iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 13 **Issue:** VIII **Month of publication:** August 2025

DOI: https://doi.org/10.22214/ijraset.2025.73589

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 13 Issue VIII Aug 2025- Available at www.ijraset.com

An Investigative Study on the Application of Artificial Intelligence in Scientific Research

Zaid Ali Bashiri
King Fahd University of Petroleum and Minerals, Saudi Arabia

Abstract: Artificial Intelligence (AI) represents one of the most significant technological advancements impacting various aspects of life, including scientific research. This study aims to explore how AI tools and techniques can enhance the efficiency and effectiveness of the research process. The research begins by providing an overview of the concept of artificial intelligence and its historical development, highlighting the various types of techniques employed. Subsequently, it addresses the practical applications of these technologies across diverse fields of scientific inquiry, including medicine, environmental science, engineering, and social sciences. The analysis focuses on how AI accelerates data collection and analysis processes, thereby enabling researchers to draw conclusions more swiftly and accurately. Furthermore, the study discusses the role of AI in enhancing predictive capabilities concerning complex models and equations that are difficult to solve using traditional methods. In conclusion, the research emphasizes the importance of collaboration between researchers and AI experts to foster knowledge transfer, exchange expertise, and develop new techniques that will support scientific research and achieve tangible advancements across various domains.

I. INTRODUCTION

The application of artificial intelligence (AI) in scientific research is one of the most significant advancements in technology and science in recent years. AI refers to the capacity of systems and algorithms to replicate human cognitive abilities such as learning, understanding, reasoning, and problem-solving. Utilizing AI in scientific research presents an opportunity to enhance the quality and efficiency of studies by accelerating data analysis, providing new insights, and increasing the capability to process vast amounts of information. The reliance on AI in research takes various forms, such as employing machine learning systems for data analysis, utilizing natural language processing applications to examine scientific texts, and implementing modeling and simulation tools that enable predictions based on precise data. AI demonstrates tremendous potential in improving collaboration among researchers, facilitating access to information, and enhancing the scientific community's ability to devise solutions to complex problems. With the increasing global investment and interest in AI, it has become essential to understand how to effectively integrate it into diverse research fields and how it can contribute to achieving sustainable scientific progress [1]. This is what this research aims to do, as it studies how artificial intelligence can affect many aspects during the preparation of scientific research AI plays a pivotal role in multiple aspects of academic writing, starting with natural language processing (NLP) tools that assist in grammar checking, sentence restructuring, and improving textual clarity. Tools such as ChatGPT facilitate the production of polished, error-free academic texts, making them more suitable for publication [2-4]. AI also streamlines the process of sourcing academic materials by leveraging advanced search engines such as Semantic Scholar and Google Scholar's AI-powered tools, which efficiently identify and analyze relevant literature [5]. Furthermore, AI-powered reference management tools like Zotero and EndNote simplify the organization and formatting of citations and bibliographies. In addition to enhancing textual quality and reference management, AI offers powerful tools for creating professional-quality visualizations and diagrams. Platforms like Tableau and Plotly enable researchers to generate detailed charts and graphs, providing clear and effective representation of quantitative and qualitative data. Moreover, machine learning algorithms allow researchers to analyze complex datasets with precision, leading to insightful and accurate results.

II. METHDOLOGY

A questionnaire was published to survey researchers' opinions about the possibility of using artificial intelligence in preparing scientific research and about the most important applications that can be used while searching for sources, writing, and analyzing quantitative and qualitative data, as well as managing references and preparing illustrations.

III. RESULTS AND DISCUSSION

A. General Data

A survey was conducted among 100 researchers of different genders, ages, fields, and levels of expertise. The study's demographic findings revealed that the majority of participants were aged 20-30, with a predominantly female sample. The participants spanned a range of research experience, with 65% having 1-4 years, 12% having 4-8 years, and 23% having over 8 years of experience. Nonetheless, there was significant support for the use of artificial intelligence applications in scientific research. This is because of the many advantages that artificial intelligence offers. **Figure 1** shows that researchers, at a rate of 35.87%, tend to use artificial intelligence while preparing scientific research because it saves time and effort, analyzes large amounts of data, and improves the quality of the results. AI streamlines the research process by automating routine tasks such as literature reviews, data extraction, and classification. This automation enables researchers to dedicate more time to idea development and result interpretation. A study indicates that these tools can reduce the time required for such tasks [6]. Additionally, AI demonstrates exceptional capability in managing large datasets, allowing researchers to efficiently analyze thousands of academic papers. These tools can uncover patterns and relationships that might otherwise remain undetected when using traditional methods [7]. Beyond enhancing efficiency, AI significantly improves the accuracy of research outcomes by minimizing errors through the application of data-driven algorithms and advanced statistical models. According to a study published in *Nature Machine Intelligence*, AI-powered tools in research enhance the precision of predictions and analyses by up to 30% compared to manual approaches [8].

