

Artificial Intelligence vs. Traditional Research Methods: An Empirical Study from Northern Croatia

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Abstract: Due to the emergence and increased development of Artificial Intelligence (AI), research in general has been significantly impacted, particularly in the field of scientific theories and models. The purpose of this study is to analyze the acceptance of both AI tools and traditional methodologies used in research. Moreover, conclusions about the respondents' perception and openness to using AI tools in research regarding gender, age and current academic position are discussed. Another goal is to compare the level of satisfaction from both the AI tools and the traditional research methods. A questionnaire-based survey was carried out between February and March 2024, and it included students and teaching staff at the University North in Croatia. The novelty of this research is mirrored in the scarcity of such empirical studies encompassing the academic community in Croatia.

Keywords: artificial intelligence; Croatia; information retrieval; research methodology

1 INTRODUCTION

Artificial Intelligence (AI) plays an important role in every aspect of people's lives and represents a transformative technology with significant potential for both risk and opportunity in various industries [1]. It is particularly crucial for maximizing the benefits of the Internet of Things and has already revolutionized many industries, including research, manufacturing, finance, and healthcare [2].

The rise and development of AI were mostly influenced by the new media era, with AI technology being optimized and applied in the field of computers and intelligent terminals. AI has thus far revolutionized various, if not all industries. This unprecedented shift is mirrored in the increased integration and application of AI into everyday life, presenting both opportunities and challenges [3]. Generative AI models created "a disruptive impact on teaching and learning, due to their ability to create text, images, and sound, revolutionizing educational content creation and modification" [4].

Desjardins-Proulx discussed the paradigm shift in science and research brought about by AI, especially in the design of algorithms for model-building [5]. Moreover, AI is changing the way people search for information. According to Waly AI is already very much present in the scientific research process [6]. Some of the features and advantages of AI technology in scientific research include speeding up research work, especially literature search and selection, given the emergence of numerous tools that serve as alternatives to traditional search tools. In the last few years, the intensive use of AI tools in higher education is discussed [7]. The use of AI-powered language tools and their impact on the student population is evident. AI tools have been integrated into a wide range of platforms including browsers, social networks, games, and other applications that students and teachers have been using for a long time. However, they were not aware that these applications and tools were based on AI technology. Therefore, it can be established that AI technology has been used in education and science for many

years, but the scale of the new tools opens a new niche for researchers to explore. AI tools should be viewed as aids in the information search process rather than as ready-made solutions. They are useful tools that can enhance the creativity of scientists and students and simplify the search process. A crucial aspect of utilizing AI tools to search scientific information is the use of reliable tools connected to pertinent databases. AI presents challenges for scientists and science in general. While AI may have a positive impact, the realisation of benefits relies on the actions and decisions of human users [8]. While using AI tools, one should not forget the importance of traditional information sources.

The integration of AI in academic research tools has significantly increased, particularly following the release of OpenAI's ChatGPT. The proliferation of AI tools and research assistants for scientific publication retrieval over the past three years highlights a trend towards using advanced AI models to keep pace with the growing body of research. This trend is evident in the way these tools are marketed and promoted, emphasizing their ability to handle large volumes of data and provide more relevant search results [9]. AI tools significantly improve the precision and relevance of search results through advanced natural language processing (NLP) and semantic search techniques. By automating the literature review process and providing AI-generated summaries, these tools promise to save researchers considerable time, addressing the ongoing pressure scientists face to publish and manage a constant workload. However, many advanced features in AI tools require subscriptions, indicating a shift towards the commercialization of academic research tools. This trend highlights the increasing reliance on paid services to access advanced AI capabilities in academic research [10]. Globally renowned scientific databases such as Scopus and Web of Science rely on lexical and keyword-based search mechanisms. Their search engines use probabilistic approaches to match search terms with indexed documents, which are heavily dependent on term frequency. This method, while effective to an extent, often provides irrelevant results, necessitating manual filtering by researchers.

Additionally, access to these databases typically requires an institutional subscription, limiting availability to affiliated researchers and academics. In contrast, AI-powered tools like Semantic Scholar and Scispace employ NLP and semantic search techniques. These tools convert text into numerical vectors, enabling a deeper understanding of context and relationships between terms. This approach results in more accurate and relevant search outcomes, addressing the issue of information overload.

