



ChatGPT for Scientific Research: Chances and Challenges

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Table of Content

- List of Figures II
- List of Tables IV
- List of Abbreviations V
- Abstract VI
- 1. Introduction..... 1
- 2. Theoretical Foundations..... 3
 - 2.1 ChatGPT 3
 - 2.2 Chatbots 5
 - 2.3 Language Models..... 7
 - 2.4 Generative Pre-Trained Transformer 8
 - 2.5 Artificial Intelligence 10
 - 2.6 Brief Portrait of OpenAI 11
 - 2.7 Technology Acceptance Model 11
- 3. Research Methods 13
 - 3.1 Literature Review..... 13
 - 3.1.1 Methods..... 13
 - 3.1.2 Analysis of the current literature..... 17
 - 3.2 Creation of a Criteria Catalogue for Scientific Research using ChatGPT 25
 - 3.2.1 Requirements for Quality Data According to Ballou and Pazer (1985) 25
 - 3.2.2 Derivation of a Criteria Catalogue Based on Quality Data Requirements 25
- 4. Systematic Tests..... 27
 - 4.1 Non-Functional Analysis 27
 - 4.2 Deriving Systematic Tests Based on the Criteria Catalogue 30
 - 4.3 Implementation of Systematic Tests 34
 - 4.3.1 Test for Accuracy..... 35
 - 4.3.2 Test for Timeliness 37
 - 4.3.3 Test for Completeness..... 39
 - 4.3.4 Test for Consistency 39

4.4 Evaluation of the Results	41
5. Discussion, Implications, Recommendations and Limitations	44
5.1 Chances	44
5.2 Challenges	46
5.3 Discussions about ChatGPT in social networks and forums	49
5.4 Recommendations	50
5.5 Limitations	51
6. Conclusion and Further Research Agenda.....	53
References.....	VII
Appendix.....	XV

1. Introduction

Since its recent introduction in November 2022, probably no other internet tool has caused so much discussion as ChatGPT. The possibility that a chatbot can give you an answer to every conceivable question and write entire essays with ease fascinated almost 100 million users in the first two months (Dennean et al., 2023). The established searching process using search engines seems to become obsolete with ChatGPT. ChatGPT can apparently search out the information in no time and present it clearly. However, there has been criticism raised against the model shortly after its launch. Especially in the field of education, concerns are becoming apparent that ChatGPT will have an impact on teaching (Opara, Mfon-Ette Theresa and Aduke, 2023). Nonetheless, the model can also have just as much influence on scientific research. In this thesis, the focus is on the aspects of scientific research where ChatGPT can have an impact. This includes, above all, information gathering, data evaluation and the process of scientific publication. In this context, the question of possible limitations and other important aspects of the model also emerges. Due to the novelty of ChatGPT, the question arises as to how this new technology affects the processes and results of scientific research. Moreover, the question emerges what opportunities and challenges may stem from the utilization of ChatGPT. It is important to recognize the possible influences and impacts to enable efficient and responsible use of ChatGPT. Based on this, two research questions can be derived for this thesis:

“Why is ChatGPT a promising tool for scientific research and what are its major challenges?”
“How does ChatGPT usage impact processes and outcomes of scientific research?”

The goal of this work is thus to identify potential chances and challenges that may arise when using ChatGPT in scientific research. The discussion of these opportunities and challenges is based on two different research methods. First, the existing literature on the subject is analyzed in a literature review according to Webster and Watson (2002). Then, a series of systematic tests are conducted to test ChatGPT on different dimensions of information quality. The basis for the research methods is provided by a theoretical foundation, which offers an overview of the most important technical terms and gives an understanding of ChatGPT itself and the technology and company behind the model. This is followed by the literature review and a derivation of the systematic tests as part of the research methods. Based on this, a series of systematic tests of ChatGPT are conducted and evaluated. This is followed by a discussion that combines the research findings of the literature review and the conducted tests. Opportunities and challenges of ChatGPT in scientific research are discussed, and opinions of the general public from social networks or forums are also examined. Recommendations for action are made based on the discussion and the limitations of this thesis. This is followed by a conclusion which includes further research agendas. Due to the novelty of ChatGPT, it is important to note that all of the information in this thesis was derived before April 24th 2023. The GPT-3.5 series of the model is used to conduct all screenshots shown in the thesis and all of the systematic tests

are conducted using this series. Furthermore, all screenshots and tests using ChatGPT are conducted under the ChatGPT/GPT-3.5 Mar 14 Version or ChatGPT/GPT-3.5 Mar 23 Version on the free research preview.