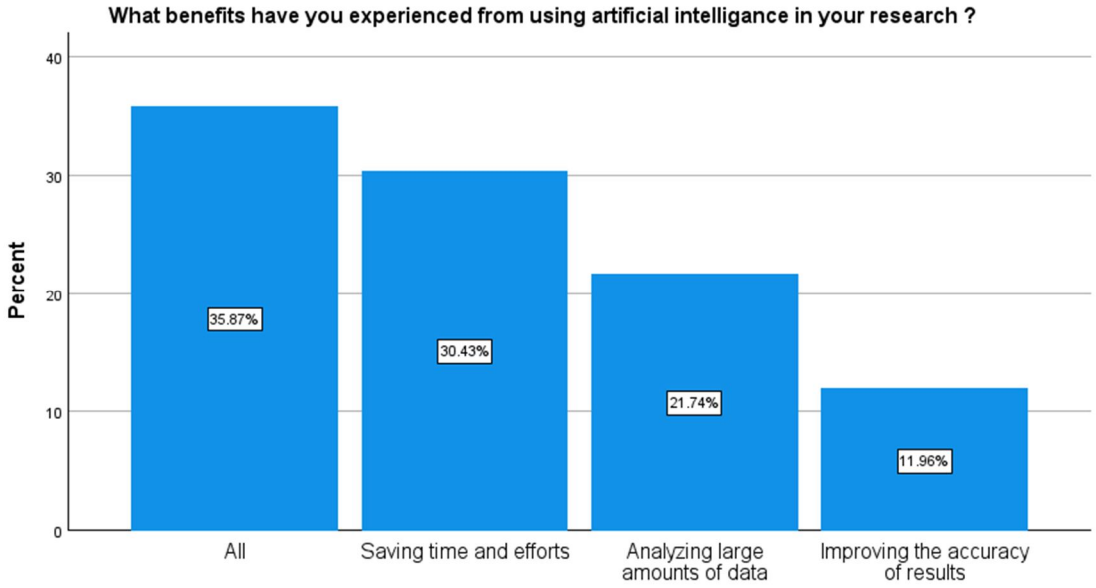

Figure 1: Survey results showing the perceived benefits of using artificial intelligence in scientific research. The majority of respondents (35.87%) reported experiencing all listed benefits, followed by 30.43% who cited saving time and effort. Other noted advantages included analyzing large amounts of data (21.74%) and improving the accuracy of results (11.96%).

B. Find Sources

Researchers have increasingly turned to artificial intelligence tools such as Connected Papers and Research Rabbit to streamline the process of extracting scientific sources during research preparation. This preference can be attributed to the unique capabilities of these tools in exploring academic literature and simplifying the research process. Figure 2. highlights researchers' tendency to utilize artificial intelligence applications for identifying relevant scientific sources during the research preparation process. The preference primarily favored Connected Papers and Research Rabbit, with a usage rate of 30.43%. The effectiveness rating of these applications was 5 out of 5, at 44.57%, because Connected Papers provides a visual representation of the research network, enabling researchers to understand the relationships between scientific papers and identify relevant works in their field. Its intuitive interface allows users to navigate through a graph-like structure of related papers, facilitating a deeper understanding of the literature landscape. Research Rabbit, on the other hand, enhances the research experience by offering personal recommendations and regular updates on newly published papers related to the user's area of interest. This feature helps researchers stay informed about the latest developments in their disciplines, ensuring that their work is grounded in current knowledge.

Both tools also offer interactive features that improve the efficiency of academic literature exploration. By saving time and effort, they allow researchers to focus more on the analytical and creative aspects of their studies. According to recent reviews, utilizing these tools not only enhances productivity but also improves the overall quality of research output.

