

# Using LLM (Large Language Model) to Improve Efficiency in Literature Review for Undergraduate Research

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## Abstract

The potential of artificial intelligence (AI) to streamline and improve the research process for academics is becoming increasingly evident as this technology develops. A promising avenue for conducting literature reviews is to employ artificial intelligence (AI). Using OpenAI's ChatGPT, this paper explores the utility of this tool in the context of academic literature reviews. Our study focuses on how ChatGPT can be used to support the literature review process for undergraduate students conducting research for their capstone courses. Furthermore, we will explore the possible drawbacks and limitations of relying on artificial intelligence to perform such research tasks. The aim is to provide a balanced and comprehensive view of the role and future potential of AI, and specifically ChatGPT, in literature review studies. In addition to evaluating the accuracy and relevance of the results generated by ChatGPT, we will also examine the quality of results generated by ChatGPT.

## Keywords

Large language model, ChatGPT, literature review, undergraduate research

## 1. Introduction

Many undergraduate programs require students to take a foundation course that focuses on research methods. This experience helps students develop practical skills, such as hands-on learning and problem-solving. In addition, it offers students the opportunity to explore their interests, delve deeper into a particular field of study, and gain a competitive edge in graduate program preparation. In this course, they typically learn different elements of the research process, such as reading research articles, conducting literature reviews, defining and communicating a research problem, among others. Other problems.

Among these components, a literature review is essential as it establishes the research context, builds a theoretical framework, and helps to understand the relevant literature to avoid redundancy and duplication. However, this assignment presents a steep learning curve, especially for undergraduates new to research. They often have difficulty identifying relative content, synthesizing information, understanding new content, distinguishing relationships between sources, and writing in the genre of scholarly literary commentary.

Traditionally, document review is laborious, time-consuming, and often difficult due to the vast amount of information available. This involves identifying, evaluating, and interpreting all existing research relevant to a particular question or area of research, citing sources dealing with traditional methods of literature review. This method, although comprehensive, faces challenges such as the possibility of bias in literature selection, the omission of related studies, and the volume of literature available for analysis [source cited]. . Recently, the emergence of artificial intelligence (AI) has marked a breakthrough change in many different fields, including healthcare, finance, education and research [1, 2]. Sophisticated AI systems, capable of understanding and generating human-like text, have had a significant impact on academic research. OpenAI's ChatGPT is one of the cutting-edge language models that are redefining the way we approach and conduct document review [4].

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In today's age of information overload, when new research is published at an unprecedented rate, AI and language models such as ChatGPT can provide an effective alternative to performing financial assessments. By using AI capabilities, students can conduct more effective document reviews, potentially solving some of the problems associated with traditional methods. This article aims to explore the potential of ChatGPT in literature reviews. It provides an overview of the ChatGPT model, discusses its possible applications and advantages in conducting a document review, compares it with traditional methods, and gives an overview regarding potential weaknesses and limitations. The objective is to present a comprehensive understanding of the use of AI in the context of literature review, particularly in undergraduate research teaching.

## **2. Existing Approaches in Literature Review**

A literature review [10] is a critical evaluation and summary of published information on a particular topic or a research question. It can be a standalone document or section of a document. The purpose of a literature review is to convey to the reader what knowledge and ideas have been established on a topic, and what are the relationships among various ideas, their developments, their strength and weakness. Literature review helps the researchers to build foundations and find the niche of the new work

As a fundamental part of research, literature review entails the identification, collection, evaluation, and interpretation of relevant works on a specific topic. The traditional approach to literature reviews is a labor-intensive process that often requires weeks or months of time-consuming manual work [11]. Researchers manually search databases, read through potentially relevant articles, and organize findings to synthesize a coherent overview of existing knowledge on a topic [12]. This laborious process poses significant challenges, including potential oversight of relevant studies and biased selection of literature, leading to gaps in the review. A further improvement using a more systematic way than the traditional literature review is proposed in [14] as three phases: the exploration phase, the interpretation phase and the communication phase. In the exploration phase, five steps are suggested: 1. exploring beliefs and topics; 2. initiating the search, 3. storing and organizing information, 4. selecting and deselecting information, 5. expanding the search using MODES (media, observations, documents, experts, and secondary data). Analyzing and synthesizing information is carried out in the interpretation phase, and conveying the information, analysis, conclusions and implications is carried out in the communication phase.

