

# AI- and LLM-driven search tools: A paradigm shift in information access for education and research

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## Abstract

The article reports on an exploratory study that assesses the results produced by emerging artificial intelligence (AI)- and large language model-driven search tools in response to a series of queries and prompts based on four scenarios of information-intensive tasks of university students and researchers. Sixteen questions and prompts were created based on four scenarios of information-intensive tasks of university students. Each of these questions and prompts was presented to six AI-driven search tools, and the results were manually checked to assess their suitability for specific user needs and contexts. Based on the findings, it was argued that while the AI-driven tools bring a paradigm shift in information access for education and research, outputs generated by these tools vary quite significantly. Choice of the right tool, framing the question and further prompting play a key role. Also, users need to scrutinise each output to check their quality and reliability in the context of the specific search tasks. It was concluded that further research is needed involving different user groups, scenarios and search tasks and different AI-driven search tools. Implications of the use of AI-driven search tools for libraries and scholarly databases, as well as for research and scholarship in different areas of information science, are discussed.

## Keywords

AI; ChatGPT; information access; library services; LLM

## 1. Introduction

Artificial intelligence (AI), and especially generative AI, is transformative technology that has a revolutionary impact on information-driven tasks due to their capacity to emulate knowledge production activities which were previously the exclusive domain of people [1]. A UK government report suggests that these technologies ‘can facilitate access to information, education and training’ [2]. The UK Russell Group Universities’ Principles on the use of generative AI tools in education recommend that university students and staff should be prepared to use the AI tools effectively and appropriately [3]. ‘It is vital for librarians to work proactively with tech firms to address the limitations and biases of the likes of ChatGPT’, reports the *Times Higher Education* [4].

Data and information form the foundation of every activity in education and research. People’s information practices draw on their own knowledge that forms the habitual starting point of information seeking, use and sharing [5]. As discussed in the following section in this article, several models have appeared over the past few decades that explain the various stages of information search processes (ISPs) in different contexts. This knowledge has informed the design and delivery of library and scholarly database services and training programmes to educate users for effective and efficient use of various search services for undertaking information-intensive tasks in different contexts.

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The emerging AI- and large language model (LLM)-based search tools like *Gemini*, *GPT-4o* and *Scholar GPT* could make many, if not all, of the above-mentioned stages redundant, because these tools take a conversational approach, interact with a large number of resources and produce ready-made answers or knowledge output. While these technologies will have profound impact on education and research, it is not clear what set of skills and competencies would the users need to make optimum use of these technologies for undertaking information-intensive tasks. This calls for new research for investigating whether and how people's information practices, and ISPs, are going to change because of the use of AI-driven search tools, especially in education and research.

The overall objective of the research reported in this article is to explore how suitable are the results produced by the emerging AI- and LLM-driven search tools in response to the queries and prompts for some search tasks of university students and researchers. By conducting an experiment involving interactions with six AI-driven search tools, for specific search tasks, based on four scenarios, the article aims to find out:

- What kind of search results are generated by these tools and how appropriate are these for the specific user needs and contexts?
- What lessons can be learnt that can inform how users should be prepared to improve their interactions with the AI-driven search tools, as well as the quality of the content and presentation of the output generated by these tools?

It is not a comparison of different AI-driven tools per se. By investigating what some emerging AI-driven search tools return in response to specific questions and prompts, and how these responses are suitable for specific user needs and contexts, this research will add new knowledge, and trigger further research, on how the interactions with these tools, and the corresponding search results, can be improved to meet specific user needs and contexts for research and scholarly activities.

## 2. Background

Typical ISPs assume an interaction cycle consisting of query specification, receipt and examination of retrieval results and then either stopping or reformulating the query and repeating the process until a relevant result set is found [6]. Over the past few decades, several theories and models have emerged which show that the information seeking process consists of a series of interconnected but diverse searches on one problem-based theme, and search results for a goal tend to trigger new goals, resulting in a search in new directions, but the context of the problem and the previous searches are carried from one stage of search to the next [6]. A generalised model of information seeking proposes that people's information practices draw on their stocks of knowledge that form the habitual starting point of: (1) information seeking – identifying, preferring and accessing information source; (2) information use – judging the value of information, filtering information and wielding information into action and (3) information sharing – giving and receiving information [5].

The 'berrypicking' model proposes that user's information need does not remain static; instead, an evolving search occurs as the user goes through an ISP [7]. The ISP of Kuhlthau presents a holistic view of information seeking in six stages: task initiation, selection, exploration, focus formulation, collection and presentation, and it incorporates three realms of experience: the affective (feelings), the cognitive (thoughts) and the physical (actions) common to each stage [8]. As per this model, thoughts that begin as uncertain, vague and ambiguous become clearer, more focused and specific as the search progresses.

Ellis's model shows six stages that a user goes through in an ISP: starting, chaining, browsing, differentiating, monitoring and extracting [9]. Meho and Tibbo [10] extended this model by adding four more stages: accessing, networking, verifying and information managing. Overall, different models of ISP demonstrate that people seek information relevant to the general topic in early stages of the search process, and the search becomes more focused towards the later stages. Research also shows that 'the main value of the search resided in the accumulated learning and acquisition of information that occurred during the search process, rather than in the final results set' [6]. Reviewing the progress of research in information seeking and retrieval, Shah et al. [11] comment that 'although existing search systems have improved incredibly and support users with specific factual information tasks, their support is still lacking for complex and exploratory search task'.

Conventional search systems are based on indices that map lexical tokens or semantic embeddings to document identifiers, and these indices are designed for retrieving responsive documents, whereas AI- and LLM-based search systems support integrating these documents into a holistic answer that are presented to the user in response to search queries or prompts [12]. The appearance of *ChatGPT* in November 2022 triggered a rapid growth in AI- and LLM-driven tools for

access to information. Some search engines have begun to use these technologies as part of their existing search services, while other specific tools like *GPT-4o*, *Scholar GPT* and *Scholar AI* have appeared to offer new services for providing access to information, and generating content and data. White [13,14] argues that technology is catching up fast with the long-held vision where information interactions will involve personal search assistants with advanced capabilities, including natural language input, rich sensing, user/task/world models and reactive and proactive experiences. However, while AI- and LLM-based tools are being used in information search, there are concerns for authoritativeness, timeliness and contextualisation of search especially in academic and research contexts [6,13].

### 3. Methods

This exploratory research is based on the outcome of interactions with six AI-driven tools to find answers for four scenario-based search tasks within specific contexts. As stated earlier, this is not meant to be a comparison of the chosen search tools. Instead, the research is based on the qualitative analysis of the search output produced by these tools to assess their suitability for specific user needs and contexts, and understand what lessons can be learnt to prepare users to improve their interactions with the AI-driven search tools, and to inform the design of these tools to improve the quality and reliability of the output, especially for academic and research contexts.

The research is based on four scenarios that are based on the experience of the authors working with the undergraduate, postgraduate and PhD students for nearly three decades. These mimic the common activities in university education and research: two of the scenarios are based on the typical search tasks for writing coursework essays for two undergraduate students; one scenario is based on the typical search tasks of a postgraduate student at the beginning of their research for an MA/MSc dissertation and the other scenario is based on the typical search tasks of a PhD student at the beginning of their research for a PhD study. All these scenarios represent typical examples of exploratory search where the search tasks [15–17] do not have a set answer, and instead, the user is required to undertake a series of activities to find the relevant information and data as they progress with the search. Recent research [11] suggests that exploratory search tasks need to be decomposed into multiple actionable sub-tasks, and they may require multiple levels of interaction with the chosen search systems or tools.

To mimic the typical interactions with the conversational AI tools, four natural language questions or prompts were created for each scenario. It may be noted that these four questions may not be enough to generate all the information and data required for the search tasks and goals associated with each scenario and the search context. However, they produce a variety of output that can be checked to find the nature and suitability of the typical search results produced by these AI-driven search tools. The scenarios, and the associated search tasks, questions and prompts, are shown in Table 1.

The following six AI-driven search tools were chosen for this study:

- *Claude* (<https://Claude.ai>)
- *Perplexity AI* (<https://www.perplexity.ai/>)
- *Copilot* ([copilot.microsoft.com](https://copilot.microsoft.com))
- *Gemini* (<https://gemini.google.com/app>)
- *GPT-4o* (<https://openai.com/index/hello-gpt-4o/>) and
- *Scholar GPT* (<https://chatgpt.com/g/g-kZ0eYXlJe-scholar-gpt>).

Free versions of *Copilot*, *Claude*, *Gemini* and *Perplexity AI* were used, while the paid versions of *GPT-4o* and *Scholar GPT* were used. All these tools are very new, appearing within the past year; *GPT-4o* and *Scholar GPT* are the latest appearing in May 2024.

Each of the 16 questions or prompts (Table 1) was presented to all the six tools, and thus altogether 96 queries and their corresponding output were analysed for this study. Each search output was manually checked and analysed by the researchers (authors of this article) who have the relevant background of teaching and research on these search topics. Each output was checked for their suitability for the specific user need and search context – in terms of the content and overall presentation of the output, and relevance and accessibility of the cited items.

### 4. Findings

Appendix 1 shows snippets of some examples of the typical search output from all the chosen search tools in response to a query. The complete set of results could not be provided due to limitations of space.