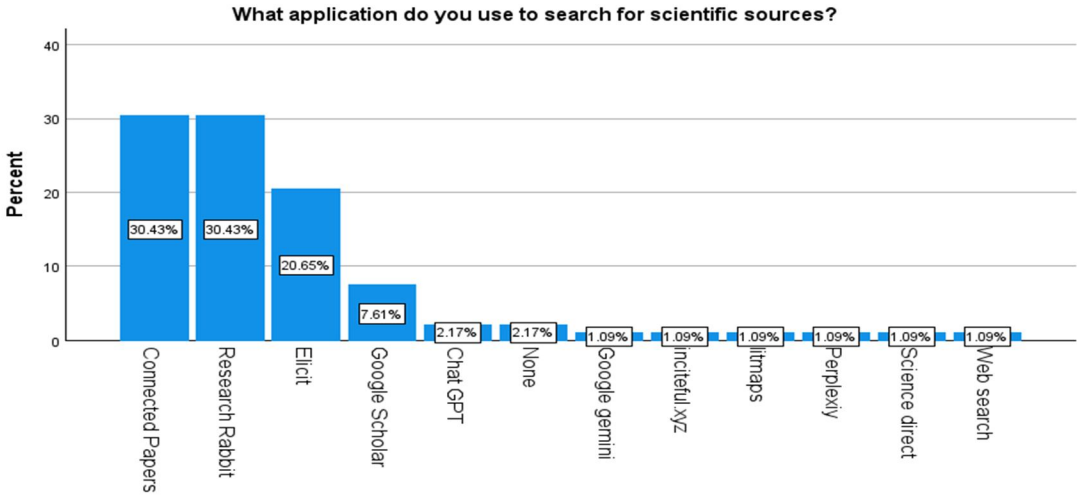

Figure 2: Preferred applications for searching scientific sources. Connected Papers and Research Rabbit led with 30.43% each, followed by Elicit (20.65%) and Google Scholar (7.61%). All other tools were used by less than 3% of respondents.

C. Improve Writing

1) Preparing for Writing

The academic community has witnessed a significant shift in research preparation methods with the increasing use of artificial intelligence applications, particularly ChatGPT. **Figure 3** revealed a significant trend toward using artificial intelligence applications in writing scientific research, with a preference of 66.57% for the ChatGPT application. Which had a rating of 5 or 4 out of 5, with a percentage ranging from 36.96%-38.04%. This preference is attributed to the application's ability to expedite writing processes, simplify complex concepts, and enhance linguistic quality and accuracy [9]. Many researchers have strongly endorsed the use of ChatGPT for drafting initial manuscripts and exploring research ideas. It is regarded as a tool that boosts academic productivity and reduces the time required for scientific writing [10]. However, this technology faces challenges such as the need for continuous verification of information accuracy and avoiding over-reliance, emphasizing the importance of integrating it cautiously into academic practices to maintain integrity and quality [11].

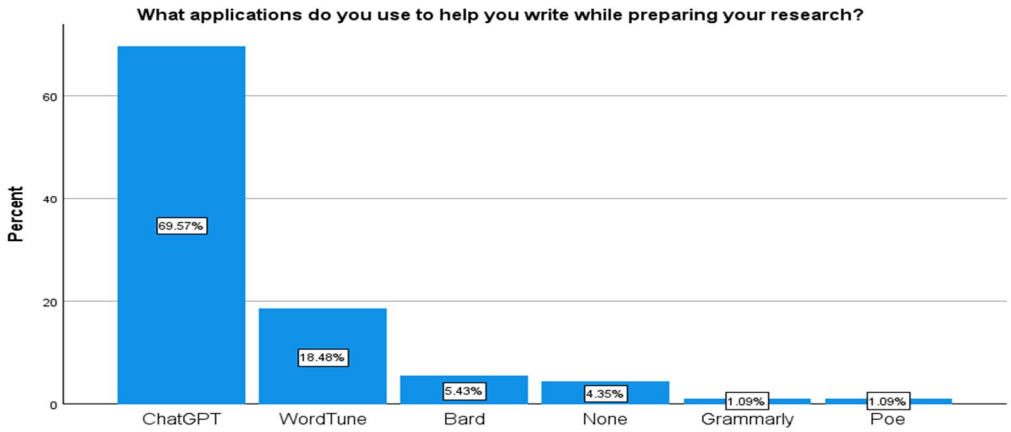

Figure 3: Applications used to assist in writing research papers. ChatGPT was the dominant choice, used by 69.57% of respondents, followed by WordTune (18.48%) and Bard (5.43%). Other tools like Grammarly, Poe, and no tools at all were selected by less than 5% each.