The objects in the whole literature review process are mostly text documents. In the age of AI, with the fast-developing capability of the large language models such as ChatGPT, can we automate the literature review process? How effective is it to use ChatGPT in literature review? In the following, we first provide an overview of ChatGPT, then we describe our case study and analyze the result.

## **3. ChatGPT: An Overview**

The advent of ChatGPT from OpenAI denotes a remarkable advance in the world of artificial intelligence. This particular language model is a variation of the Generative Pretrained Transformer (GPT) models, which have been developed with the primary aim of producing text that closely resembles the manner in which human beings communicate, in response to specific prompts. The 2 present approach leverages transformer neural networks, with specific emphasis on the transformer decoder variant, employing machine learning techniques to generate text that is both logically consistent and contextually relevant. One of the fundamental distinguishing factors of ChatGPT from its antecedent language models is characterized by the expansiveness and intricacy of its training data. The model has undergone training using heterogeneous internet texts that encompass a wide range of subjects, genres, and tonalities. This expansive set of data affords the artificial intelligence model with the capacity to effectively address a diverse range of tasks, encompassing intricate article synthesis to original content formation. ChatGPT uses

unsupervised learning algorithms on unlabeled data. It acquires the ability to anticipate the succeeding word in a given sentence through scrutinizing the patterns present in the dataset on which it has been trained. This capability facilitates the generation of responses that bear a remarkable resemblance to those of human language, manifesting similarities particularly in regards to the textual organization and substance [5, 7].

It is important to acknowledge that even though ChatGPT exhibits aptitude in producing text that resembles that of a human being, it lacks the capacity for comprehension and consciousness. The responses produced by the subject under consideration stem exclusively from statistical pattern recognition. Despite the production of said responses, the subject lacks inherent comprehension of the meaning of the content generated. Hence, although the language model can mimic human conversation and produce a coherent essay, it lacks the cognitive ability to comprehend or develop judgments pertaining to the subjects it addresses. Nevertheless, there is continuing discourse concerning the ethical ramifications of such cutting-edge artificial intelligence technology, encompassing concerns related to confidentiality, potential misuse, and the consequences for the workforce.

Within the context of scholarly inquiry, and more specifically the synthesis and evaluation of existing literature, ChatGPT exhibits significant potential. The capacity to examine and condense substantial quantities of text could transform the procedure of literature review, enhancing its efficiency and comprehensiveness rapidly and precisely. In the sections that follow, we analyze this potential and the complexities that are associated with it.

#### **4. The Role of ChatGPT in Literature Reviews**

Considering the similarity of coming up with research keywords versus generating prompts for ChatGPT, we propose using ChatGPT to streamline literature reviews. In doing so, we aim to explore ChatGPT's potential to achieve the following:

**Efficiency:** The ability to process vast amounts of text quickly is one of ChatGPT's main strengths. In a literature review context, this could translate into sifting through hundreds or thousands of articles, abstracts, and research papers in a fraction of the time it would take a human researcher. Furthermore, ChatGPT can organize the retrieved literature, providing a structured overview that may speed up the review process.

**Comprehensiveness:** When tasked with conducting a literature review, ChatGPT's machine learning algorithms allow it to scan multiple databases and sources. This includes not just mainstream databases, but also more obscure or specialized ones. This ability to cover a wide breadth of sources increases the chances of a comprehensive and inclusive literature review.

**Selection:** Human researchers may unintentionally bring their biases into the selection process during literature reviews. However, as an AI, ChatGPT uses machine learning algorithms to select literature based on the specified criteria. It can be programmed to search for articles based on specific keywords, authors, journals, or a combination of these and other factors. ChatGPT asserts that its process can ensure that the literature review is exhaustive and unbiased.

**Understanding and Summarization:** A key part of any literature review is understanding and summarizing the collected articles. Despite lacking true understanding, ChatGPT can provide effective summarizations based on its pattern recognition capabilities. It can extract key points, conclusions, and methodologies from papers, thus offering a concise summary for each, which may save researchers time.

