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RANKING OF ARTIFICIAL INTELLIGENCE TOOLS TO ASSIST IN THE WRITING OF SCIENTIFIC ARTICLES USING THE GAUSSIAN AHP METHOD

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ABSTRACT

Due to the complexity in the preparation of articles for publication in scientific journals, there is a growing use of artificial intelligence (AI) tools to support researchers and increase their productivity and efficiency. This article aims to rank AI models programmed to assist the researcher in the scientific writing process. The criteria evaluated are related to the research problem, the state of the art, the gap and the bibliographic reference. The methodology consisted of scoring the AI tools on a scale of 0 to 10, where zero would be an indication of no potential and ten of high potential of the AI tool. And also, rank the AIs through the multicriteria decision-making method Gaussian AHP of Operations Research, having as alternatives ChatGPT3.5, Elicit, Dimensions AI, Paper Digest, Semantic Scholars, Connected Paper, Jenni.ai, SciSpace Copilot and Grok. Results showed that Semantic Scholars was identified as the most effective alternative, evidencing the importance of the "Bibliographic Reference" criterion. The lower influence of the "Research Problem" highlights the greater predominance of other factors in the choice of these tools, such as the state of the art and the gap. These results offer insights for researchers,

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highlighting the need for context-specific considerations and continuous improvements in the integration of AI into the academic environment.

Keywords: Bibliometrics. Scientific Production. Systematic Review of the Literature.

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INTRODUCTION

Decision-making is part of the professional and corporate perspective, so the ability to solve problems, through choices that best meet the decision-maker's demand, can be carried out through a scientific approach. In this context, the multicriteria decision-making method proposed by Santos, Costa and Gomes (2021), entitled Gaussiano AHP, is found, which is a statistical variant of the original AHP method proposed by Saaty (1980).

Artificial intelligence (AI) tools to assist researchers in their scientific writing have already become a reality, however, there is a paucity of studies that address the effectiveness and suitability of the Gaussian AHP method, specifically, for the task of ranking AI models intended to support the scientific writing process.

Thus, the central objective of this research is to investigate the effectiveness of the Gaussian AHP method in the ordering of artificial intelligence (AI) models, intended to facilitate the process of scientific writing for researchers. This assessment aims to fill a gap in knowledge by systematically and in-depth looking at how the Gaussian AHP method applies to the selection and classification of AI models in the specific context of scientific writing assistance.

THEORETICAL FOUNDATION

The original AHP method created by Thomas Lorie Saaty is a multi-criteria method of decision-making in response to military and business contingency planning, decision-making, allocation of scarce resources, conflict resolution, and the necessary political participation in negotiated agreements (Schmidt, 1995).

The statistical variant of the AHP method, the cardinal AHP-Gaussian method, refers to a new approach to the original method, based on a sensitivity analysis coming from the Gaussian factor. With this approach, it is possible to obtain the weights of the criteria through the quantitative entries of the alternatives of each criterion under analysis, that is, from the data of the decision matrix itself. One of the highlights of the new model is related to the reduction of the decision-maker's cognitive effort, from the moment that it is no longer necessary to evaluate the criteria for obtaining their respective weights (Santos *et al.*, 2021), however, the viability of the model is only satisfactory in scenarios in which the alternatives have cardinal entries in the criteria under analysis.

The method presents the following steps according to Santos *et al.* (2021):

1) Determination of the Decision Matrix;

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2) Calculation of the average of the alternatives in each criterion;
3) Calculation of the standard deviation of the criteria based on the sample of alternatives;
4) Calculation of the Gaussian factor for each criterion;
5) Weighting of the decision matrix;
6) Standardization of results;
7) Obtaining the ranking.

The application of the Gaussian AHP method appears in scientific research such as that of Silva, Gomes and Santos (2021) which made it possible, based on quantitative criteria, to rank hospital acquisitions, evidencing the most appropriate alternative. The study by Pereira et al. (2023) aims to identify the best real estate funds in the Agroindustrial sector to compose a diversified investment portfolio.

From the above, we point out the Gaussian AHP method as a mathematical tool of potential in the ordering of AI's used to support the writing of articles in scientific research.

METHODOLOGY

The methodology adopted in this research was structured to evaluate and classify artificial intelligence (AI) tools intended to assist researchers in scientific writing. The selected evaluation criteria were carefully chosen, considering the AIs chosen for the present study, including: relevance to the research problem, state of the art, identification of gaps and bibliographic reference base.

The research problem consists of defining the question to be investigated within the proposed theme. The state of the art characterizes the survey of research on a theme, pointing out its advances and gaps. The gap is an issue that has not yet been studied or fully developed. The bibliographic reference is the technical classification of studies already published that aims to detail where and how to find them and supports the researcher's theory.