**Table 1.** Scenarios, search context and search questions/interactions.

Scenario and search topic	Search context	Questions/interactions with the AI tool
Scenario 1: Older people's use of the internet for digital government services in the United Kingdom	An undergraduate student is required to write an essay on the topic to discuss issues and challenges facing older people in their use of the internet for digital government services, with supporting data and research papers, relevant reports and so on. The search task should produce some basic information on the topic; various issues and challenges and so on; some comparable data and some research papers and reports supporting this.	<ol style="list-style-type: none"> <li>1. What major challenges do older people in the United Kingdom face for using digital government services?</li> <li>2. I am writing an essay on the above topic; so, can you suggest some research papers supporting this?</li> <li>3. Can you suggest some more research papers on the digital exclusion of older people in the United Kingdom?</li> <li>4. Can you suggest some research papers that compare the data between the United Kingdom and Europe on digital exclusion for older people?</li> </ol>
Scenario 2: Relations between digital skills and work and employment of people in the United Kingdom and Europe	An undergraduate student is required to write an essay on how digital skills improve people's work, employment and income, with supporting data and research papers, relevant reports and so on. The search task should produce some basic information on the topic of digital access/inclusion, digital skills and work and employment; some comparable data between the United Kingdom and Europe and some research papers and reports supporting the data and discussions.	<ol style="list-style-type: none"> <li>1. How digital skills improve people's work, employment and income?</li> <li>2. Can you give me some supporting research literature on this?</li> <li>3. How does the United Kingdom compare with other European countries in terms of digital inclusion?</li> <li>4. Can you suggest some research papers that compare the impact of digital skills on the work and employment opportunities of people in the United Kingdom and Europe?</li> </ol>
Scenario 3: Role of AI- and LLM-driven search tools on information access	A postgraduate student has chosen a topic for their MA/MSc dissertation on the topic. The search task should produce some background information and data on the topic such as how and where AI is being used for information access, what are the recent developments and challenges and these should be supported by the relevant literature and reports. The search should also produce some authoritative and relevant literature for writing a literature review, showing the key areas and trends of research.	<ol style="list-style-type: none"> <li>1. What is the role of AI- and LLM-driven search tools on information access?</li> <li>2. What are the potential challenges and pitfalls of the use of AI-driven search tools for information search for research purposes?</li> <li>3. What skills should the students and researchers have to make the best use of the AI-driven search tools in their studies and research?</li> <li>4. Suggest some most relevant and recent research on this topic.</li> </ol>
Scenario 4: What role library and information services can play in addressing the climate emergency?	A PhD student has chosen a topic for their thesis on the topic. The search task should produce some background information and data on the topic showing what role libraries can play in addressing the climate change issues, what are the recent developments and challenges and these should be supported by the relevant literature and reports. The task should also produce some authoritative and relevant literature to help them begin to write a literature review, showing the key areas and trends of research.	<ol style="list-style-type: none"> <li>1. What role library and information services can play in tackling the climate emergency?</li> <li>2. Can you suggest some relevant research literature on this topic?</li> <li>3. What is the current state of research on the role that libraries can play in tackling the climate emergency?</li> <li>4. Who are the most leading authors, researchers and institutions on this topic that one must read?</li> </ol>

Search results were checked and scored based on the overall content of the response, the overall presentation, availability and accessibility of the relevant citations, which gave an overall score for the suitability of the output for the specific search context. One point was provided for each point mentioned in the search output, For example

- Content: 1 point for each answer or item of information;
- 1 point for overall presentation, for example easy-to-read text in summary form

**Table 2.** Output for Scenario 1 – Question 1.

Tool	Content (score)	Presentation (score)	Citations (score)	Suitability score
<i>Perplexity AI</i>	5 challenges (5)	Separate headings; easy to read summary text; additional summary (3)	5 citations, relevant, accessible (15)	23
<i>Claude</i>	6 challenges (6)	Separate headings; easy to read summary text; additional summary (3)	Not available (0)	9
<i>Copilot</i>	8 challenges (8)	Separate headings; easy to read summary text with some statistics; additional information on how the challenges can be addressed (3)	2 citations, relevant, accessible (6)	17
<i>Gemini</i>	4 challenges (4)	Separate headings; easy to read summary text (2)	Not available (0)	6
<i>GPT-4o</i>	12 challenges (12)	Separate headings; easy to read summary text; additional information on how the challenges can be addressed (3)	Not available (0)	15
<i>Scholar GPT</i>	14 challenges, 5 solutions (19)	Separate headings; easy to read summary text; separate sections on challenges and solutions; a conclusion (4)	Not available (0)	23

- 1 point for each additional information, for example an overall summary or a conclusion;
- Citations:
  - 1 point for each cited item;
  - 1 point for relevance of each cited item, based on its quality and the search context;
  - 1 point for accessibility of each cited item, based on the given citation details or link;
- Overall suitability: sum of all the above scores.

The score for accessibility was determined based on whether the cited item could be accessed using the citation data provided, for example using the hyperlink where it was provided, or using the citation data such as the title and source-related information such as the title of the cite journal or conference and so on.

Relevance and quality scores are based on the researchers' judgement. An item was deemed relevant if it provided information that fully or partially met the user need and context (mentioned in Table 1). The quality of the item was determined by the nature of the cited item; for example one point was assigned to the item if it appeared in a journal, conference or an institutional report and so on, but no point was assigned if the cited item was a blog or a personal opinion of an individual.

These scores are subjective based on the judgement of the researcher, and therefore they are not universal. However, it gives an indication of how suitable the output is – based on its content, presentation and citations – for the given search context.

The words 'challenges' and 'solutions' shown in some tables below indicate that the search results were presented under these headings by the respective search tool in response to the specific question or prompt.

Table 2 presents a summary of the type of responses produced by the chosen search tools for Question 1. Questions 2, 3 and 4 asked for similar type of information: relevant citations on a given topic. Hence, the results and the corresponding scores for these questions are presented together in Table 3. Since these questions specifically asked for the relevant citations, the overall suitability of the score focused more on the relevance, quality and accessibility of the cited items.

Results produced by all the six tools are somewhat similar in terms of the content and presentation style. However, upon a closer look several differences were noticed. For example, for Question 1, results from *Claude*, *Gemini*, *GPT-4o* and *Scholar GPT* did not include any citations. Although the results from *Perplexity AI* listed five citations, the content refers to only two of those sources, and the data presented in the response from *Copilot* are taken from one source.

While the responses for Questions 2, 3 and 4 provided by all the search tools were in easy-to-read summary text with headings and some key points, they also varied. For example:

**Table 3.** Output for Scenario 1 – Questions 2, 3 and 4.

Tool	Content (score)	Presentation (score)	Citations (score)	Suitability score
<i>Perplexity AI (Q2)</i>	5 challenges, 5 solutions (10)	Separate headings; easy to read summary text; a summary (3)	5 citations, all relevant and accessible (15)	28
<i>Perplexity AI (Q3)</i>	5 points (5)	Separate headings; easy to read summary text; a summary (3)	5 citations, all accessible, 4 relevant (14)	22
<i>Perplexity AI (Q4)</i>	5 points (5)	Separate headings, easy to read summary text (2)	5 citations, all accessible, 4 relevant (14)	21
<i>Claude (Q2)</i>	10 points (10)	Separate headings; easy to read summary text (2)	5 citations, all relevant, 3 accessible (13)	25
<i>Claude (Q3)</i>	5 points (5)	Easy to read summary text (1)	5 citations, all relevant, 3 accessible (13)	19
<i>Claude (Q4)</i>	5 points (5)	Easy to read summary text (1)	5 citations, all relevant, 3 accessible (13)	19
<i>Copilot (Q2)</i>	4 points (4)	Separate headings; easy to read summary text (2)	4 citations, all relevant and accessible (12)	18
<i>Copilot (Q3)</i>	5 points (5)	Separate headings; easy to read summary text (2)	5 citations, all relevant and accessible (15)	22
<i>Copilot (Q4)</i>	3 points (3)	Separate headings; easy to read summary text (2)	3 citations, all relevant and accessible (9)	14
<i>Gemini (Q2)</i>	5 points (5)	Separate headings; easy to read summary text (2)	5 citations, all relevant but not accessible (10)	17
<i>Gemini (Q3)</i>	7 points (7)	Separate headings; easy to read summary text (2)	7 citations, all relevant but not accessible (14)	23
<i>Gemini (Q4)</i>	5 points (5)	Separate headings; easy to read summary text (2)	5 citations, all relevant, none accessible (10)	17
<i>GPT-4o (Q2)</i>	7 points (7)	Separate headings; easy to read summary text; a summary (3)	5 citations, all relevant and accessible (15)	25
<i>GPT-4o (Q3)</i>	5 points (5)	Separate headings, easy to read summary text (2)	5 citations, all relevant and accessible (15)	22
<i>GPT-4o (Q4)</i>	4 points (4)	Separate headings; easy to read summary text; a summary (3)	4 citations, all relevant and accessible (12)	19
<i>Scholar GPT (Q2)</i>	4 sources for search; 5 more items are recommended (9)	Separate headings; easy to read summary text; advice on where to find more items (3)	5 citations, all relevant, none accessible (10)	22
<i>Scholar GPT (Q3)</i>	9 points (9)	Separate headings; easy to read summary; guidelines for where and how to find more items (3)	9 citations, all relevant and accessible (27)	39
<i>Scholar GPT (Q4)</i>	5 points (5)	Separate headings; easy to read summary text; advice on where to find more items (3)	5 citations, all relevant and accessible (15)	23

- *Perplexity AI* responses included five citations for all the three questions, and some of those were good and relevant for the specific search context; one cited item was a student paper submitted to a university, and not peer-reviewed;
- *Claude* responses included five relevant citations for all the three questions, some of those could not be accessed because of the lack of complete citation or link to the source;
- *Copilot* responses included relevant and accessible sources for all the three questions; however, the number of cited items varied between two and five;
- *Gemini* responses provided some relevant sources but some items could not be located;
- *GPT-4o* responses included relevant and accessible sources, but focused heavily on the sources from *BioMed Central*, and hence the information is based on the health domain;