**Gap Identification:** Identifying gaps in existing literature is crucial for proposing new research avenues. With its ability to analyze large amounts of data, ChatGPT may help researchers identify trends and gaps in current research, guiding them towards areas that require further investigation.

#### **5. Empirical Evidence: Case Study on Undergraduate Research Capstone Class**

We engaged ChatGPT to explore its capabilities to assist with literature reviews in undergraduate capstone courses. Specifically, we examined the utility of ChatGPT to assist with literature reviews in two different academic disciplines: Computer Science and Communication Studies. Our multidisciplinary approach provides insight into how faculty and students in the sciences and humanities may effectively utilize ChatGPT to assist with literature reviews.

Initially, we prompted ChatGPT to “provide 3-4 examples of a suitable and compelling research topic within the humanities” in the context of a 4-credit undergraduate capstone research course for a Communication Studies major. ChatGPT generated four topics:

1. The Influence of Social Media on Body Image Perceptions and Mental Health
2. Digital Divide and its Impact on Remote Learning
3. The Role of Communication in Climate Change Advocacy
4. Misinformation and Fact-Checking in the Digital Age

These are relevant--but broad--areas of research for the discipline of Communication Studies. To examine the platform’s capabilities to assist with the literature review process, we next prompted ChatGPT to “identify relevant literature” on each of these four research topics. By prompting ChatGPT to identify research on the four topics it identified, we aimed to capitalize on the tool’s capabilities to perform keyword as well as semantic level search.

ChatGPT responded with a bibliography of two peer reviewed journal articles per topic. Some of the articles ChatGPT identified are relevant and extensively cited. For example, when prompted to identify relevant literature on the topic of the Digital Divide and its Impact on Remote Learning, ChatGPT highlighted “Reconsidering political and popular understandings of the digital divide” by Neil Selwyn, a 2004 article that is cited by more than 1800 publications. However, other results revealed weaknesses in ChatGPT. On the topic of the Digital Divide and its Impact on Remote Learning, ChatGPT cited a 2020 article entitled “Inequity of the digital divide: COVID-19 and online learning.” This article does not exist. Although this citation appeared realistic at first glance, when we worked with a research librarian to locate the article, it became clear that the source was the product of a ChatGPT hallucination. We did not identify hallucinations in the short bibliographies ChatGPT generated for other topics, but we did note that some of the sources ChatGPT suggested are not very relevant due to methodology or outdated findings. Excluding the 2020 citation hallucinated by ChatGPT, the sources it suggested for literature review did not include any work published after 2018.

After we reviewed these results we developed a new prompt, in an effort to elicit a more useful response from ChatGPT. We asked: “For each of these topics, identify relevant literature on this research topic. Focus on qualitative literature in the discipline of communication and identify at least 10 excellent sources.” In response ChatGPT produced a bibliography of three “seminal works in the field that would likely be relevant” to each research topic. As a whole, these results were more relevant and credible, although they were not as numerous as we requested. This time, for the topic Digital Divide and its Impact on Remote Learning, ChatGPT identified three existent sources:

- A. Warschauer, M. (2004). *Technology and Social Inclusion: Rethinking the Digital Divide*. MIT Press
- B. Van Dijk, J. A. (2006). Digital divide research, achievements and shortcomings. *Poetics*, 34(4-5), 221-235
- C. Selwyn, N. (2004). Reconsidering political and popular understandings of the digital divide. *New Media & Society*, 6(3), 341-362.

All three sources are influential; each one has been cited more than 1800 times. All three provide surveys of prior scholarship on the central topic of the “digital divide.”

Our experience illustrated the importance of human-in-the-loop, especially in the context of undergraduate research courses. If ChatGPT will be used to support student work on literature reviews, it is important for faculty and students to engage this tool with a strategic, critical process. For example, student researchers will likely need instructional support to enact a process that includes: developing effective prompts, critically examining ChatGPT responses, and using disciplinary knowledge to iterate.