2) Grammar Checking

Advanced grammar applications are advanced technical tools used to improve writing quality and reduce linguistic errors. These applications depend on artificial intelligence algorithms to process text and discover grammatical, spelling errors. **Figure 4** indicates that researchers rely heavily on using qualitative grammar checking applications, with a preference for using QuillBot by 47.83%.

QuillBot is an advanced AI-powered tool designed to provide comprehensive solutions for paraphrasing, grammar checking, and enhancing writing style. Widely used in academic writing, report preparation, and professional correspondence, it helps users improve the quality of their texts through a variety of integrated features [12]. Its key functionalities include paraphrasing sentences to enhance clarity and adapt to specific writing styles, summarizing lengthy texts without losing essential meaning, and identifying grammatical and spelling errors with precise correction suggestions. Additionally, QuillBot allows users to choose from multiple writing modes—such as formal, creative, or simplified styles making it a versatile tool [13].

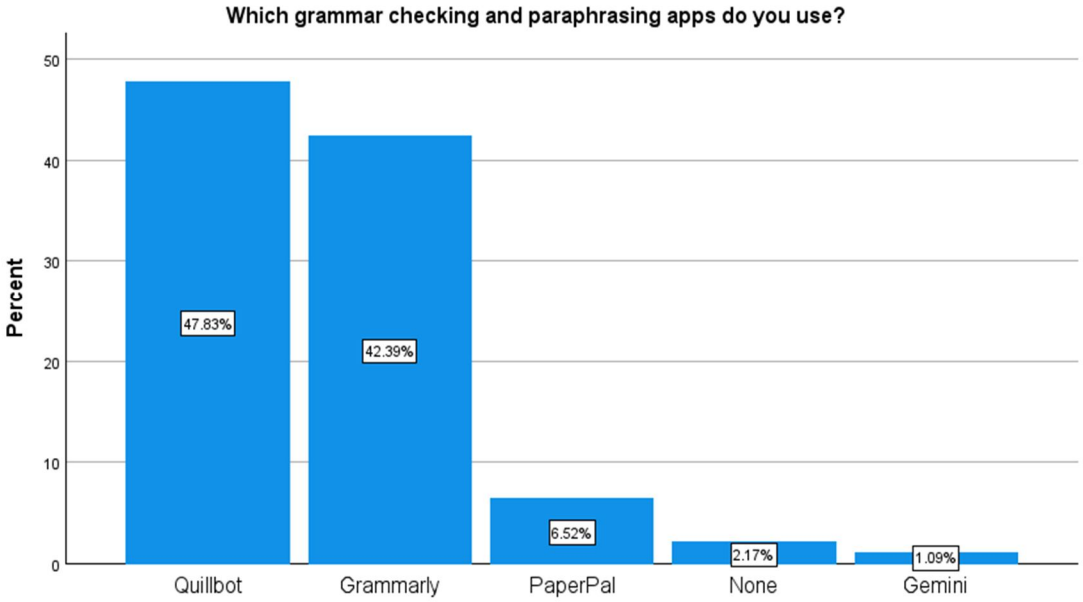

Figure 4: Quillbot (47.83%) and Grammarly (42.39%) were the most commonly used grammar checking and paraphrasing tools, while PaperPal (6.52%), None (2.17%), and Gemini (1.09%) were far less used.

D. Data Analysis

Using artificial intelligence (AI) is an ideal option for data analysis because it provides accuracy and efficiency in processing large amounts of data.

1) Quantitative data

Figure 5. shows researchers tendency to use Quantitative data analysis applications, with a preference for using SPSS by 44.57%.

SPSS (Statistical Package for the Social Sciences) is considered one of the most prominent tools used for data analysis, recognized for its efficiency in handling both quantitative and qualitative data. enabling researchers to perform advanced analyses with speed and precision. Its user-friendly interface simplifies usage, making it accessible even to beginners [14]. SPSS supports a wide range of statistical analyses, including descriptive statistics, Analysis of Variance (ANOVA), linear regression, and factor analysis. It also facilitates data cleaning and preparation by identifying and addressing missing values, creating new variables, and ensuring the dataset is ready for analysis. Moreover, the software allows users to generate professional reports and visualizations, making it easier to interpret and present results effectively [15].

A notable feature of SPSS is its integration capabilities with other tools such as Excel and SQL, which streamline data import and export processes. Additionally, the software supports predictive analytics through advanced algorithms that help identify patterns and derive insights for data-driven decision-making. SPSS is particularly effective for analyzing large datasets with a high level of accuracy, saving both time and effort compared to traditional methods [16].