**Table 4.** Output for Scenario 2 – Question 1.

Tool	Content (score)	Presentation (score)	Citations (score)	Suitability score
<i>Perplexity AI</i>	7 points (7)	Separate headings; easy to read summary text; a summary (3)	5 citations, all accessible, 4 relevant (14)	24
<i>Claude</i>	14 points (14)	Separate headings; easy to read summary text; a summary (3)	Not available (0)	17
<i>Copilot</i>	12 points (12)	Separate headings; easy to read summary text with some statistics; a summary (3)	2 citations, all relevant and accessible (6)	21
<i>Gemini</i>	9 points (9)	Separate headings; easy to read summary text; a summary (3)	Not provided (0)	12
<i>GPT-4o</i>	12 points (12)	Separate headings; easy to read summary text; a summary (3)	12 citations, all relevant, 2 accessible (26)	41
<i>Scholar GPT</i>	21 points (21)	Separate headings; easy to read summary text; a summary (3)	10 citations, all relevant and accessible (30)	54

**Table 5.** Output for Scenario 2 – Question 3.

Tool	Content (score)	Presentation (score)	Citations (score)	Suitability score
<i>Perplexity AI</i>	8 points (8)	Separate headings; easy to read summary text; some comparable data; a summary (4)	5 citations, all relevant and accessible (15)	27
<i>Claude</i>	12 points (12)	Separate headings; easy to read summary text; some comparable data; a summary (4)	6 citations, all relevant and accessible (18)	34
<i>Copilot</i>	9 points (9)	Separate headings; easy to read summary text; a summary (3)	2 citations, all relevant and accessible (6)	18
<i>Gemini</i>	9 points (9)	Separate headings; easy to read summary text; a summary (3)	Not provided (0)	12
<i>GPT-4o</i>	6 points (6)	Separate headings; easy to read summary text; a summary (3)	6 citations, all relevant and accessible (18)	27
<i>Scholar GPT</i>	13 points (13)	Separate headings; easy to read summary text; comparative data; a conclusion (4)	3 citations, all relevant and accessible (9)	26

- *Scholar GPT* responses varied: for Question 2, it did not provide any sources as such, but provided guidelines on where and how to find them, and for Questions 3 and 4, it provided results with some relevant sources with links.

For academic and research purpose, content and data should be supported by accessible and reliable citations. Therefore, the search results required more scrutiny to ensure that the information and data produced by the responses are supported by relevant, reliable and good quality research papers and reports.

#### 4.1. Scenario 2

Results for Questions 1 and 3 are presented separately (Tables 4 and 5) because they are different, and those for Questions 2 and 4 are presented together (Table 6) because they specially ask for the relevant research literature and reports. Appendix 2 shows some snippets of the results produced by the chosen tools on Question 4.

For Questions 1 and 3, all the tools produced useful information in summary form with relevant information and data, presented under appropriate headings, and:

- *Copilot*, *GPT-4o* and *Scholar GPT* provided some relevant and accessible citations;
- *Gemini* provided some relevant sources and advice on how to find more, but full citations or links were not provided;

**Table 6.** Output for Scenario 2 – Questions 2 and 4.

Tool	Content (score)	Presentation (score)	Citations (score)	Suitability score
<i>Perplexity AI</i> (Q2)	5 points (5)	Separate headings; easy to read summary text; a summary (3)	5 citations, all relevant and accessible (15)	23
<i>Perplexity AI</i> (Q4)	5 points (10)	Easy to read summary text; a conclusion (2)	5 citations, all relevant and accessible (15)	27
<i>Claude</i> (Q2)	12 points (12)	Easy to read summary text; a summary (2)	6 citations, all relevant and accessible (18)	32
<i>Claude</i> (Q4)	10 points (10)	Separate headings; easy to read summary text; a conclusion (3)	5 citations, all relevant and accessible (15)	28
<i>Copilot</i> (Q2)	4 points (4)	Separate headings; easy to read summary text (2)	4 citations, all relevant and accessible (12)	18
<i>Copilot</i> (Q4)	4 points (4)	Separate headings; easy to read summary text; a summary (3)	4 citations, all relevant and accessible (12)	19
<i>Gemini</i> (Q2)	4 points (4)	Separate headings; easy to read summary text (2)	4 citations, all relevant and accessible (12)	18
<i>Gemini</i> (Q4)	6 points (6)	Easy to read summary text; advice on how to find more sources; a summary (3)	3 citations, all relevant and accessible (9)	18
<i>GPT-4o</i> (Q2)	5 points (5)	Easy to read summary text; a summary (2)	5 citations, all relevant and accessible (15)	22
<i>GPT-4o</i> (Q4)	6 points (6)	Easy to read summary text; a summary (2)	6 citations, all relevant and accessible (18)	26
<i>Scholar GPT</i> (Q2)	10 points (10)	Separate headings; easy to read summary text; a summary (3)	10 citations, all relevant and accessible (30)	43
<i>Scholar GPT</i> (Q4)	8 points (10)	Easy to read summary text; comparable data; a conclusion (3)	8 citations, all relevant and accessible (24)	37

- *Perplexity AI* provided some relevant and accessible citations, but for Question 1, one cited item was a review paper focusing on young people, 12 to 17 years old, and hence not relevant for the key theme of the query and
- *Claude* results did not include any citations.

For Questions 2 and 4, all the tools produced some relevant information, and provided the relevant citations.

#### 4.2. Scenario 3

Since the first three questions were on specific aspects of the topic, and the fourth question was on the relevant literature, results from the first three questions are presented in Table 7, and those for the fourth question in Table 8. Appendix 3 provides some snippets of the search results for Question 1, and Appendix 4 provides some snippets of results for Question 2.

For Scenario 3, results for all the three questions (1, 2 and 3) returned by all the search tools included relevant information and data presented in easy-to-read summary forms, but there were some differences in relation to the cited items:

- Some *Perplexity AI* results cited company pages and blogs, rather than peer-reviewed research papers or reports.
- Some *Copilot* results cited opinion papers rather than peer-reviewed research papers or reports.
- Results produced by *Claude*, *Gemini*, *GPT-4o* and *Scholar GPT* did not include any citations.

The lack of peer-reviewed references was also noted in the results produced for Question 4 that specifically asked for research papers on the topic:

- None of the items cited by *Perplexity AI* was a peer-reviewed research paper.
- Results from *Copilot* were presented under four headings with brief abstract of the source materials, but they all led to the same item.
- Some of the items cited by *Claude*, *Gemini* and *GPT-4o* could not be accessed with the details provided.



**Table 7.** Output for Scenario 3 – Questions 1, 2 and 3.

Tool	Content (score)	Overall presentation (score)	Citations (score)	Suitability score
<i>Perplexity AI (Q1)</i>	8 points (8)	Separate headings; easy to read summary text; a summary (3)	5 citations, all relevant and accessible (15)	26
<i>Perplexity AI (Q2)</i>	15 points (15)	Separate headings; easy to read summary text; a summary (3)	5 citations, all relevant and accessible (15)	33
<i>Perplexity AI (Q3)</i>	18 points (18)	Separate headings; easy to read summary text; a summary (3)	5 citations, all relevant and accessible (15)	36
<i>Claude (Q1)</i>	7 points (7)	Separate headings; easy to read summary text; a summary (3)	Not available (0)	10
<i>Claude (Q2)</i>	7 points (7)	Separate headings; easy to read summary text (2)	Not available (0)	9
<i>Claude (Q3)</i>	7 points (7)	Separate headings; easy to read summary text; a summary (3)	Not available (0)	10
<i>Copilot (Q1)</i>	6 points (6)	Separate headings; easy to read summary text; a summary (3)	4 citations, all relevant and accessible (12)	21
<i>Copilot (Q2)</i>	8 points (8)	Separate headings; easy to read summary text; a summary (2)	4 citations, all relevant and accessible (12)	22
<i>Copilot (Q3)</i>	9 points (9)	Separate headings; easy to read summary text; a conclusion (2)	4 citations, all relevant and accessible (12)	23
<i>Gemini (Q1)</i>	9 points (9)	Separate headings; easy to read summary text; a summary (3)	Not available (0)	12
<i>Gemini (Q2)</i>	12 points (12)	Separate headings; easy to read summary text; a summary (3)	Not available (0)	15
<i>Gemini (Q3)</i>	12 points (12)	Separate headings; easy to read summary text; a summary (3)	Not available (0)	15
<i>GPT-4o (Q1)</i>	17 points (17)	Separate headings; easy to read summary text; a summary (3)	Not available (0)	20
<i>GPT-4o (Q2)</i>	24 points (24)	Separate headings; easy to read summary text; a summary (3)	Not available (0)	27
<i>GPT-4o (Q3)</i>	21 points (21)	Separate headings; easy to read summary text, a conclusion (3)	Not available (0)	24
<i>Scholar GPT (Q1)</i>	7 points (7)	Separate headings; easy to read summary text; a set of AI tools; a conclusion (4)	Not available (0)	11
<i>Scholar GPT (Q2)</i>	23 points (23)	Separate headings; easy to read summary text; a conclusion (3)	Not available (0)	26
<i>Scholar GPT (Q3)</i>	20 points (20)	Separate headings; easy to read summary text; a conclusion (3)	Not available (0)	23

- Results from *Scholar GPT* began with a comment advising that the search results were indicative. The results were presented under four headings with brief descriptions of the issues, followed by some recommended references and how to find them. However, complete citations or links to the items were not provided.

The lack of peer-reviewed research papers and hence reliance on opinion papers and blogs may be due to the nascent state of research in the area on generative AI.

### 4.3. Scenario 4

Since Questions 1 and 3 pose queries on a specific topic, the findings are presented together in Table 9, and since Questions 2 and 4 specifically ask for relevant research literature and reports and so on, the findings are presented together in Table 10. Appendix 5 provides some snippets of the results on Scenario 4, Question 4.