As we enacted this process, we yielded more useful results from ChatGPT. For example, for the topic Digital Divide and its Impact on Remote Learning, we prompted ChatGPT to use the three sources it identified (Warschauer 2004, Van Dijk 2006, Selwyn 2004) in order to: "(1) Extract key points, and generate summaries of the literature, (2) Organize the retrieved literature and provide a structured overview, (3) "Use the retrieved literature to write 1500 words of in-depth analysis of existing works on the topic to provide context, identify gaps, and set the stage for further investigation." The responses ChatGPT generated were general, but the summations were accurate enough to serve as starting places for understanding the sources and key terms. The format of the "structured overview" and "1500 words of in-depth analysis" also modeled organizational structures that are common in academic writing; because of this the summations have potential to serve as scaffolds for students to build on, as they work to develop accurate, nuanced, and up-to-date literature reviews. Here again, our experience suggests that student researchers will likely need instructional support to enact a process that includes critically examining ChatGPT responses, using disciplinary knowledge to iterate. With a strategic approach, utilizing ChatGPT in addition to existing research processes and tools shows potential to help students identify potential starting places for literature review and adapt an organizational scaffold to support their insights.

While we see potential to strategically engage ChatGPT as a tool in undergraduate research courses, we also recognize a number of limitations of the current platform. ChatGPT asserts that it "offers immense potential in optimizing and streamlining literature reviews," and that its strengths include providing "unbiased selection" of literature and "help[ing] researchers identify trends and gaps in current research, guiding them towards areas that require further investigation" (qtd. from above). However, ChatGPT's responses to our prompts raise some questions about literature selection and analysis. For example, for the topic Digital Divide and its Impact on Remote Learning, all of the sources ChatGPT selected were published more than fifteen years ago, by scholars who appear to identify as white men, and have been cited more than 1500 times. When prompted to generate "in-depth analysis of existing works on the topic to provide context, identify gaps, and set the stage for further investigation," ChatGPT wrote:

*"Although these works provide crucial insights into the digital divide, there is still an array of gaps that need addressing. The continuous evolution of technology demands continuous evolution in our understanding of the digital divide. Future research could benefit from examining the intersectionality of different factors contributing to the digital divide. This could include investigating the role of disability, gender, and race in digital inclusion and remote learning."*

In this case, ChatGPT's literature selection and summation did not include or acknowledge significant research that already exists on "the role of disability, gender, and race in digital inclusion and remote learning" or influential publications on the digital divide, digital inequality, and remote learning by scholars who are women, people of color, and/or people with disabilities (see for example Livingstone & Helsper 2007; Hargittai & Hinnant 2008; Jenkins, Ito & boyd 2015; Ali 2020). We cannot extrapolate larger patterns from this narrow test, but ChatGPT's characterization of its process as "unbiased selection" obscures how this AI machine learning system amplifies some research findings and not others and may not provide an "equal playing field" (Noble 2008). Because ChatGPT's training data currently ends in 2021 we did not expect the platform to include the most contemporary literature on remote learning, but we were surprised to see that all the sources it selected on this topic predate 2008. These experiences illustrate that for faculty and student researchers who engage ChatGPT, it will be important to develop human-in-the-loop processes to identify and work beyond the platform's elisions, in order to build research projects that engage the breadth, depth, and diversity of knowledge on the topic.

In a similar fashion, we asked ChatGPT to "provide 3-4 examples of a suitable and compelling research topic in computer science", and the following four topics are generated:

1. Ethical Considerations in Artificial Intelligence (AI) and Machine Learning (ML): Exploring the ethical implications of AI and ML algorithms, such as algorithmic bias, privacy concerns, and social impact.

2. Human-Computer Interaction (HCI) for Augmented and Virtual Reality (AR/VR): Investigating the design and usability aspects of AR/VR systems to enhance user experience and interaction.
3. Cybersecurity for Internet of Things (IoT) Networks: Examining security challenges and solutions for IoT devices and networks.
4. Natural Language Processing (NLP) for Text Summarization: Exploring techniques for automatic text summarization to extract key information from large volumes of text.