Semantic Scholar is one of the oldest popular usages of AI in reference searching. It was used even before the big boom of the new online tools that came to be with the proliferation of the OpenAI AI model. Semantic Scholar, launched by the Allen Institute for AI, utilizes the SPECTER2 model to process and generate word embeddings for document titles and abstracts. The tool's AI-generated summaries (TLDRs) and custom folder organization further enhance its utility. Semantic Scholar sources data from major publishers and databases such as PubMed, Springer Nature, and IEEE, providing comprehensive coverage of scientific literature.

Elicit, developed by Ought in 2021, leverages AI to accelerate literature reviews by extracting key publications from Semantic Scholar [11]. Created in the years following the release of the OpenAI API, Elicit uses a fine-tuned version of the GPT-3 model to perform its tasks. Unlike traditional search tools, Elicit and Scite can identify relevant studies without perfect keyword matches, structuring queries in the form of specific research questions [12]. This capability is particularly beneficial for hypothesis-driven research, where precise data extraction and synthesis are critical. Scispace integrates semantic search with a vast corpus of over 280 million papers, utilizing GPT-3 to offer interactive literature reviews, PDF-based question answering, data extraction, and citation generation. This tool's AI assistant facilitates an in-depth exploration of scientific literature, though access to premium features requires a subscription, reflecting a growing trend towards the commercialization of AI-driven research tools. Sourceely and Minerva cater to specific aspects of reference management. Sourceely analyses longer texts to find relevant references, though it has limitations in language support and filtering options. Minerva focuses on the biomedical field, combining large language models (LLMs) with structured graphs to display interdisciplinary connections and generate summaries from PubMed articles.

In this study, the main objective was to determine how AI tools are associated with various academic positions. For this purpose, an extensive empirical study on a sample of 69 has been done in the period February–March 2024 at the University North in Croatia. The questionnaire was divided into 3 parts. The first part of the questionnaire covered the demographic characteristics of the respondents, the second part of the survey was related to the familiarity and use of AI tools, and the third related to the use of traditional databases in research.

The main scientific contribution of this study is mirrored in the fact that it comprises the first-ever empirical study in the Republic of Croatia, and most probably among the first

empirical studies on AI in research globally. The rest of this paper is structured as follows. After the introduction, in Section 2, an extensive literature review of relevant published papers on AI tools, their application in the academic community, their use by different age groups as well as the perception and use of AI versus the traditional research methods is provided. Section 3 includes the methods used and the used sample. Thereafter, in Section 4, the research results are revealed. Section 5 opens a discussion regarding the results and adds concluding remarks.

2 LITERATURE REVIEW

The integration of AI into various aspects of human life, including scientific research, is increasingly widespread. Today, AI tools are assisting scientists in overcoming obstacles related to the growing demand for publishing their work. Scientists face the primary challenge of effectively managing restricted time, limited resources and budget, and finite cognitive capacity. These factors are pivotal when utilizing AI tools to access scientific information. AI offers opportunities for enhanced productivity, enabling scientists to publish more work and fostering greater objectivity in their research endeavours. AI is a branch of computer science that focuses on creating intelligent programs (systems) that largely "imitate" human intelligence [6]. The definition of AI has evolved over the years to include tools that can perform cognitive tasks, particularly learning and problem-solving, with technological innovations such as machine learning and neural networks [13]. According to the citation database Web of Science, 157,947 papers are available on the topic of "AI." The oldest available paper dates to 1960 [14]. The numerical indicators of works show a slight growth in 1984, with increasing interest in the topic from 1990 to 1991. Since 2018, AI has become a "hot" topic, as the number of published papers on this subject has reached high numbers. The countries showing the most interest in this topic are the USA and China. In the field of information librarian science, there are 2,019 available works, and the oldest work is from 1972 by Reilly, KD, titled "Computers and AI."

The scientific community's increasing interest is connected to using AI tools in the scientific information search process, providing a quicker alternative to traditional information search methods.

Analysing the citation database of Web of Science, focusing on AI tools used for the literature search process, it was searched using the key term in the category all fields "AI tools and academic research". The number of papers on this topic is 2276. The oldest paper appears in the early nineties of the 20th century and includes topics dealing with hybrid learning and simulations in computer science.

Most of the papers that are thematically based on AI tools and scientific research are in the field of Computer Science AI and Education Educational research. Using selection criteria on these two fields, 325 papers were extracted. The thematic frameworks of the searched works cover different topics. The main topics are AI tools in academic writing, AI tools like teaching and learning assistants, and ethical components of using AI tools.

Different approaches are described like frameworks for the acceptable use of generative AI in student academic research and writing [15] or evaluating the efficacy of AI content detection tools in differentiating between human and AI-generated text [16].