For Questions 1 and 3, results returned by all the six search tools included relevant information and data presented in easy-to-read summary forms, but there were some differences in relation to the cited items.

For Question 1:

- *Perplexity AI*, *Gemini* and *Copilot* provided citations to some relevant items.
- For *Copilot*, all the citations led to the same item which is a blog.

**Table 8.** Output for Scenario 3 – Question 4: suggest some most relevant and recent research on this topic.

Tool	Content (score)	Overall presentation (score)	Citations (score)	Suitability score
<i>Perplexity AI</i>	5 items (5)	Separate headings; easy to read summary text; a summary (3)	5 citations, all relevant and accessible (15)	23
<i>Claude</i>	7 items (7)	Separate headings; easy to read summary text; a summary (3)	7 citations, all relevant and accessible (21)	31
<i>Copilot</i>	4 items (4)	Separate headings; easy to read summary text; a summary (3)	4 citations, all relevant and accessible (12)	19
<i>Gemini</i>	6 items (6)	Separate headings; easy to read summary text; advice on where to find more; a summary (3)	3 citations, all relevant and accessible (9)	18
<i>GPT-4o</i>	10 items (10)	Separate headings; easy to read summary text; a summary (3)	10 citations, all relevant and accessible (30)	43
<i>Scholar GPT</i>	14 points (14)	Separate headings, easy to read summary text; advice on where to find items; a summary (4)	Not available (0)	18

**Table 9.** Output for Scenario 4 – Questions 1 and 3.

Tool	Content (score)	Overall presentation (score)	Citations (score)	Suitability score
<i>Perplexity AI (Q1)</i>	6 points (6)	Separate headings; easy to read summary text; a summary (3)	5 citations, all relevant and accessible (15)	24
<i>Perplexity AI (Q3)</i>	6 points (6)	Separate headings; easy to read summary text; a summary (3)	5 citations, all relevant and accessible (15)	24
<i>Claude (Q1)</i>	7 points (7)	Separate headings; easy to read summary text; a summary (3)	Not available (0)	10
<i>Claude (Q3)</i>	7 points (7)	Separate headings; easy to read summary text; a summary (3)	Not available (0)	10
<i>Copilot (Q1)</i>	6 points (6)	Separate headings; easy to read summary text; a summary (3)	3 citations, all relevant and accessible (9)	18
<i>Copilot (Q3)</i>	4 points (8)	Separate headings; easy to read summary text; a summary (3)	4 citations, all relevant and accessible (12)	23
<i>Gemini (Q1)</i>	12 points (12)	Separate headings; easy to read summary text; a summary (3)	Not available (0)	15
<i>Gemini (Q3)</i>	12 points (12)	Separate headings; easy to read summary text; a summary (3)	4 citations, all relevant and accessible (12)	27
<i>GPT-4o (Q1)</i>	21 points (21)	Separate headings; easy to read summary text; a summary (3)	Not available (0)	24
<i>GPT-4o (Q3)</i>	4 points (4)	Separate headings; easy to read summary text; a summary (3)	4 citations, all accessible, 3 relevant (11)	18
<i>Scholar GPT (Q1)</i>	14 points (14)	Separate headings; easy to read summary text; a summary (3)	Not available (0)	17
<i>Scholar GPT (Q3)</i>	5 points (5)	Separate headings; easy to read summary text; a summary (3)	5 citations, all relevant and accessible (15)	23

- No citations were provided in the results produced by *Claude*, *GPT-4o* and *Scholar GPT*.

For Question 3, all the tools, except *Claude*, provided some relevant citations and links, but not all were accessible through the given citation details. Overall, the results for Question 3 were better across the board.

All the chosen tools produced useful results for both Questions 2 and 4, especially in terms of the content and presentation, but there were some differences in terms of the relevance and accessibility of the cited items.

For Question 2:

- *Perplexity AI* results provided some good citations, two of which were research papers;
- *Claude* provided some citations, but not all of them were of high quality, and some could not be found;

**Table 10.** Output for Scenario 4 – Questions 2 and 4.

Tool	Content (score)	Overall presentation (score)	Citations (score)	Suitability score
<i>Perplexity AI (Q2)</i>	5 points (5)	Separate headings; easy to read summary text; a summary (3)	5 citations, all relevant and accessible (15)	23
<i>Perplexity AI (Q4)</i>	5 individuals, 5 institutions (10)	Separate headings; easy to read summary text; a summary (3)	5 citations, all relevant and accessible (15)	28
<i>Claude (Q2)</i>	7 points (7)	Separate headings; easy to read summary text; a summary (3)	7 citations, all relevant and accessible (21)	31
<i>Claude (Q4)</i>	6 individuals, 6 institutions (12)	Separate headings; easy to read summary text; a summary (3)	6 citations, all relevant, but 3 not accessible (15)	30
<i>Copilot (Q2)</i>	4 items (4)	Separate headings; easy to read summary text; a summary (3)	4 citations all relevant and accessible (12)	19
<i>Copilot (Q4)</i>	3 institutions, 2 individuals (5)	Separate headings; easy to read summary text; additional summary (3)	5 citations, all relevant and accessible (15)	23
<i>Gemini (Q2)</i>	5 points (5)	Separate headings; easy to read summary text; a summary (3)	5 citations, all relevant and accessible (15)	23
<i>Gemini (Q4)</i>	3 individuals, 5 institutions (8)	Separate headings; easy to read summary text; additional summary (3)	8 citations, all relevant and accessible (24)	35
<i>GPT-4o (Q2)</i>	10 points (10)	Separate headings; easy to read summary text; a summary (3)	4 citations, all relevant and accessible (12)	25
<i>GPT-4o (Q4)</i>	4 individuals, 5 institutions (9)	Separate headings; easy to read summary text; a summary (3)	4 citations, all relevant and accessible (12)	24
<i>Scholar GPT (Q2)</i>	Does not provide the answer, but recommends where to look for (1)	Separate headings; easy to read guidelines (2)	Not provided (0)	3
<i>Scholar GPT (Q4)</i>	3 individuals; 5 institutions (8)	Separate headings; easy to read summary text; a summary (3)	8 citations, all relevant and accessible (24)	35

- *Copilot* provided some citations but three of these led to a commentary from 2018;
- *GPT-4o* provided some good citations, but some could not be found with the citation details provided;
- *Scholar GPT* did not provide any recommended items as such, but it provided some useful guidelines for searching the relevant literature.

Overall, the results produced for Question 4 by all the four tools were better.

- *Perplexity AI* provided a list of five individuals and five institutions, each with links.
- *Claude* provided six human and six institutions. However, full citations or links were not provided.
- *Copilot* provided three institutions – one international professional organisation and two university libraries, and two items with individual authors, each with a brief summary of the work and a link.
- *GPT-4o* provided four individuals and five institutions – two of which were university libraries and three were professional associations and networks – one international and two American. It also listed four key publications and reports. Full citations or links to the cited items were not provided.
- *Scholar GPT* provided three individuals and five institutions with links to the sources. Also, a brief summary was provided.

So, overall, the results for Question 4 were better for all the tools, except that full citations or links were not provided by two tools, which means that in those cases users would need to spend some additional times to find those items, if they exist. However, unlike library and scholarly databases, results produced for the same question or prompt, by the same search AI-driven search tool, can be different at different times on the same day, let alone different days. Appendix 6 provides an example of the search results returned by *Scholar GPT* at different times on the same day.

## 5. Summary and conclusion

‘For ILS [Information and Library Science] professionals, human interest is not an add-on or afterthought but rather the reason we do the work at all – it is fundamentally baked into information generation, management, and use’, remarked Marchionini in a recent article [18]. The rapid growth of AI- and LLM-driven search technologies, and their adoption by search engines, makes it evident that the AI-driven search tools are going to become an integral part of information access in every sphere of life, and especially in education and research. So, are these transformative technologies and tools going to replace the existing library and information services, and if so, how?

‘Just as society reached a consensus about the role of calculators, a similar discourse is urgently needed for integrating LLM technologies like ChatGPT into educational settings’ [19]. Some key questions that such discourse needs to address in the context of access to information are:

1. How these tools can be trained to select the most reliable and peer-reviewed sources and summarise data and information that are the most relevant to a user’s needs and context?
2. What new skills do the users need to acquire to be able to make optimum use of these tools to access information and data required for specific education and research activities?
3. What role libraries and educational institutions should play to impart this new set of skills to their students and researchers?
4. How libraries and database search services may adapt these tools to improve access to information and data?

The findings of this research provide some insights for addressing such questions.

Traditionally, libraries and database search services have expected people to use specific search terms to formulate queries using a structured search interface to retrieve documents that match the search terms. However, libraries and databases evolved over time, and they offer various useful features and support for searching, filtering and ranking of search results. Nevertheless, the onus is still on the users for finding the most appropriate search terms, select the most appropriate database, conduct the search and finally go through the retrieved documents to find the required data and information. The key burdens on the user in such conventional information access scenario are: (1) decomposing the search goals into queries; (2) choosing the right words and phrases to represent the query; (3) choosing the right search engines or databases; (4) conducting the searches and retrieving the relevant items and (5) reading, analysing and synthesising content and data from one or more retrieved documents, all of which require a significant amount of time and skills.

All these burdens can be reduced by the AI- and LLM-driven search tools. These search tools take a conversational approach: users can enter a question, a request or a prompt, in a natural language; the tool selects and searches multiple sources or databases; fuses information from multiple documents and presents the results addressing the question directly in an easy-to-read summary format, often with the supporting data and relevant references, and all these happen almost instantaneously. This clearly shows a paradigm shift in information access. However, the findings of this study show that the data and information provided by these search tools need to be scrutinised by the user before using them, especially for academic and research purposes.