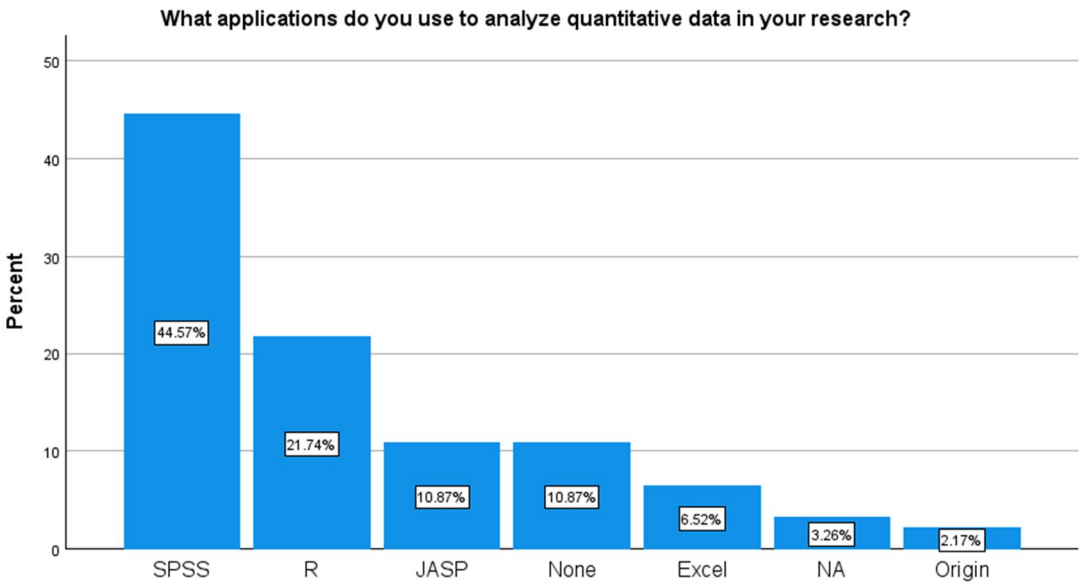

Figure 5: SPSS was the most used application for quantitative data analysis (44.57%), followed by R (21.74%). JASP and no tool tied at 10.87%, while Excel, NA, and Origin were used by less than 7% of respondents.

2) Qualitative Data

Figure 6. indicates that researchers use artificial intelligence to analyze qualitative data, with a preference for using ATLAS.it at a rate of 29.35%. The evaluation indicated that the efficiency of these applications is 4 out of 5 at a rate of 34.78%.

ATLAS.ti is one of the most prominent tools used for qualitative data analysis, providing researchers with a comprehensive environment to organize and effectively analyze unstructured data. The software can handle various types of data, including text, images, audio, and video, making it suitable for diverse research fields such as sociology, education, and anthropology [17]. ATLAS.ti relies on advanced methodologies for coding and organizing information, enabling researchers to identify patterns and key themes within their data. Additionally, the software supports the creation of conceptual networks to clarify the relationships between ideas and data [18]. With its robust and flexible tools, ATLAS.ti is an ideal choice for qualitative data analysis, offering deep insights that enhance the quality of scientific research.