AI in education can help students develop and improve personalized learning and enhance and improve learning skills [17]. AI-based tools have the potential to customize the learning experience, boost productivity, and increase student engagement [18]. The papers encompass a variety of tools designed to provide learning support. These tools are utilized by teachers to facilitate and enhance the overall learning experience for students. Studying the development of new methods that provide a personalized approach to teaching and learning, including integration of artificial intelligence (AI) tools that can revolutionize education [19].

The ethical aspect is not a new concept in scientific research; therefore, it is logical to maintain interest in this topic, especially regarding AI tools. AI tools can cause both positive and negative consequences. Ethical considerations include data security, safety risks associated with autonomous technologies, and fairness in decision-making processes [6]. In the context of researching the ethical dimensions of using AI tools for scientific purposes, the study focuses on tools that can detect plagiarism in scientific papers [20].

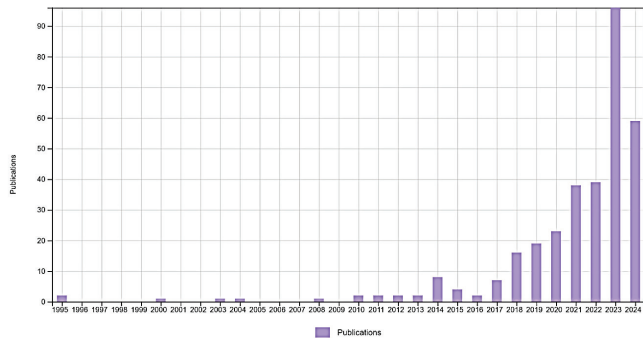


Figure 1 AI tools and academic research Articles from Web of Science Published by Year

Information experts, especially librarians specializing in science, play a vital role in identifying the most effective tools and educating users, such as scientists and students, on how to recognize and utilize these tools correctly. The importance of AI literacy is growing, and this literacy needs to be seamlessly integrated into the information literacy framework. Being AI literate includes knowledge, understanding, use, evaluation, and ethical principles [21]. As information specialists, librarians have the task of familiarizing themselves with the tools that are offered, recognizing their values and shortcomings, and familiarizing their users with their applications. AI literacy has emerged as a new skill set in response to this new era of intelligence.

Finally, as Saġin stated, the academic community is nowadays "polarized, with some embracing AI for its accessibility and efficiency thus advocating it as an indispensable tool, while others cautioning against risks to academic integrity and intellectual development" [4].

3 METHODS AND SAMPLE

To conduct this research, an online anonymous questionnaire was conducted in the period January – March 2024 at the University North in Croatia and included all academic positions (i.e. students and academics). The questionnaire was divided into 3 parts. The first part of the questionnaire covered the demographic characteristics of the respondents, the second part of the survey was related to the familiarity and use of AI tools, and the third related to the use of traditional databases in research. The analysis of data collected based on an anonymous questionnaire is based on statistical methods.

The sample of respondents was described by distribution according to defined characteristics: gender, age groups and academic position at the University North. Selected descriptive statistical indicators were calculated and interpreted for quantitative variables. The distribution of quantitative variables was assessed using the Kolmogorov-Smirnov test. It was found to significantly deviate from a normal distribution. Therefore, the non-parametric Mann-Whitney U test (two-tailed) and the Kruskal-Wallis test were employed to evaluate the statistical significance of the differences among the defined groups of respondents. Differences confirmed at the $p < 0.05$ level were considered statistically significant.

The sample consisted of 69 respondents from the academic community of the University North, i.e. respondents who participated and confirmed their familiarity with and use of AI tools. Tab. 1 reveals the distribution of respondents according to gender, age groups and academic position. The sample consisted of 42% male respondents and 58% female respondents. With regard to age, the respondents were divided into three age groups. The first age group consisted of respondents of Generation Z, i.e. respondents aged 18 to 27 years. The second group consisted of millennials, i.e. respondents aged 28 to 43, and the third group respondents aged 44 or older, i.e. Generation X. The first age group was the most numerous. Regarding the academic position at the University North, one-fourth respondents were teaching staff, and the rest were students. The most numerous were undergraduate students.

Table 1 Distribution of respondents according to gender, age and academic position

		Number of respondents	Percentage
Gender	Male	29	42
	Female	40	58
Age groups	Generation Z	32	46
	Millennials	22	32
	Generation X	15	22
Academic position	Teaching staff	17	25
	Undergraduate students	32	46
	Graduate students	20	29

In the second part of the survey, the level of familiarity, use and attitudes towards AI tools for searching and surveying scientific databases and their comparison with traditional databases among members of the academic community of the University North in Croatia.