Academic users should divide the search tasks into small sub-tasks and engage with the right AI-driven search tool to find the relevant data and information. The right approach to conversation and prompting the tools clearly is essential. Choice of the search tool is also important since the search results on the same query may vary from one tool to another. Also, the same tool produces different results at different times of the same day, let alone on different days (see Appendix 6). It is imperative that the user reads and verifies the search output and the cited items in relation to the specific search context. As this study shows, some tools provide full citations or links, others don’t; and so, answers that provide full citations or links should be preferred, and the cited items should be checked for the accuracy of the information and for their reputation and reliability of the sources. Libraries and database search services ensure the quality of the information through a selection process, and they also provide a number of tools for ranking and filtering the research results, for example by date, authors and institutions, number of citations and so on. As the findings of this study show, it is difficult to know how the recommended items are selected and ranked by the AI-driven tools, especially when asked for the best or the most important research works.

Not all the AI-driven search tools are designed only for providing research and scholarly information as such, and hence academic users should choose the right tool. However, some special services are now appearing specifically to suit the needs of academic users. The recently introduced *GPT Store* offers a number of new tools such as *Consensus*, *Scholar GPT* and *Scholar AI*. As shown in this study, *Scholar GPT* produces better results, especially when recommendation for research literature is asked for. However, ranking the results in a way that benefits users and, at the same time, provides societal relevance is paramount, and yet this is also extremely complex, consequential and contentious [20].

Therefore, it is obvious that new research is needed to ensure all these happen while using the AI-driven search tools for information access.

It will be interesting to see how library and database search services adapt to these tools to provide the academic users with the best of the both worlds: a conversational tool that: (1) instantaneously provides search results in summary form, with the relevant headings, with supporting data and citations; (2) the quality of the cited items is ensured through one or more transparent selection criteria for the sources that are used to provide the answer; (3) provides search results with a better understanding of the user needs and contexts, for example different sets of results for an undergraduate student who needs to write an essay, and for a PhD student who requires updated results as the project progresses and (4) produces search results that are trustworthy, comprehensive and consistent.

The findings of this research also provide some insight into how the teaching and research in information science should be adjusted in areas around information access, information behaviour and related areas. The knowledge and discourse for teaching and research on these topics have evolved with the conventional library database and Internet search services with a focus on how the users formulate their questions, and how the search systems interpret those queries to produce the relevant results based on some knowledge of the user contexts, gathered directly – for example through the knowledge of the user groups as in case of a library, a scholarly database or a repository – or indirectly through mining of access data. Use of the AI- and LLM-based search services for information access, that is going to be the obvious choice for most users, and certainly for university students, needs to be studied closely in different education and research settings to build the required knowledge to inform teaching and research in information science and cognate disciplines around information behaviour, information literacy and information seeking and retrieval.


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## Appendix I

Snippets of sample results for Scenario 1 – Question 1.

Tool	Result
<i>Perplexity AI</i>	<p>Older people in the UK often face several challenges when using digital government services:</p> <ol style="list-style-type: none"> <li>1. <b>Digital Literacy and Skills Gap:</b> Many older adults lack the necessary digital skills and confidence to navigate online platforms and services effectively. This digital divide can make it difficult for them to access and utilize digital government offerings. [1]</li> </ol> <p>.....</p> <p>To address these challenges, the UK government has recognized the importance of providing assisted digital support, improving accessibility standards, and offering alternative channels for accessing services.</p> <p>Citations:                      [1] <a href="https://granicus.com/dictionary/digital-government-services/">https://granicus.com/dictionary/digital-government-services/</a> .....                      [5] <a href="https://www.gov.uk/government/organisations/government-digital-service">https://www.gov.uk/government/organisations/government-digital-service</a></p>
<i>Claude</i>	<p>Older people in the UK often face several challenges when it comes to using digital government services. Here are some of the major challenges:</p> <p>....</p> <p>To address these challenges, it is crucial for government agencies to prioritize digital inclusion initiatives, provide accessible and user-friendly digital services, offer targeted training and support programs, and ensure that alternative non-digital options remain available for those who cannot or prefer not to use digital channels.</p>
<i>Copilot</i>	<p><b>Older people in the UK</b> face several challenges when it comes to using digital government services. Let’s delve into some of these difficulties:</p> <ol style="list-style-type: none"> <li>1. <b>Digital Exclusion:</b> Although many older individuals fully embrace the digital world, <b>digital exclusion</b> increases with age and disability. <b>Approximately 2.7 million people aged 65 and above in the UK do not use the internet at all, equivalent to around one in five of this age group<sup>1</sup>.</b> Some older adults may only use the internet in limited ways, which doesn’t necessarily mean they have the confidence and skills to safely apply for support online.</li> <li>2. ...</li> </ol> <p>In summary, while digitalization offers convenience, it’s essential to ensure that older people are not left behind. ....<sup>21</sup>.</p>
<i>Gemini</i>	<p>Older people in the UK face several challenges when using digital government services:</p> <ul style="list-style-type: none"> <li>• <b>Digital Literacy and Skills Gap:</b> Many older adults lack the basic digital skills needed to navigate government websites, complete online forms, or use digital authentication methods.</li> <li>• .....</li> <li>• <b>Lack of Access to Technology:</b> Not all older adults have access to a computer or reliable internet connection, which is essential for using online government services.</li> </ul> <p>These challenges can lead to social exclusion and hinder older people's ability to access essential government services.</p>
<i>GPT-4o</i>	<p>Older people in the UK face several major challenges when using digital government services. These challenges can be broadly categorized into technological, educational, and accessibility issues, as well as broader socio-economic factors. Here are some key challenges:</p> <p><b>Digital Literacy and Skills:</b></p> <p><b>Lack of Digital Skills:</b> Many older adults have not had the same exposure to digital technology as younger generations. This results in a lack of basic digital skills needed to navigate online services effectively.</p> <p>..</p> <p>Addressing these challenges requires a multifaceted approach that includes improving digital literacy through education and training programs, designing user-friendly and accessible .....</p>
<i>Scholar GPT</i>	<p>Older people in the UK face several major challenges when using digital government services. These challenges can be broadly categorized into the following areas:</p> <p>### 1. <b>**Digital Literacy and Skills**</b></p> <ul style="list-style-type: none"> <li>- <b>**Lack of Digital Skills**:</b> Many older adults may not have the necessary skills to navigate digital interfaces effectively. This includes using computers, smartphones, and ...</li> <li>- <b>**Training and Support**:</b> There is often insufficient training and support available ...</li> </ul> <p>### Addressing These Challenges</p> <p>#### 1. <b>**Digital Literacy Programs**</b></p> <ul style="list-style-type: none"> <li>- Implementing comprehensive digital literacy programs specifically tailored for .....</li> </ul> <p>### Conclusion: By addressing these challenges through targeted interventions and support systems, older .... essential services.</p>

## Appendix 2

Snippets of results for Scenario 2 – Question 4.

Tool	Result
<i>Perplexity AI</i>	<p>Here are some relevant research papers that compare the impact of digital skills on work and employment opportunities in the UK and other European countries:</p> <ol style="list-style-type: none"> <li>"The Digital Skills Gap in the Workforce: Evidence from New Economies and Labour Markets" by Curtarelli et al. (2017) [1][2]</li> </ol> <p>This paper examines the digital skills gap across several European countries, including the UK. It compares the demand for digital skills by employers and the supply of skills .....</p> <p>....</p> <p>These research papers offer valuable insights into the varying levels of digital skills across different European countries, including the UK, and how these skills ....</p> <p>Citations: [1] <a href="https://learningandwork.org.uk/resources/research-and-reports/disconnected-exploring-the-digital-skills-gap/">https://learningandwork.org.uk/resources/research-and-reports/disconnected-exploring-the-digital-skills-gap/</a></p>
<i>Claude</i>	<p>Certainly, here are some research papers that compare the impact of digital skills on work and employment opportunities in the UK and other European countries:</p> <ol style="list-style-type: none"> <li>"Digital Skills and the Labor Market: Diverging Patterns of Digital Skills across European Economies" by van Deursen et al. (2021), published in the International Journal of Communication.</li> </ol> <p>- This study compares the levels of digital skills and their impact on employment across .....</p> <p>....</p> <p>These research papers offer comparative analyses of the impact of digital skills on work and .....</p>
<i>Copilot</i>	<p>Certainly! Here are some research papers that compare the impact of digital skills on work and employment opportunities in the UK and Europe:</p> <ol style="list-style-type: none"> <li><b>"Disconnected? Exploring the digital skills gap"</b> - Learning and Work Institute:       <ul style="list-style-type: none"> <li>This report examines the future of digital skills in the UK's economy, the demand for skills among employers, and the digital skills gap. <a href="#">It also looks at the perspectives of young people on digital skills and their importance for succeeding in the labor market!</a></li> </ul> </li> </ol> <p>These papers should provide a comprehensive view of how digital skills impact work and employment opportunities in the UK and Europe, offering valuable insights for your research.</p>
<i>Gemini</i>	<p>Here are some research papers that compare data between the UK and Europe on digital exclusion for older people:</p> <ul style="list-style-type: none"> <li><b>"Digital exclusion and functional dependence in older people: Findings from five longitudinal cohort studies" (The Lancet):</b> This research utilizes data from several European countries, including the UK, to analyze the association ... [The Lancet website].</li> </ul> <p>.....</p> <p>....</p> <p>In addition to these specific papers, here are some resources that might be helpful for finding comparative data:</p> <ul style="list-style-type: none"> <li><b>Eurostat:</b> The statistical office of the European Union provides data on various topics, including information and communication technologies (ICT) access ...</li> </ul> <p>By using these resources, you can effectively compare digital exclusion data for older people between the UK and Europe, enriching your essay with a broader European context.</p>
<i>GPT-4o</i>	<p>Sure! Here are some research papers that compare the impact of digital skills on work and employment opportunities in the UK and Europe:</p> <ol style="list-style-type: none"> <li><b>"Digital Skills in the UK and Europe: Bridging the Gap"</b> <ul style="list-style-type: none"> <li>Authors: John Doe, Jane Smith</li> <li>Summary: This paper provides a comparative analysis of the digital skills gap in the UK and various European countries. It examines how these ...</li> <li>Source: Journal of European Labor Studies, 2021.</li> </ul> </li> </ol> <p>These papers provide a comprehensive view of the impact of digital skills on employment across different regions in Europe, including the UK. ....</p>
<i>Scholar GPT</i>	<p>Here are some research papers that compare the impact of digital skills on work and employment opportunities in the UK and Europe:</p> <ol style="list-style-type: none"> <li><b>"**Changing demand for skills in digital economies and societies"</b> - International Labour Organization (ILO)**</li> </ol> <p>- This paper examines the impact of digitalization on skills within and across sectors, with empirical evidence collected from case studies in selected countries.</p> <p>- [Link to PDF](<a href="https://www.ilo.org/media/378741/download">https://www.ilo.org/media/378741/download</a>) .....</p> <p>These papers and articles provide a comprehensive look at the impact of digital skills on work and employment opportunities in the UK and Europe, highlighting both the benefits .....</p>



## Appendix 3

Snippets of results for Scenario 3 – Question 1.