To carry out the evaluation, a scoring scale ranging from 0 to 10 was implemented, in which zero indicates the absence of potential and ten represents a high potential of the AI tool. This approach allowed a quantitative and comparative analysis of the different tools considered. In addition to direct scoring, the multicriteria method of decision-making Gaussian AHP of Operations Research chosen was used due to its ability to deal with

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multiple criteria and provide a more comprehensive analysis of the efficiency of the AI tools in question.

The AI alternatives considered in the study were chosen considering as criteria the effectiveness in solving the proposed question, their popularity in the market and the accessibility of having at least a free trial version. With so many AI options currently available and being developed, it was necessary to make a cut within this universe. ChatGPT3.5, Elicit, Dimensions IA, Paper Digest, Semantic Scholars, Connected Paper, Jenni.ai, SciSpace Copilot, and Grok were evaluated in the study.

ChatGPT3.5 was developed by OpenAI, which is an advanced language model based on generative artificial intelligence, designed to reproduce a cohesive and contextually relevant text and is known for its ability to answer questions, provide information, and perform various linguistic tasks.

Elicit is an AI tool focused on content generation and optimization, and it uses advanced algorithms to analyze and enhance the style, structure, and clarity of text, making it easier to produce more impactful and efficient content.

Dimensions AI is an artificial intelligence platform focused on the analysis and visualization of scientific data and offers resources to explore and understand trends, collaborations, and impact on scientific research, contributing to a more comprehensive view of the academic landscape.

Paper Digest is a tool that uses natural language processing techniques to automatically analyze and summarize scientific articles and helps researchers gain a quick and efficient understanding of the content of lengthy academic documents.

Semantic Scholars is a platform that uses AI to analyze and organize large volumes of scientific literature and offers advanced search and discovery capabilities, making it easy to access relevant and up-to-date information.

Connected Paper seeks to establish connections between scientific articles, identifying relationships and links between different academic works and helps researchers to explore thematic interconnections and discover new *insights* in their areas of study.

Jenni.ai is an AI designed to assist in the generation of ideas and creative content and uses advanced algorithms to offer suggestions and insights, contributing to the process of creating and writing texts.

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SciSpace is a tool that aims to facilitate scientific collaboration by offering resources to identify potential collaborators, analyze research networks, and provide information on relevant academic activities.

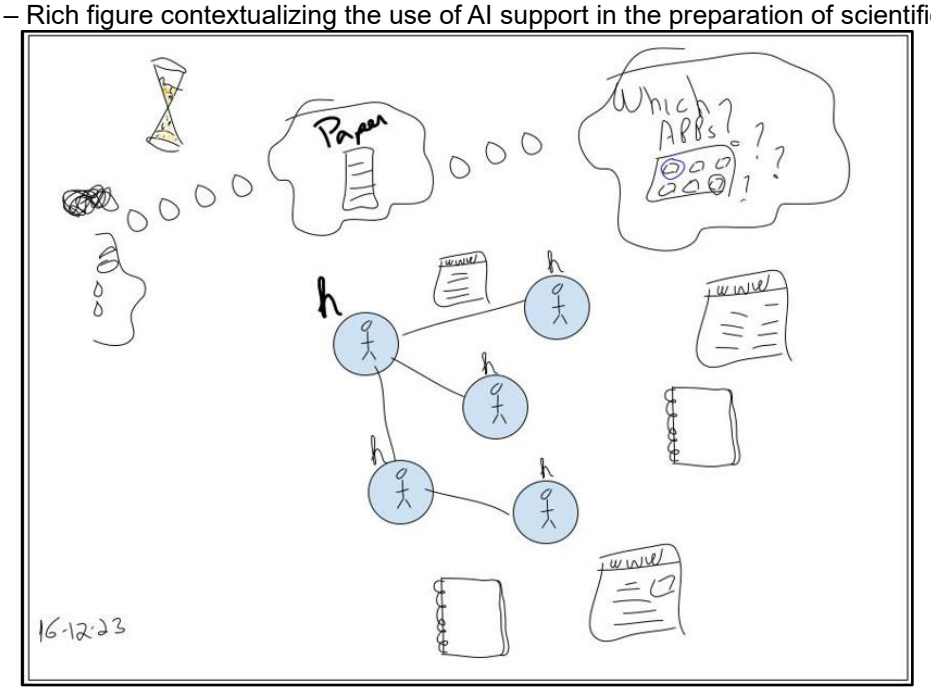
Finally, Grok is a competitor of ChatGPT3.5 with the main feature being integrated with the social network "X", where it allows a more up-to-date understanding of the world.