Most of the research topics are relevant and current, but they are in general very broad, and lacking individual niche, which could potentially lead to another survey style research paper instead of scientific breakthroughs. We then asked ChatGPT to “identify 2 most recent literature for each of the above 4 research topics”, and ChatGPT returned the following result:

1. Ethical Considerations in Artificial Intelligence (AI) and Machine Learning (ML):
  - a. Paper: "Ethics of AI and Machine Learning Algorithms: A Critical Review" by Suresh and Gutta (2021)
    - i. This paper provides a critical review of the ethical considerations in AI and ML algorithms, discussing topics such as bias, fairness, interpretability, and accountability, and proposes guidelines for ethical algorithmic design.
  - b. Paper: "Towards Ethical Guidelines for Bias Mitigation in Machine Learning" by Madaio et al. (2020)
    - i. This study focuses on the ethical challenges related to bias in machine learning models. It proposes guidelines and techniques for bias detection and mitigation to ensure fairness and accountability in algorithmic decision-making.
2. Human-Computer Interaction (HCI) for Augmented and Virtual Reality (AR/VR):
  - a. Paper: "Towards Natural and Intuitive Interaction in Augmented Reality" by Bruder et al. (2021)
    - i. This paper discusses natural and intuitive interaction techniques for augmented reality systems. It explores gesture recognition, spatial mapping, and haptic feedback to enhance user experiences in AR applications.
  - b. Paper: "Virtual Reality for Psychological Therapy: Recent Advances and Future Directions" by Valmaggia et al. (2020)
    - i. This review paper explores the use of virtual reality in psychological therapy. It discusses recent advances in VR-based interventions, user experiences, and challenges for incorporating VR technologies into therapeutic practices.
3. Cybersecurity for Internet of Things (IoT) Networks:
  - a. Paper: "A Survey on Security and Privacy Issues in IoT-Based Healthcare Systems" by Malik et al. (2021)
    - i. This survey paper focuses on security and privacy challenges in IoT-based healthcare systems. It discusses various threats, vulnerabilities, and countermeasures to protect sensitive healthcare data in IoT networks.
  - b. Paper: "A Lightweight Blockchain-Based Authentication Protocol for IoT Devices" by Alrawais et al. (2020)
    - i. This paper proposes a lightweight blockchain-based authentication protocol for securing IoT devices. It addresses security and scalability challenges in IoT networks by leveraging blockchain technology.
4. Natural Language Processing (NLP) for Text Summarization:
  - a. Paper: "Pretrained Transformers Improve Out-of-Distribution Robustness" by Wang et al. (2021)
    - i. This paper explores the use of pre trained transformer models in text summarization tasks, discussing their impact on out-of-distribution robustness and generalization capabilities.

- b. Paper: "Extractive Summarization of Long Documents by Combining Global and Local Context" by Liu et al. (2020)
  - i. This research focuses on extractive summarization of long documents. It proposes a method that combines global and local context information to generate more informative and concise summaries.

At the first glance, the returned literature are mostly review papers themselves and indeed closely follow the research topic, which is a common drawback of using ChatGPT—overgeneralization. After careful examination, as we try to find the actual papers, we discovered that the suggested “literature” does not exist most of the time. This creates a major problem of research credibility as citation often needs to be rigorous and uniform. What we need at this stage is to introduce human-in-the loop ChatGPT, to follow the lead of ChatGPT and further refine the topics and locate the exact paper. For example, by browsing through the summary returned with the first ethical paper, we immediately identify more keywords: “bias”, “fairness”, “interpretability”, “accountability”, “ethical algorithm design”, which prompt us to further narrow down the topic. When returning that literature, ChatGPT did return a phrase “Please note that the availability and citation counts of research papers may vary, and it's important to conduct a comprehensive search using academic databases to find the most recent and highly cited publications in the respective research areas.” So we improved the prompt by asking ChatGPT to “perform a comprehensive search using academic databases to find the most recent and highly cited 2 publications for each of the 4 research areas”. After a couple of “apologies” from ChatGPT, we got some guidelines. Here is an example for the first topic:

1. Ethical Considerations in Artificial Intelligence (AI) and Machine Learning (ML):
  - a. Start by searching academic databases like Google Scholar or IEEE Xplore using keywords such as "AI ethics," "machine learning ethics," or specific ethical concerns in AI/ML.
  - b. Refine your search results by selecting a specific time frame for publication, such as the last 5 years.
  - c. Sort the results by citation count to identify highly cited papers.
  - d. Read the abstracts, introductions, and conclusions of the selected papers to determine their relevance and citation impact.