Tool	Result
<i>Perplexity AI</i>	<p>Based on the provided search results, AI and large language models (LLMs) are playing an increasingly important role in transforming information access and search capabilities. Here are some key ways AI and LLMs are shaping the search engine landscape:</p> <ol style="list-style-type: none"> <li>1. Enhanced Query Understanding [1][2] Traditional search engines relied on keyword matching, which could miss the context or intent behind a query. LLMs, combined with advanced embedding models, provide more relevant and context-aware search results by better understanding the user's query and intent.</li> <li>2. Natural Language Search Interfaces [1][2] Users can now interact with search engines using conversational language, making search more accessible and intuitive. This is particularly beneficial for non-technical users who might struggle with formulating complex query syntax. ....</li> </ol> <p>Overall, the integration of AI and LLMs into search engines is transforming how users access and interact with information, enabling more natural, personalized, and efficient search experiences. However, this also raises important considerations around data privacy, model accuracy, and the need for human oversight in certain applications.</p> <p>Citations: [1] <a href="https://analyticsestimates.com/resources/news-events/large-language-models-unstructured-datas-new-best-friend/">https://analyticsestimates.com/resources/news-events/large-language-models-unstructured-datas-new-best-friend/</a> [2] <a href="https://www.linkedin.com/pulse/ais-role-shaping-search-engine-landscape-marco-van-huurne-nuhce">https://www.linkedin.com/pulse/ais-role-shaping-search-engine-landscape-marco-van-huurne-nuhce</a> .....</p>
<i>Claude</i>	<p>AI-powered language models (LLMs) and search tools have the potential to significantly impact and transform the way we access and interact with information. These advanced technologies can play several crucial roles in enhancing information access:</p> <ol style="list-style-type: none"> <li>1. Natural language processing: LLMs and AI-driven search tools can understand and process natural language queries, making it easier for users to express their information needs in a conversational and intuitive manner. This can help bridge the gap between how humans think and how traditional search engines operate, improving the overall search experience.</li> <li>2. Personalized and contextual search: By leveraging machine learning and natural language understanding, these “” .....</li> </ol> <p>However, it's important to note that the role of AI-driven search tools also raises concerns about potential biases, privacy issues, and the need for transparency and accountability in how these systems operate. Additionally, there .....</p>
<i>Copilot</i>	<p>AI- and LLM-driven search tools have significantly transformed the landscape of information access. Here's how they play a pivotal role:</p> <ol style="list-style-type: none"> <li>1. <b>Enhanced Understanding:</b> These tools use advanced Natural Language Processing (NLP) to deeply understand language patterns, information, and contextual nuances. <a href="#">This allows them to interpret user queries more effectively and provide responses that are not only relevant but also contextually rich</a><sup>1</sup>.</li> <li>2. <b>Personalized Assistance:</b> AI-driven search tools can engage users in natural language interactions, providing personalized assistance. <a href="#">They can clarify preferences and offer tailored recommendations based on individual needs and context</a><sup>1</sup>. .....</li> </ol> <p>In essence, AI- and LLM-driven search tools are redefining the way we interact with information, making the search process more efficient, personalized, and accessible</p>
<i>Gemini</i>	<p>AI- and LLM-driven search tools are revolutionizing how we access information, offering both advantages and potential drawbacks:</p> <p><b>Advantages:</b></p> <ul style="list-style-type: none"> <li>• <b>Enhanced Search Accuracy and Relevance:</b> AI and LLMs can understand the context and intent behind a user's query. This allows them to go beyond keyword matching and retrieve information that is truly relevant to the user's needs.</li> <li>• <b>Natural Language Interaction:</b> These tools can handle natural language queries, ...</li> </ul> <p><b>Potential Drawbacks:</b></p> <ul style="list-style-type: none"> <li>• <b>Filter Bubbles and Bias:</b> AI algorithms can personalize results in a way that reinforces existing biases. Users may only see information that confirms their existing beliefs and miss out on diverse perspectives.</li> <li>• <b>Explainability and Transparency:</b> It can be difficult to understand how AI-powered search tools t ...</li> </ul> <p>Overall, AI- and LLM-driven search tools are powerful tools that can significantly improve information access. ....</p>
<i>GPT-4o</i>	<p>AI- and Large Language Model (LLM)-driven search tools play a significant role in enhancing information access in several ways:</p> <p><b>1. Improved Search Relevance</b> AI and LLMs can understand and process natural language queries more effectively than traditional keyword-based search algorithms. This means they can better interpret the intent behind a search query and provide more relevant results.</p> <p><b>2. Contextual Understanding .....</b></p> <p><b>Challenges and Considerations</b> While AI-driven search tools offer numerous benefits, they also present challenges such as potential biases in training data, privacy concerns, and the need for transparency in how results are generated. Addressing these challenges ...</p> <p>In summary, AI- and LLM-driven search tools significantly enhance the ability to access and utilize information by improving relevance, understanding context, summarizing content, and offering personalized and efficient ...</p>
<i>Scholar GPT</i>	<p>AI- and Large Language Model (LLM)-driven search tools significantly enhance information access in several ways:</p> <p>### 1. <b>**Improved Search Accuracy and Relevance**</b> - <b>**Natural Language Understanding**:</b> LLMs understand and process natural language queries more effectively, leading to more accurate and relevant search results. ....</p> <p>### Examples of AI- and LLM-driven Search Tools</p> <ul style="list-style-type: none"> <li>- <b>**Google Scholar**:</b> Uses AI to index and rank scholarly articles, providing relevant academic resources.</li> <li>- <b>**Semantic Scholar**:</b> Employs AI to enhance the search and discovery of scientific literature....</li> </ul> <p>### Conclusion</p> <p>AI- and LLM-driven search tools revolutionize information access by improving the accuracy, speed, and .... valuable in academic research, decision-making, and everyday information-seeking activities.</p>

## Appendix 4

Snippets of results for Scenario 3 – Question 2.

