to broaden its knowledge or linking to outside applications. When you interact with a GPT, it operates based on the specialized information and guidelines it has been given. For example, if you frequently ask ChatGPT questions about generating syntax for specific analyses in SPSS, you can create a GPT containing documentation and examples related to SPSS programming. Queries made to this specialized GPT will then have access to these resources in addition to the general knowledge contained in ChatGPT's training materials. In addition to creating their own customized GPTs, users can browse a collection of GPTs created by others. By using a GPT tailored to your needs, you can get straight to your question or task, eliminating the need to explain the context or provide needed resources each time.

8.4. Data Analysis

Advanced ChatGPT models include a data analysis feature allowing users to provide ChatGPT with data, verbally describe the analyses or visualizations they want, and have the AI perform the rest of the work. In the data analysis module, ChatGPT uses its linguistic abilities to generate Python code in response to the user's prompt. It then executes this code and presents the results. The way the analyses were run and how the results are formatted can be modified through additional prompts. The Python code used to perform the analysis is provided as part of the output, so it can be scrutinized and shared. Although Python is rarely used for statistical analysis in educational research, it is the data analysis program of choice for many other fields including data science and machine learning (Terra, 2024) and can accommodate most analyses used in education. The data analysis module represents a significant leap forward in making sophisticated data manipulation, analysis, and visualization more accessible to a broader audience, which is particularly beneficial for professionals lacking extensive programming expertise (Oladigbolu, 2024).

9. Concerns with Using Generative AI

As educators and researchers begin to integrate advanced tools like ChatGPT into their work, it's crucial to be aware of their limitations and how this affects the way they should be used. Addressing these challenges is essential for the responsible and effective use of ChatGPT.

9.1. Hallucinations

ChatGPT sometimes generates responses that are inaccurate or irrelevant, a phenomenon known as "hallucinations" (Alkaissi & McFarlane, 2023). Hallucinations occur when the model presents false information as fact or constructs a narrative that, although plausible, does not align with reality. This issue arises due to the way the model recognizes and replicates patterns of language. When generating responses, the model might generate sequences of text that seem appropriate but contain factual inaccuracies. It is therefore vital to validate ChatGPT's responses, particularly when its results are used for high-stakes purposes.

9.2. Bias

The content of ChatGPT's responses reflects the content of its training data. Given that the data is drawn from text written by humans, it naturally reflects societal and cultural biases, such as gender or racial biases, and may not represent diverse groups adequately (Ray, 2023). To check for biases in ChatGPT's responses, researchers can craft queries requesting answers to the question from different perspectives and then analyze the responses to detect evidence of biased patterns or assumptions. For example, a researcher might ask, "What are the contributions of women in science?" and "What are the contributions of men in science?" Comparing the responses to these queries can reveal any disparities in how contributions are characterized or emphasized based on gender, allowing researchers to identify and address potential biases in the generated content.

9.3. Privacy

Be aware that conversations with ChatGPT are stored in the browser and on OpenAI servers by default (OpenAI, 2024b). They can be used as training data for future versions of ChatGPT and may also be read by

human trainers. It is therefore important to avoid including private information in your prompts. As an example, recall that articles and grants submitted for review are deemed confidential. For this reason, APA (APA, 2023) and NIH (Lauer, Constant, & Wernimont, 2023) guidelines prohibit reviewers from using generative AI to assist their evaluations of journal and grant submissions. Similarly, it is important to avoid uploading data for analysis that includes identifiable information. If you do not want your conversations included in the training data, you can disable Chat history and training in the settings (OpenAI, 2023). Taking this precaution helps protect the confidentiality and security of your data.

9.4. Crediting ChatGPT

Given the concerns described above, many people justifiably want researchers to be transparent about their use of generative AI in their work. Transparency is crucial to maintain the integrity and credibility of academic research and publications. Publishing outlets (e.g., APA, 2023) have provided guidelines on the use of generative AI tools like ChatGPT, typically focusing on transparency about their use. Generative AI can be used both in the creation of research materials and to assist with writing, but its use must be disclosed when presenting the research. However, a distinction is typically made between assistive AI (like the writing or formatting assistants built into word processors) and generative AI (like ChatGPT) in these guidelines (e.g., Sage Publications, 2023). While the use of generative AI requires disclosure, the use of assistive AI typically does not.

10. Conclusions

The integration of AI technologies like ChatGPT into educational research signifies a pivotal shift in how knowledge is cultivated, shared, and applied in academia. This paper explains the operational mechanisms, practical applications, and advanced features of ChatGPT, highlighting its ability to enhance research efficiency, foster innovative thinking, and expand access to educational insights across diverse languages and cultures. The potential of ChatGPT to transform educational research practices is immense, enabling researchers to process and analyze data with unprecedented speed and flexibility, generate content that bridges disciplinary gaps, and disseminate findings more effectively to broader audiences.

However, leveraging this technology also requires careful consideration of its limitations and ethical implications. Issues such as data privacy, hallucinations, and inherent biases within AI models present challenges that must be addressed to harness ChatGPT responsibly. Researchers are urged to remain vigilant, verifying AI-generated content and continually refining their interaction strategies to mitigate these risks.

Reflecting on Alvin Toffler's insightful words, it becomes evident that the 'illiterates' of the 21st century may not be those who lack traditional reading and writing skills, but rather those who cannot adapt to evolving technologies such as ChatGPT. Educational researchers are positioned at a critical juncture where embracing ChatGPT can significantly redefine the scope and methodology of their work. The ability to learn how to use such advanced AI tools, unlearn outdated research methodologies that limit flexibility and innovation, and relearn new approaches facilitated by AI can dramatically enhance their research outcomes. This continuous cycle of adaptation is essential for researchers aiming to stay relevant and effective in a landscape increasingly dominated by rapid technological change.

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