Each of these AI's were submitted to the scoring and analysis process by the Gaussian AHP method, whose code was developed in the R language, aiming to provide a holistic and reasoned view of its suitability to support scientific writing. This methodology is designed to ensure a systematic and robust approach in the evaluation of AI tools in order to contribute to the informed selection and optimization of these resources in academic and scientific practice.

RESULTS AND DISCUSSION

Considering the criteria and alternatives outlined in Table 1, through the rich figure method, a predominance of the "Bibliographic Reference" criterion stands out, while the "Research Problem" reveals a lower influence on the use of artificial intelligence tools, as evidenced in Figure 1.

Figure 1 – Rich figure contextualizing the use of AI support in the preparation of scientific articles



Source: Authors (2023)

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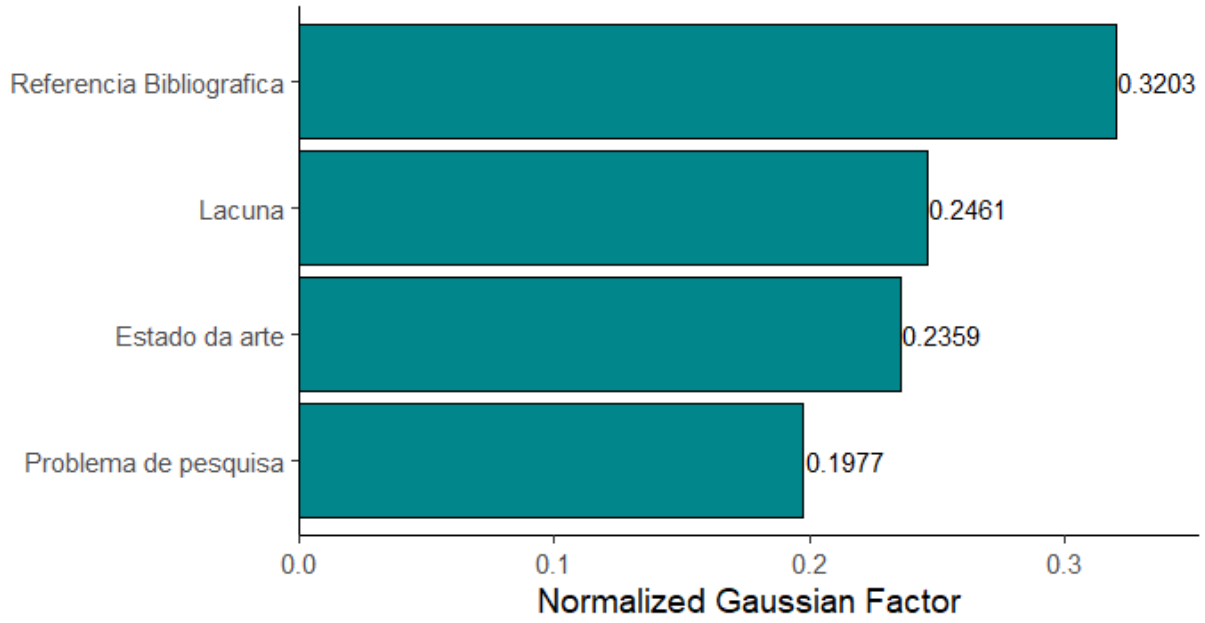
Table 1 – Decision matrix with the criteria in the rows and alternatives in the column.

Criteria/Alternatives	Research Problem	State of the art	Gap	Bibliographic Reference
Semantic scholars	9	9	8	8
Connected paper	8	8	9	8
SciSpace Copilot	8	7	7	10
Elicit	7	8	8	9
Paper Digest	8	7	8	9
Jenni.ai	8	8	7	9
It's a good way to get the most out	8	9	7	8
ChatGPT3.5	9	8	8	7
Grok	8	8	7	7

Source: Authors (2023)

With the decision matrix established, the arithmetic mean of each criterion and the standard deviation are calculated. The Gaussian factor is calculated by dividing the mean by the standard deviation. Following steps 5 and 6 of the method, figure 2 provides the normalized Gaussian factor for each criterion.