Tool	Result
<i>Perplexity AI</i>	<p>Based on the provided research papers and articles, there are several potential challenges and pitfalls associated with the use of AI-driven search tools for information search and research purposes:</p> <ol style="list-style-type: none"> <li>1. Accuracy and Reliability Concerns [3][4] <ul style="list-style-type: none"> <li>- AI language models are known to generate incorrect or nonsensical information, presenting falsehoods as facts.</li> <li>- They lack true understanding of the meaning behind text, which can lead to inaccurate search results or summaries.</li> <li>- Blindly trusting AI-generated search outputs without verifying the information can propagate misinformation.</li> </ul> </li> </ol> <p>.....</p> <p>While AI-driven search tools offer potential benefits in terms of efficiency and personalization, it is essential to address these challenges and pitfalls to ensure their responsible and effective use in research contexts. Maintaining human oversight, verifying information accuracy, addressing biases, and prioritizing transparency and privacy are crucial considerations.</p> <p>Citations:</p> <p>[1] <a href="https://www.reworked.co/knowledge-findability/search-challenges-ai-is-here-to-help/">https://www.reworked.co/knowledge-findability/search-challenges-ai-is-here-to-help/</a>  [2] <a href="https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10982680/">https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10982680/</a>  [3] <a href="https://www.technologyreview.com/2023/02/14/1068498/why-you-shouldnt-trust-ai-search-engines/">https://www.technologyreview.com/2023/02/14/1068498/why-you-shouldnt-trust-ai-search-engines/</a>  [4] <a href="https://searchanise.io/blog/ai-powered-site-search/">https://searchanise.io/blog/ai-powered-site-search/</a>  [5] <a href="https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10636627/">https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10636627/</a></p>
<i>Claude</i>	<p>While AI-driven search tools powered by large language models (LLMs) offer many potential benefits for accessing information, there are also several challenges and pitfalls that need to be considered, especially when it comes to using these tools for research purposes:</p> <ol style="list-style-type: none"> <li>1. Bias and skewed perspectives: LLMs are trained on vast amounts of data from the internet, which can perpetuate biases and skewed perspectives present in the training data. This could lead to search results that reflect societal biases or present incomplete or one-sided views on certain topics, potentially affecting the validity and objectivity of research findings.</li> </ol> <p>.....</p> <p>To mitigate these challenges, it is crucial to develop robust evaluation frameworks, establish clear guidelines for the responsible use of AI-driven search tools in research, and promote transparency and accountability in the development and deployment of these technologies. Additionally, fostering critical thinking skills and maintaining a healthy balance between human expertise and AI assistance will be essential for ensuring the integrity and validity of research findings.</p>
<i>Copilot</i>	<p>The use of AI-driven search tools for research purposes comes with several potential challenges and pitfalls:</p> <ol style="list-style-type: none"> <li>1. <b>Data Fabrication and Falsification:</b> There's a concern that AI tools could inadvertently fabricate or falsify data, which can compromise ethical standards and academic integrity. <a href="#">This is particularly problematic in fields where data integrity is paramount</a><sup>1</sup>.</li> <li>2. <b>Bias:</b> AI systems can inherit biases present in their training data, leading to skewed search results. <a href="#">This can affect the quality and fairness of research findings</a><sup>2</sup>.</li> </ol> <p>.....</p> <p>These challenges highlight the importance of a balanced approach to using AI in research, where the tools are used as aids rather than replacements for human judgment and expertise.</p>
<i>Gemini</i>	<p>AI-driven search tools offer a powerful new approach to information search, but they also come with potential challenges and pitfalls for researchers. Here's a breakdown of some key areas to consider:</p> <p><b>Bias and Algorithmic Blind Spots:</b></p> <ul style="list-style-type: none"> <li>• <b>Reinforcing Bias:</b> AI algorithms can perpetuate existing biases in the data they are trained on. This can lead to biased search results, limiting your exposure to diverse perspectives and potentially hindering .....</li> </ul> <p><b>Additional Considerations:</b></p> <ul style="list-style-type: none"> <li>• <b>Data Privacy and Security:</b> Researchers may be concerned about the privacy and security of their search data when using AI-powered search tools. Understanding the data practices of these tools is ...</li> </ul> <p>While AI-driven search tools offer numerous benefits, researchers should be aware of their limitations and potential pitfalls. Maintaining a critical approach, diversifying search strategies, and prioritizing source evaluation remain essential for effective and unbiased research.</p>
<i>GPT-4o</i>	<p>AI-driven search tools offer significant advantages for information search and research purposes, but they also come with several challenges and pitfalls that need to be addressed to ensure their effective and ethical use. Here are some of the key challenges:</p> <ol style="list-style-type: none"> <li>1. <b>Bias and Fairness</b> <ul style="list-style-type: none"> <li>• <b>Training Data Bias:</b> AI models are trained on large datasets that may contain biases. These biases can be reflected in the search results, potentially leading to skewed or unfair representations of information....</li> </ul> </li> </ol> <p><b>Mitigation Strategies</b></p> <ul style="list-style-type: none"> <li>• <b>Bias Mitigation:</b> Implementing techniques to identify and reduce biases in training data and algorithms.</li> <li>• .....</li> </ul> <p>By addressing these challenges, the potential of AI-driven search tools for research purposes can be maximized while minimizing the associated risks and pitfalls.</p>
<i>Scholar GPT</i>	<p>The use of AI-driven search tools for information search in research purposes offers many benefits, but it also comes with several challenges and pitfalls:</p> <p>### 1. <b>Bias and Misinformation</b></p> <ul style="list-style-type: none"> <li>- <b>Algorithmic Bias:</b> AI models can inherit biases present in the training data, leading to biased search results.</li> <li>- <b>Misinformation:</b> AI-driven tools may sometimes provide or prioritize incorrect or misleading information, especially if they are not properly trained or updated.....</li> </ul> <p>### Mitigation Strategies</p> <p>To address these challenges, several strategies can be implemented: .....</p> <p>### Conclusion: While AI-driven search tools significantly enhance research capabilities, it is crucial to be aware of their limitations and potential pitfalls. Addressing these challenges through careful implementation, ongoing evaluation, and ethical considerations can help maximize their benefits while minimizing risks.</p>

## Appendix 5

Snippets of results on Scenario 4 – Question 4.

Tool	Result
<i>Perplexity AI</i>	<p>Based on the provided sources, the current state of research on the role that libraries can play in tackling the climate emergency is still emerging, but several key themes and perspectives are highlighted:</p> <ol style="list-style-type: none"> <li>1. Libraries as hubs for climate information and literacy [1][2][3]</li> </ol> <p>There is a recognition that libraries can serve as trusted sources of accurate and up-to-date information on climate change, its impacts, and potential solutions. They can curate and disseminate authoritative resources, counter misinformation, and promote climate literacy through educational programs, workshops, and resource sharing. ....</p> <p>While the research on this topic is still emerging, there is a growing recognition of the unique position and potential of libraries to contribute to climate action through their various roles and functions, ranging from information dissemination to community engagement and sustainable practices.</p> <p><b>Citations:</b>  [1] <a href="https://www.ifla.org/news/coming-up-in-2023-libraries-addressing-the-climate-emergency/">https://www.ifla.org/news/coming-up-in-2023-libraries-addressing-the-climate-emergency/</a>  [2] .....</p>
<i>Claude</i>	<p>The current state of research on the role of libraries in tackling the climate emergency is still relatively limited, but there is growing interest and focus on this topic. Here's an overview of the current state of research:</p> <ol style="list-style-type: none"> <li>1. Emerging field: The intersection of libraries and climate action is a relatively new area of research, with most studies and publications appearing within the last decade. However, there is increasing recognition of the potential for libraries to contribute to climate solutions and sustainable development.</li> </ol> <p>.....</p> <p>While the current state of research on this topic is still developing, there is a growing recognition of the vital role that libraries can play in addressing the climate emergency through their diverse functions and community connections. However, more comprehensive and empirical research is needed to fully understand the challenges. ....</p>
<i>Copilot</i>	<p>Certainly! Here are some recent research papers related to the role of libraries and information services in addressing climate emergencies:</p> <ol style="list-style-type: none"> <li>1. <b>“From Publications to Public Actions: The Role of Universities in Facilitating Academic Advocacy and Activism in the Climate and Ecological Emergency”:</b> <ul style="list-style-type: none"> <li>○ This article discusses the role of universities in promoting sustainability through research, teaching, and institutional practices. However, it argues that these initiatives alone may be insufficient to catalyze the necessary transformations. The paper suggests that academics should move beyond publications and engage in advocacy and activism to drive urgent and transformational change. <a href="#">It also proposes actions that universities can adopt to support academic engagement in advocacy</a>. <a href="#">Read the full article</a>.</li> </ul> </li> </ol> <p>These resources provide insights into the current state of research on the role of libraries, universities, and information services in tackling climate emergencies</p>
<i>Gemini</i>	<p>Here are some leading authors, researchers, and institutions to explore regarding the role of libraries in tackling the climate emergency:</p> <p><b>Authors and Researchers:</b></p> <ul style="list-style-type: none"> <li>• <b>Dr. Christine Finnan:</b> A prominent researcher and advocate for climate change literacy. Her work focuses on libraries' role in building public awareness and understanding of the issue (repository.ifla.org [invalid URL removed]). .....</li> </ul> <p><b>Institutions:</b></p> <ul style="list-style-type: none"> <li>• <b>The Green Library Movement:</b> A global network of libraries committed to environmental sustainability. Their website offers resources, case studies, and best practices for libraries (greenlibrarymovement.org [invalid URL removed]). .....</li> </ul> <p><b>Additional Resources:</b></p> <ul style="list-style-type: none"> <li>• <b>Department for Digital, Culture, Media &amp; Sport (UK Government):</b> Their blog post "Public libraries and climate change" offers practical examples of library initiatives (dcmslibraries.blog.gov.uk [invalid URL removed]). .....</li> </ul> <p>Remember, the field of research on libraries and climate change is constantly evolving. Consider searching for recent publications (within the last 3-5 years) to ensure you have the most up-to-date information.  By exploring the work of these authors, researchers, and institutions, you can gain valuable insights into thr ....</p>
<i>GPT-4o</i>	<p>Searched 4 sites</p> <p>The role of libraries and information services in addressing the climate emergency is an emerging and crucial area of research and action. Libraries, as centers for community engagement and information dissemination, are well-positioned to play a significant part in climate change mitigation and adaptation efforts. Current research highlights several ways in which libraries can contribute:</p> <ol style="list-style-type: none"> <li>1. <b>Educational and Community Engagement Hubs:</b> Libraries can serve as focal points for educating the public about climate change, offering resources and programs that raise awareness and promote sustainable practices. The American Library Association (ALA) has emphasized the importance of libraries in leading climate adaptation and promoting climate justice, framing sustainability as a core value of the profession (<a href="#">American Library Association</a>).</li> </ol> <p>Key research highlights the need for interdisciplinary approaches, integrating expertise from various fields to address the complex challenges posed by climate change. Libraries, with their extensive networks and resources, are: .....</p> <ul style="list-style-type: none"> <li>• "How Climate Change is Impacting Galleries, Libraries, Archives and Museums" from LSU (<a href="#">LSU</a>) ...</li> <li>• .....</li> </ul>
<i>Scholar GPT</i>	<p>Here are some relevant articles on the role of libraries in tackling the climate emergency from various databases:</p> <ol style="list-style-type: none"> <li>1. <b>**LIS's Climate Change: What LIS Means within a Pandemic and Climate Crisis Context**</b> <ul style="list-style-type: none"> <li>- Source: JSTOR - [Link to article](https://www.jstor.org/stable/4864444)</li> <li>- Summary: Discusses the role of Library and Information Science (LIS) in addressing climate change and pandemic crises, focusing on systemic changes within libraries.</li> </ul> </li> <li>2 .....</li> </ol> <p>These articles provide a range of perspectives on how libraries can contribute to addressing the climate emergency through education, policy support, and community engagement.</p>

## Appendix 6

Examples of some search results from *Scholar GPT* (at different times on the same day; prompt: Find the latest research on AI- and LLM-based tools for information access).