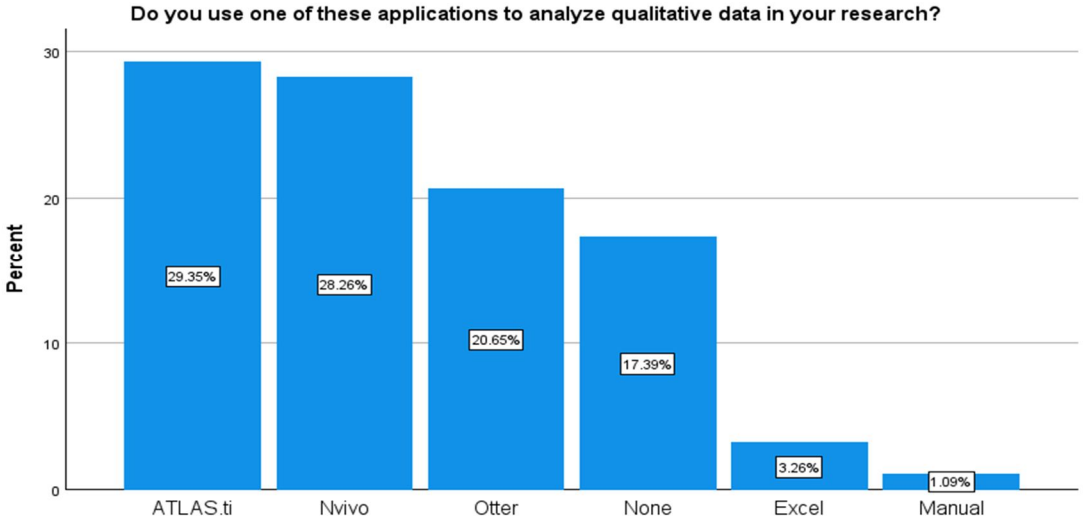

Figure 6: ATLAS.ti (29.35%) and Nvivo (28.26%) were the most commonly used tools for qualitative data analysis. Otter followed with 20.65%, while 17.39% of respondents reported not using any tool. Excel and manual methods were the least used, at 3.26% and 1.09% respectively.

E. Create Illustrations

The use of artificial intelligence (AI) in creating illustrations has witnessed significant development in recent years, as it has become an effective tool in designing images and infographics in innovative and precise ways. **Figure 7.** indicates that researchers tend to use artificial intelligence to create illustrations, with a 64.13% preference for using Canva, and the effectiveness of these applications was rated 5 out of 5 by 42.39%.

Canva is an innovative and user-friendly graphic design platform that provides a comprehensive set of tools and templates for creating high-quality illustrations to meet various needs. Widely used in fields such as education, marketing, and presentations, Canva offers an extensive library of visual elements, including icons, fonts, and customizable images [19]. The platform features a simple interface, making it accessible to users with limited design experience, while allowing them to modify text, colors, and layouts to align with brand identity or project goals. Canva also supports collaborative work by enabling users to share and co-edit projects. With its cutting-edge tools, Canva is utilized to produce educational posters, visual reports, marketing materials, and engaging presentations, enhancing visual communication and delivering professional content efficiently. Research indicates that design tools like Canva contribute to improving creative skills and the quality of visual content, making it an ideal tool for both beginners and professionals [19].

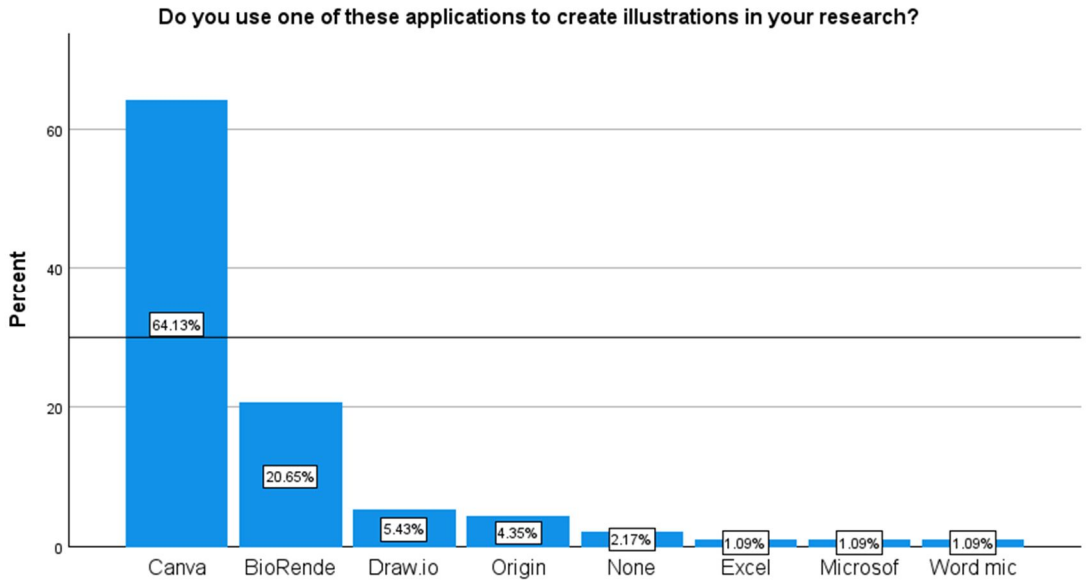

Figure 7: Canva was the most widely used tool for creating research illustrations (64.13%), followed by BioRender (20.65%). Other tools like Draw.io, Origin, and Excel were used by less than 6% of respondents.