4 RESULTS

In Fig. 2, the frequency of use of traditional databases to which the University North has a subscription is presented. The results revealed new insights into the practical functions of AI tools in a small sample of the academic community in Croatia. 38% of the respondents answered they sometimes use traditional databases for research, 19% of them claimed they often use traditional databases and 4% very often. Interestingly, 20% of the respondents never use the traditional databases and 19% of them stated they rarely make use of the traditional databases for research. This issue calls for in-detail exploration in future work.

Regarding the question related to the use of AI tools, multiple answers were available to the respondents. More than one-third of the respondents use the Semantic Scholar AI tool when searching scientific databases (Fig. 3). Open Read and Scite tools are used by 19% of them. Next in order of use are PapersGPT (under development), SciSpace, Connected Papers Elicit and Research Rabbi. Other tools were used in less than 10% of cases.

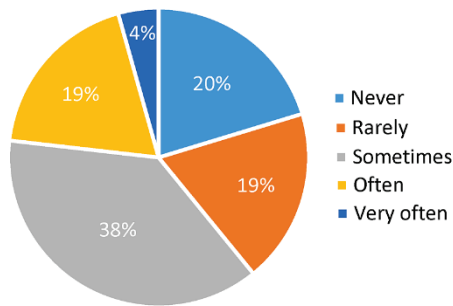


Figure 2 Frequency of use of traditional databases for research

When asked about the academic purpose of their employment of AI tools in research, most of the respondents (more than half of them) answered they use AI tools for initial literature review, whereas the rest of the answers were distributed between "for a more detailed search of relevant works", "for organization and management of references" and "for analysis and synthesis of scientific information". According to the data shown in Fig. 4, more than half of the respondents use AI tools for a more detailed search for relevant works. AI tools for the organization and management of references and the analysis and synthesis of scientific information are used in a slightly lower but similar percentage.

The conducted survey sought to determine the attitudes towards the use and perception of AI tools for browsing scientific databases at the University North in Croatia. Respondents evaluated their views on a five-point Likert scale, ranging from 1 (insufficient rating) to 5 (excellent rating).

Male respondents evaluated their satisfaction with the use of AI with a slightly higher average rating than female respondents (Tab. 2). The median value was the same for both groups of subjects. According to the results of the Mann-Whitney test, no statistically significant difference in attitudes about the use of AI tools was confirmed by gender. Gender does not influence on the use and perception of AI tools for searching scientific databases.

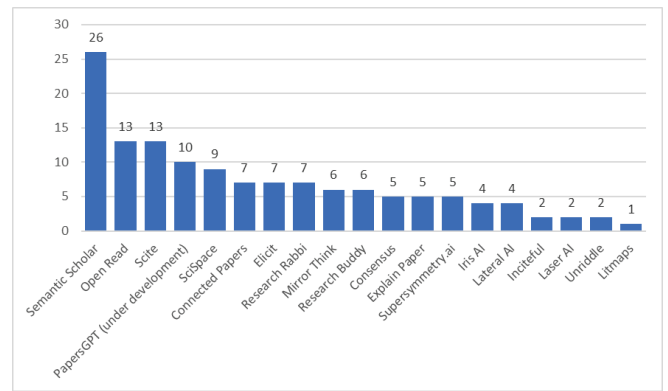


Figure 3 Use of specific AI tools in research

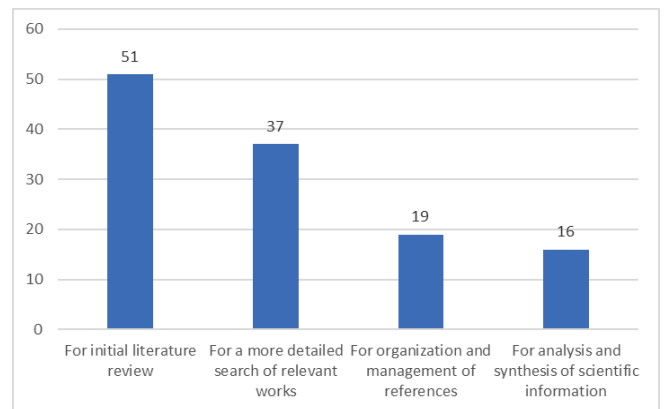


Figure 4 Academic purpose of using AI tools in research

Table 2 Respondents' views on the use and perception of AI tools for searching scientific databases by gender

Gender				Mann-Whitney test	
Male		Female		Z	p
Mean	Median	Mean	Median		
3.89	4	3.77	4	-0.480	0.631

Table 3 Respondents' views on the use and perception of AI tools for searching scientific databases by age group.