Figure 2 – Ranking of the weights of each of the criteria



Source: Authors (2024)

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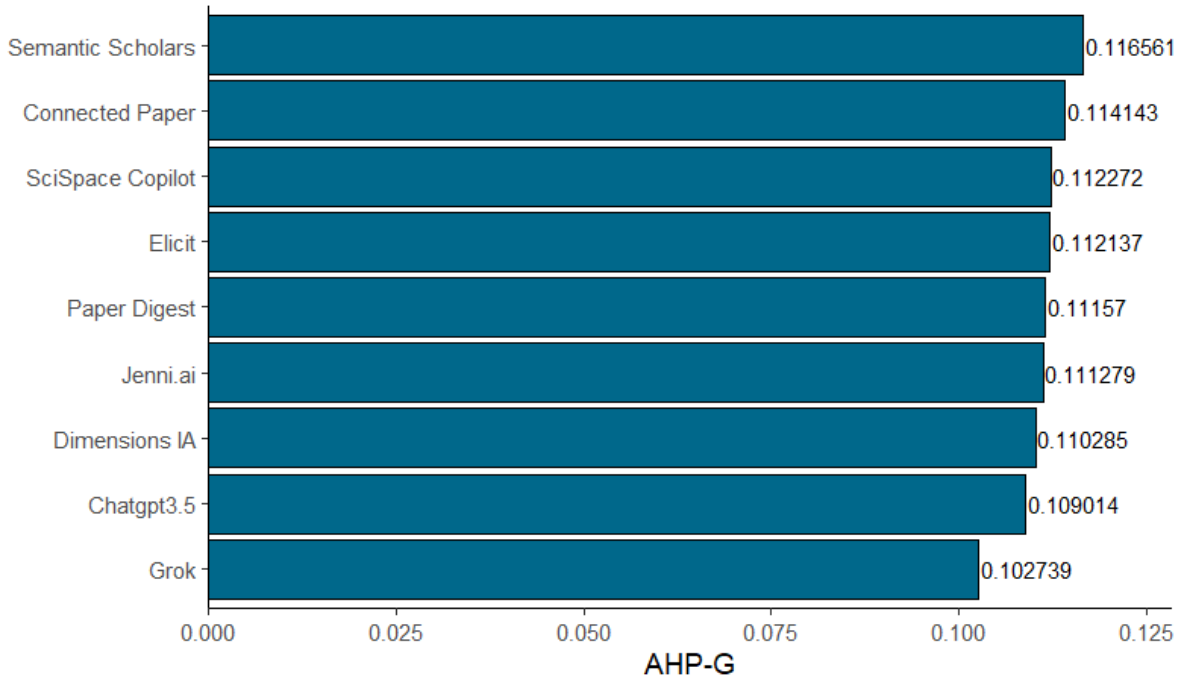
Figure 3 – Ranking and classification of AIs



Source: Authors (2024)

The results of Figure 3 indicate that Semantic Scholars obtained the highest score, being classified as the best alternative according to the established criteria. Such criteria show their ability to search for works in literature, thus contributing to the writing in a comprehensive and effective way. In contrast, Grok with a 0.014 difference in score for first place had the lowest score followed by ChatGPT3.5, two tools with similar functionalities, suggesting a comparatively lower efficiency under the same evaluation conditions for generative AI solutions. In second place and with a difference of 0.002 for the first place, the AI Connected Paper also obtained a good result, where it has a similar characteristic to Semantic Scholars when searching for articles in the literature. These results are fundamental to guide the selection and adoption of AI tools in the context of scientific writing, providing *insights* for researchers and professionals interested in the efficiency and productivity of their academic practices.

FINAL CONSIDERATIONS

This exploratory study sought to evaluate and classify artificial intelligence (AI) tools designed to support researchers in the scientific writing process. The application of the Gaussian AHP method allowed a ranking of the alternatives, highlighting Semantic Scholars as the most effective alternative, with a higher score in relation to the others.

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When analyzing the specific criteria, it was observed that the "Bibliographic Reference" played a preponderant role, indicating the critical importance of this aspect in the choice and use of AI tools for scientific writing. On the other hand, the "Research Problem" was identified as the criterion with the least influence.

These results offer insights, where the predominance of AI tools that search for scientific works and analyze connections between these articles is seen as the options that most support the researcher and these are the recommendations. On the other hand, the generative AIs addressed in the study still need to bring more quality in the aspects evaluated, and these are also impacted by the lack of accuracy in the information because their database is linked to internet data in general that did not necessarily have any validation.

In addition, the continuous need for improvement and innovation is highlighted, considering the rapid development of the field of AI and its applications in the academic context.

In the future, an expansion of this research to include a more in-depth analysis of the specific characteristics of each tool is recommended, considering feedback from real users and the nuances of different academic contexts. It is also worth noting the importance of considering the use of AI in terms of the authorial factor of writing and scientific production, as well as academic, as a topic of relevant debate.

This more holistic approach would provide a more complete understanding of the potential and limitations of AI tools in the practice of science writing. This research represents a crucial initial step towards the effective integration of AI technologies into the academic production process, providing tangible benefits to the scientific community and its research activities.

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