F. Organizing References

Artificial intelligence (AI) significantly facilitates the process of organizing scholarly references with precision and speed. Modern tools, leverage advanced algorithms to automatically extract references from various sources and format them according to academic citation styles like APA and MLA. These tools save researchers time and effort while minimizing common formatting errors. **Figure 8.** indicates support for using applications to organize references. The preference for using the Mendeley application was 39.13%, and these applications proved effective with a rating of 5 out of 5, 39.13%.

Mendeley is an advanced tool for managing and organizing scholarly references, widely used by researchers and academics to streamline the research and writing process. The platform allows users to store, classify, and retrieve references effortlessly through a personal digital library that can be synchronized across multiple devices [20]. Mendeley supports importing references directly from academic databases and websites, as well as automatically inserting citations into texts and generating consistent reference lists in various citation styles such as APA and Chicago [21]. Additionally, the platform promotes academic collaboration by enabling the creation of research groups to share references and notes among team members. Furthermore, Mendeley provides tailored recommendations for relevant research based on the content of the personal library, helping users discover new sources to support their work. With these features, Mendeley is considered a comprehensive tool that enhances researchers' productivity and ensures accurate reference organization [21].

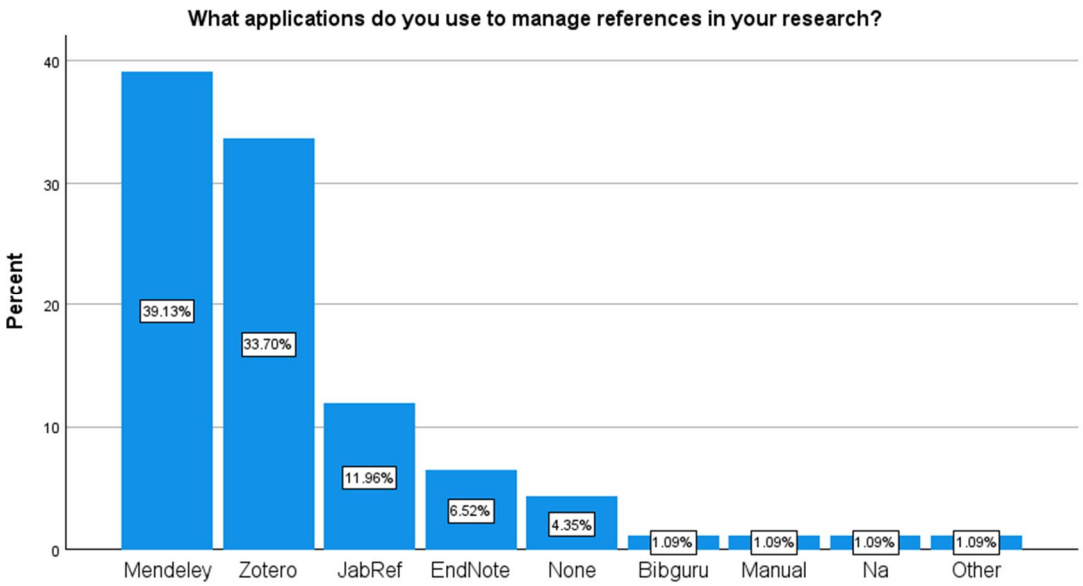

Figure 8: Mendeley (39.13%) and Zotero (33.70%) were the most commonly used reference management tools among respondents. JabRef (11.96%) and EndNote (6.52%) followed, while all other options, including manual methods and Bibguru, were used by less than 5%.

IV. CONCLUSION

In conclusion, it is evident that artificial intelligence applications have significantly transformed the nature of scientific research and the way various tasks within it are executed. With the increasing volume of data and the variety of scientific sources, adopting advanced technologies like artificial intelligence has become essential for improving efficiency and accuracy in gathering and analyzing this data. AI has enabled researchers to process large amounts of information much faster than traditional methods, thereby accelerating the overall research workflow. Furthermore, artificial intelligence assists in organizing references, creating accurate databases, and developing predictive models that support research outcomes. These tools have become indispensable during the stages of writing research, from gathering sources and citations to analyzing data and results. AI also has the potential to enhance research quality by providing accurate insights based on large-scale data analysis, insights that were previously difficult to obtain or required significant time and effort to extract manually. As AI technologies advance, there are limitless opportunities to improve scientific research. For example, machine learning can enhance the discovery of patterns in complex data and improve the ability to predict future outcomes, opening up entirely new areas for research and exploration. AI also serves as a valuable tool in fostering collaboration among researchers worldwide by facilitating the exchange of ideas and feedback through intelligent platforms that manage these processes. While there are numerous benefits associated with AI, it is important to also acknowledge the challenges that may accompany the application of these technologies, such as privacy concerns, over-reliance on technology, and the continuous need for training users. However, with ongoing development and innovation, these challenges can gradually be overcome. Ultimately, integrating AI into scientific research represents a pivotal step toward achieving a revolution in the field of research and discovery. This integration will continue to improve the ability to process information and offer innovative solutions to the complex challenges faced by various scientific disciplines.