6. Conclusion and Further Research Agenda

This thesis focuses on ChatGPT, a recently developed large language model by the company OpenAI. This tool is one of the fastest growing internet phenomena, reaching over 100 million users in a little over two months (Dennean et al., 2023). The thesis deals with the impact of ChatGPT on scientific research and which challenges and chances are associated with the use of the model in this discipline. It also analyses the impacts on processes and outcomes of scientific research. A variety of research approaches were used to answer these research questions. First, a literature review based on Watson and Webster (2002) was conducted. Based on the literature, four concepts could be identified: Capabilities of ChatGPT, limitations of the model, impacts on scientific research and society as a whole and ethical considerations. Furthermore, a non-functional analysis of ChatGPT was performed and a series of tests of the program were derived from the quality data requirements according to Ballou and Pazer (1985). The tests included the dimensions of accuracy, consistency, completeness, and timeliness.

Both the tests and the analysis of the literature show that ChatGPT offers opportunities to increase productivity and efficiency in the field of scientific research. The test on accuracy shows that ChatGPT can provide overviews of topics. Sources in literature mention the model as a good tool to assist with daily tasks (Xames and Shefa, 2023). This gives researchers the opportunity to focus on more complex tasks (Van Dis et al., 2023). Being able to focus on more elaborate tasks may make it possible for researchers to improve the quality of research. On the other hand, ChatGPT can take over tedious routine tasks that may be prone to human errors, which can again affect outcomes in a positive way. An application of ChatGPT to as technology acceptance model by Davis (1989) shows that ChatGPT has good chances to be accepted and established in society.

However, these opportunities do not come without challenges. While the model can handle a variety of functions, it still has limitations in some areas. The test on accuracy shows that ChatGPT fabricates sources based on so-called hallucinations. ChatGPT users in online forums and social networks have also reported similar phenomena (Lifan Wang, 2023), with literature sources also pointing out inaccuracies in other areas (Megahed et al., 2023). The test on consistency shows that ChatGPT does not always provide the same quality output even with the same input. A test on timeliness revealed that ChatGPT is not able to access information after the training-data cutoff date. In some instances of the test, it even fabricates information instead of letting the user know of its limitations regarding timeliness. The need for cross-checking information generated by ChatGPT therefore forms a challenge, with the potential errors lowering the quality of research.

In addition to challenges due to technical limitations, there are obstacles due to ethical concerns. Due to the novelty of the model, little to no framework exists with respect to plagiarism,

ownership of outputs, biased or toxic outputs and privacy. With regard to scientific publications, an answer must be found to the question of how far ChatGPT may act as co-author or contributor. Challenges are also forming in the area of employment. ChatGPT's capabilities may lead to less need for scientific workers in these areas. This requires researchers to adapt and develop new skills in the evolving landscape of technology-driven research. Recommendations are given for both OpenAI and researchers alike. OpenAI should be more transparent with the development, as the progress can currently be described as a black box. More transparency in combination with a crowdsourcing approach can help to overcome some challenges in relation to the technical aspects of the model. In addition, rule frameworks regarding the use of ChatGPT in publications should be established and researchers should be taught how to use it responsibly, especially with respect to the limitations that exist.

The scientific research process in connection to ChatGPT does pose as a future research approach, given that most current literature focuses on academia and education. While these sectors do offer many crossovers in the research discipline, it is important to focus on all aspects of the research process, especially regarding scientific publications and workplace routines. As time moves on it is important to deepen the results. Due to the current novelty of the phenomena, studies and interviews might result in different outcomes in the future, as ChatGPT becomes more established in daily routines. Research can be conducted to explore how future changes in routines and outputs of scientific research can be attributed to ChatGPT.