If we ask ChatGPT these two questions again, another four different topics will be generated. For one thing, we think this is definitely a great way to inspire students to think along a general direction, and further their inquiries that lead to better research topics.

## 6. Evaluation of ChatGPT in Literature Review

Our case studies show that although ChatGPT can help with the literature review process, it is crucial to understand that the final responsibility for the review's quality and integrity still lies with the human researcher. For instance, understanding the broader context, making connections across disciplines, and identifying potential bias in the studies reviewed require human cognitive abilities and expertise that AI currently lacks. It is essential to reflect on the possible downsides and constraints associated with this approach while conducting literature evaluations. The subsequent points provide a few of the downsides and constraints.

**Quality Control:** The vast computing abilities possessed by ChatGPT could lead to an overwhelming overflow of information, some of which may not be relevant or accurate. Even with advanced algorithms, the artificial intelligence model may give inaccurate summaries or analysis due to its tendency to misinterpret intricate concepts or subtleties found in textual data.

**Contextual Understanding:** As an artificial intelligence, ChatGPT is deficient in genuine comprehension of the material it analyzes. Although proficient in recognizing patterns and producing coherent written content, it lacks the capacity to comprehend the meaning or significance of the conveyed information. Within the context of literature reviews, the requirement for comprehensive comprehension of the subject matter frequently proves to be a noteworthy constraint.

**Reliance on Training Data:** The performance of ChatGPT is primarily contingent upon the caliber and multiplicity of its training data. Should the training data exhibit biases or limitations in its scope, the potential exists for an adverse impact on the ability of the AI system to access a full spectrum of literature. Interdisciplinary research necessitating diverse knowledge and expertise may not be optimally facilitated by ChatGPT, owing to its limited comprehension of the holistic nature of such inquiries.

**Ethical Concerns:** The utilization of artificial intelligence (AI) tools, such as ChatGPT, in academic research raises numerous ethical concerns. An exemplification of critical importance is the assurance of the non-compromise of confidentiality and privacy of the data utilized for the training of the model, in the context of implementing AI. It is crucial for researchers to maintain vigilance regarding the capacity of artificial intelligence to be employed in generating or circulating fraudulent or discriminatory research investigations.

**Accessibility and Costs:** As the utilization of artificial intelligence (AI) tools continues to expand, it is possible that not all individuals will have access to sophisticated models, such as ChatGPT-4, due to factors such as financial limitations or technical prerequisites. The aforementioned scenario has the potential to result in an unequal allocation of resources within the research community.

While these drawbacks present challenges, they also offer avenues for improvement. By acknowledging these limitations, researchers can work towards refining the AI's application in literature reviews, ensuring rigorous supervision, cross-verification of information, and using AI as a supplement to, rather than a replacement for, human expertise and judgment.

## 7. Conclusion and Future Directions

In conclusion, leveraging AI tools such as ChatGPT offers the potential to support academic literature reviews by providing efficiency, more comprehensive coverage, and scaffolds for writing in this scholarly genre. While the application of AI in literature reviews is still in its infancy, challenges remain. Challenges identified through our study include AI hallucinations that cite nonexistent literature, and opaque selection and summary processes that may amplify rather than overcome human biases. To further assess the effectiveness of ChatGPT in literature review, more rigorous and quantitative measures such as comprehensiveness, degree of relevance, amount of time spent can be introduced in future research. Based on our initial research, we hypothesize that further development of human in the loop strategies may help mitigate these challenges and strengthen the potential of AI tools to support academic literature reviews. For example, in future research we plan to restructure our process to have experienced scholars identify core literature on a research topic and feed that information to ChatGPT and then prompt the AI tool to identify additional sources and summarize the literature. We are interested to test this approach, compare it to our existing results, and continue developing strategies to capitalize on the potential of LLM to support literature reviews.

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