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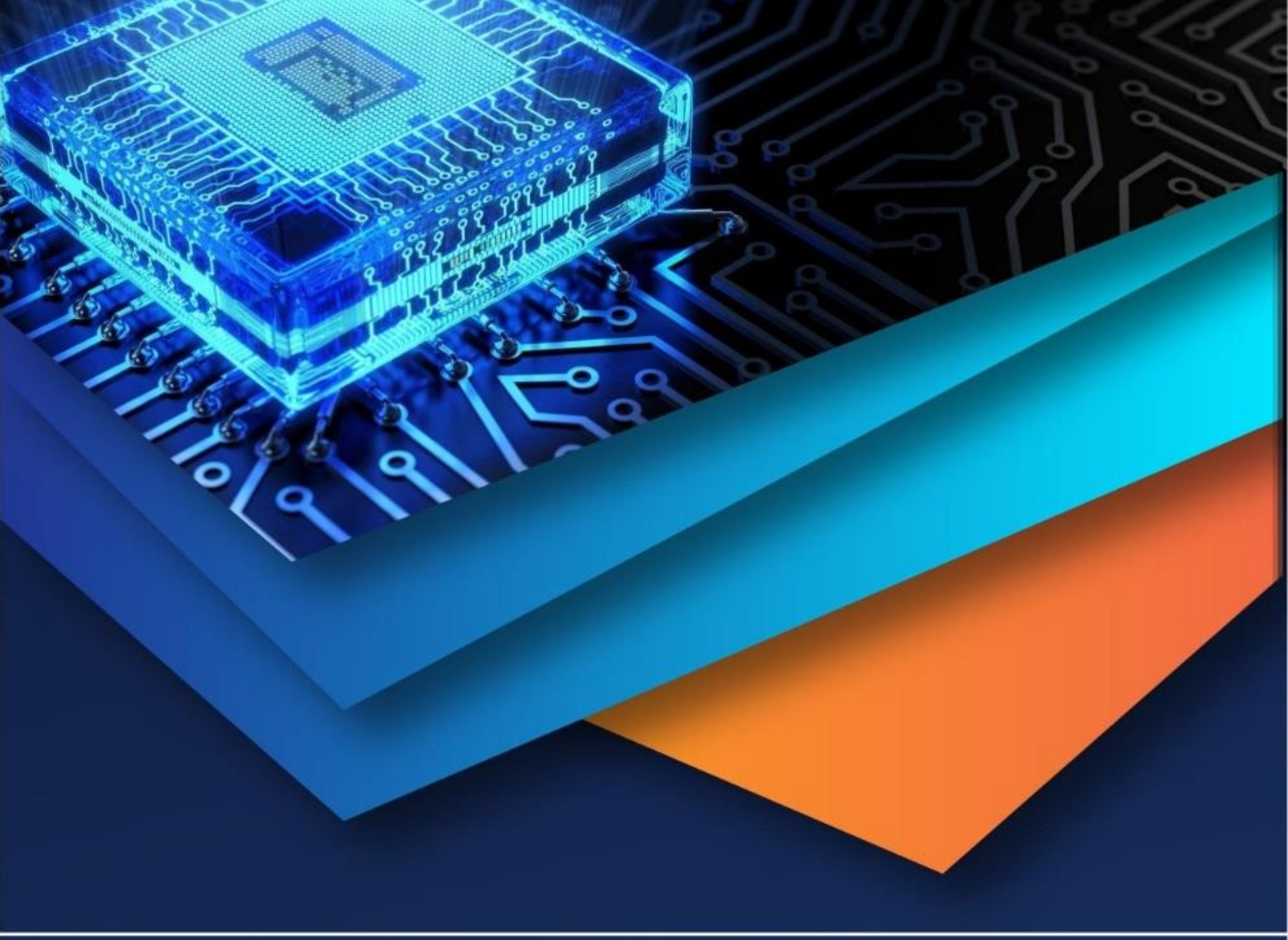

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