Result 1	Result 2	Result 3
<p>Here are some of the latest research articles and discussions on AI- and LLM-based tools for information access in education and research:</p> <ol style="list-style-type: none"> <li>1. <b>Utilizing Generative AI for Instructional Design: Exploring Strengths and Challenges</b>(<a href="https://link.springer.com/article/10.1007/s11528-024-00967-w">https://link.springer.com/article/10.1007/s11528-024-00967-w</a>)** - This article explores how generative AI tools, including LLMs, can be effectively used in instructional design to curate essential resources.</li> <li>2. <b>The Evolution of AI Large Language Models</b> #llm(<a href="https://www.linkedin.com/pulse/evolution-ai-large-language-models-llm-data-innovation-ric-spair-o2d6e">https://www.linkedin.com/pulse/evolution-ai-large-language-models-llm-data-innovation-ric-spair-o2d6e</a>)** - This LinkedIn post discusses the evolution of LLMs and their application in educational and research settings, focusing on transparency and innovation.</li> <li>3. <b>Research, Academic Integrity, and Artificial Intelligence (AI)</b>(<a href="https://libguides.southernct.edu/plagiarism/AI">https://libguides.southernct.edu/plagiarism/AI</a>)** - This guide covers various AI and LLM tools used in academic research, highlighting their implications for academic integrity.</li> <li>4. <b>Teachers, Parents, and Students' Perspectives on Integrating AI</b>(<a href="https://dl.acm.org/doi/10.1145/3613904.3642438">https://dl.acm.org/doi/10.1145/3613904.3642438</a>)** - This research focuses on the use of AI systems in literacy education, particularly LLM-based chatbots for language learning and scientific writing.</li> <li>5. <b>Large Language Models for Education: A Survey</b>(<a href="https://arxiv.org/html/2405.13001v1">https://arxiv.org/html/2405.13001v1</a>)** - This survey paper discusses the application of LLMs in education, covering various AI technologies like natural language processing used to understand and generate texts.</li> <li>6. <b>Defining Generative AI - Generative Artificial Intelligence</b>(<a href="https://libguides.richmond.edu/genai/defininggenai">https://libguides.richmond.edu/genai/defininggenai</a>)** - This guide explains the distinctions between LLMs and the tools that utilize their training data, providing foundational insights into generative AI.</li> <li>7. <b>How to Use LLMs in the Classroom - AI x Education</b>(<a href="https://aixeducation.substack.com/p/how-to-use-llms-in-the-classroom">https://aixeducation.substack.com/p/how-to-use-llms-in-the-classroom</a>)** - This article offers strategies for leveraging LLMs in the classroom, with insights from recent studies on integrating generative AI tools into K-12 education.</li> <li>8. <b>Integrating Artificial Intelligence (AI) Into Adult Education</b>(<a href="https://fuse.franklin.edu/cgi/viewcontent.cgi?article=1134&amp;context=facstaff-pub">https://fuse.franklin.edu/cgi/viewcontent.cgi?article=1134&amp;context=facstaff-pub</a>)** - This paper discusses how adult learners are using generative AI tools to access information, and how educational institutions are adopting these technologies.</li> </ol>	<p>Here are some of the latest research articles and resources on AI- and LLM-based tools for information access from 2023:</p> <ol style="list-style-type: none"> <li>1. <b>AI and Generative AI for Research Discovery and Summarization</b> - This article reviews the current landscape of AI tools available for statistical and data analysis, including LLM-based chatbots. - [Read the full paper](<a href="https://arxiv.org/html/2401.06795v2">https://arxiv.org/html/2401.06795v2</a>)</li> <li>2. <b>Generative Artificial Intelligence (AI) Library &amp; Technology Services</b> - This resource discusses the application of generative AI and LLMs in computing and learning sciences. - [Read more](<a href="https://its.lehigh.edu/generative-artificial-intelligence-ai">https://its.lehigh.edu/generative-artificial-intelligence-ai</a>)</li> <li>3. <b>Stuff We Figured Out About AI in 2023</b> - A weblog summarizing key developments in AI and LLMs in 2023, highlighting their smart yet sometimes limited capabilities. - [Read the blog](<a href="https://simonwillison.net/2023/Dec/31/ai-in-2023/">https://simonwillison.net/2023/Dec/31/ai-in-2023/</a>)</li> <li>4. <b>Microsoft New Future of Work Report 2023</b> - This report by Microsoft explores how early LLM-based tools for enterprise information workers can significantly boost productivity. - [Download the report](<a href="https://www.microsoft.com/en-us/research/uploads/prod/2023/12/NFWReport2023_v5.pdf">https://www.microsoft.com/en-us/research/uploads/prod/2023/12/NFWReport2023_v5.pdf</a>)</li> <li>5. <b>Introducing New AI Experiences Across Our Family of Apps</b> - Meta's announcement about integrating technology from Llama 2 and their latest LLM research into their applications. - [Read the announcement](<a href="https://about.fb.com/news/2023/09/introducing-ai-powered-assistants-characters-and-creative-tools/">https://about.fb.com/news/2023/09/introducing-ai-powered-assistants-characters-and-creative-tools/</a>)</li> <li>6. <b>AI Tools I Have Found Useful with Research (Reddit Discussion)</b> - A discussion on Reddit about various AI tools useful for research, including those using LLMs. - [Join the discussion](<a href="https://www.reddit.com/r/PhD/comments/14d6g09/ai_tools_i_have_found_useful_w_research_what_do/">https://www.reddit.com/r/PhD/comments/14d6g09/ai_tools_i_have_found_useful_w_research_what_do/</a>)</li> <li>7. <b>Large Language Models in Official Statistics - UNECE</b> - This paper explores the use of LLMs in official statistics, focusing on access to the latest research and ethical AI practices. - [Read the paper](<a href="https://unece.org/sites/default/files/2023-12/HLGMOS%20LLM%20Paper_Preprint_1.pdf">https://unece.org/sites/default/files/2023-12/HLGMOS%20LLM%20Paper_Preprint_1.pdf</a>)</li> <li>8. <b>Supercharging Research: Harnessing Artificial Intelligence to Meet Global Challenges</b> - A White House report on how AI-based tools, including LLMs, are being harnessed for research and data processing. - [Read the report](<a href="https://www.whitehouse.gov/wp-content/uploads/2024/04/AI-Report_Upload_29APRIL2024_SEND-2.pdf">https://www.whitehouse.gov/wp-content/uploads/2024/04/AI-Report_Upload_29APRIL2024_SEND-2.pdf</a>)</li> </ol>	<p>Here are some of the latest research articles and discussions on AI- and LLM-based tools for information access:</p> <ol style="list-style-type: none"> <li>1. <b>LLM Comparator: A tool for human-driven LLM evaluation</b>(<a href="https://medium.com/people-ai-research/llm-comparator-a-tool-for-human-driven-llm-evaluation-81292c17f521">https://medium.com/people-ai-research/llm-comparator-a-tool-for-human-driven-llm-evaluation-81292c17f521</a>)** - This article introduces the LLM Comparator, a tool designed for evaluating large language models (LLMs) in a human-centric manner.</li> <li>2. <b>Foundation Models, Generative AI, and Large Language Models</b> (<a href="https://journals.lww.com/cinjjournal/fulltext/2024/05000/foundation_models_generative_ai_and_large_ll.aspx">https://journals.lww.com/cinjjournal/fulltext/2024/05000/foundation_models_generative_ai_and_large_ll.aspx</a>)** - This journal entry discusses how foundation models and generative AI serve as the basis for more specific AI tools, including LLMs.</li> <li>3. <b>Research, Academic Integrity, and Artificial Intelligence (AI)</b> (<a href="https://libguides.southernct.edu/plagiarism/AI">https://libguides.southernct.edu/plagiarism/AI</a>)** - This guide covers various AI and LLM tools used in academic research, highlighting their implications for academic integrity.</li> <li>4. <b>How to Mitigate LLM Privacy Risks in Fine-Tuning and RAG</b>(<a href="https://www.anonos.com/blog/llm-privacy-security">https://www.anonos.com/blog/llm-privacy-security</a>)** - This blog post addresses the privacy and security concerns associated with fine-tuning LLMs and generative AI tools.</li> <li>5. <b>Artificial intelligence and large language model tools in business</b>(<a href="https://www.filde.com/news/artificial-intelligence-and-large-language-model-tools-business-sandbox-creators-or-key-growth">https://www.filde.com/news/artificial-intelligence-and-large-language-model-tools-business-sandbox-creators-or-key-growth</a>)** - This article explores the application of LLM tools in business, emphasizing their role in information retrieval, translation, and speech recognition.</li> <li>6. <b>Defining Generative AI - Generative Artificial Intelligence</b>(<a href="https://libguides.richmond.edu/genai/defininggenai">https://libguides.richmond.edu/genai/defininggenai</a>)** - This guide explains the distinctions between LLMs and the tools that utilize their training data, providing a foundational understanding of generative AI.</li> <li>7. <b>AI-powered Code Review with LLMs: Early Results</b> (<a href="https://arxiv.org/pdf/2404.18496">https://arxiv.org/pdf/2404.18496</a>)** - This research paper presents early results of using LLMs for AI-powered code review, highlighting their ability to predict future risks in code.</li> <li>8. <b>The Shift from Traditional Education Data Systems to LLM-Based AI</b>(<a href="https://www.linkedin.com/pulse/shift-from-traditional-education-data-systems-llm-based-richard-tong-xdhyt?trk=public_post">https://www.linkedin.com/pulse/shift-from-traditional-education-data-systems-llm-based-richard-tong-xdhyt?trk=public_post</a>)** - This LinkedIn article discusses the transition from traditional education data systems to LLM-based AI systems, emphasizing the paradigm shift in data collection and analysis.</li> </ol>