Age groups						Kruskal-Wallis test	
Generation Z		Millennials		Generation X		H	p
Mean	Median	Mean	Median	Mean	Median		
3.71	4	4.09	4	3.73	4	3.226	0.199

Table 4 Respondents' views on the use and perception of AI tools for searching scientific databases by academic position.

Academic position						Kruskal-Wallis test	
Undergraduate studies		Graduate studies		Teaching staff		H	p
Mean	Median	Mean	Median	Mean	Median		
3.79	4	3.90	4	3.8	4	0.089	0.956

Table 5 Respondents' satisfaction with search results obtained through AI tools and traditional databases

Respondents' satisfaction				Mann-Whitney test	
AI tools		Traditional databases		Z	p
Mean	Median	Mean	Median		
3.83	4	3.52	4	2.253	0.024

With regard to age groups, an average score greater than 4 was calculated only for millennials, while the average scores for Generation Z and X were almost equal (Tab. 3). The median value for all 3 analyzed groups was 4. The results of the Kruskal-Wallis test indicate that there is no statistically

significant difference in attitudes between respondents of the three analyzed age groups.

According to the selected descriptive statistical indicators and the results of the Kruskal-Wallis test (Table 4), it is clear that there is no statistically significant difference in the opinions of respondents with different academic positions about their views on the use and perception of AI tools for searching scientific databases.

To examine whether there is a statistically significant difference in satisfaction with search results obtained through AI tools or obtained through traditional databases, the Mann-Whitney test was applied. The test results are given in Table 5.

The respondents expressed slightly higher average satisfaction with search results obtained through AI tools than those obtained through traditional databases. The median in both groups was 4. The results of the Mann-Whitney test indicate there is a statistically significant difference in the satisfaction of the search results obtained through AI tools and traditional databases among respondents at the 5% significance level.

5 DISCUSSION AND CONCLUSION

Due to its potential advantages over conventional research methodologies, AI is being applied in a growing number of study disciplines. By evaluating student data and suggesting activities, AI can tailor learning experiences in the classroom [22]. AI, in particular neural networks, has been shown to perform more accurately and flexibly than conventional forecasting techniques [23]. With an emphasis on efficacy and effectiveness, AI techniques are frequently employed to anticipate treatment results [24].

Furthermore, numerous studies have shown how much more accurate and versatile some AI techniques—like neural networks—are than more conventional predicting techniques. Recurrent neural networks (RNNs) surpassed conventional econometric techniques in the prediction of conditional volatility, according to Bucci [25]. Forecasting accuracy was increased by Khashei & Bijari's hybrid model, which combined auto-regressive integrated moving average (ARIMA) methods with artificial neural networks [26]. Ghiassi introduced a dynamic neural network model that outperformed traditional neural network and ARIMA models in forecasting time series events [27]. Rasp & Lerch demonstrated that neural networks could significantly outperform benchmark methods in post-processing ensemble weather forecasts [28]. All these papers demonstrate how powerful AI techniques may be to improve research methodologies in a variety of research disciplines. Considering these findings, the main objective of this study is to analyze the acceptance of both AI tools and traditional methodologies used in research. Moreover, the conclusions about the respondents' perception and openness to using AI tools in research regarding gender, age and current academic position were drawn. Another goal was to compare the level of satisfaction from both the AI tools and the traditional research methods.

This empirical study revealed very interesting and a bit surprising result. Namely, the gender, age group and academic position do not influence the use, perception and attitudes toward AI tools for searching scientific databases. Moreover, the findings show that there is a statistically significant difference in respondents' satisfaction with using AI tools and traditional databases. The obtained results call for additional research and education of both students and teaching staff at Croatian universities, regarding the potential benefits of AI tools and their ethical application and use.

The main limitation of this study is the relatively small sample. A bigger sample could contribute to drawing more precise conclusions and would tackle important trends and issues in this research area. In future work, these limitations will be addressed. Namely, the authors plan to investigate the use of AI among the overall Croatian academic community and include members of the other universities in Croatia. Moreover, a comparative study including the Western Balkans is planned for future study. Both the practical and scientific contributions of this paper are relevant. First and foremost, this is among the very few empirical studies conducted in the Republic of Croatia that encompass a fraction of the academic community and tackle the use of AI in research; second, this study is among the very few that incorporate a comparison between the traditional databases and tools and the AI tools in research among the academic members.

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