

Impact of ChatGPT on academia - Potential future scenarios

Soma Balla¹¹, Peter Csiba¹², Daniel Simon¹³

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Abstract

The rapid development and growing utilization of advanced artificial intelligence (AI) models, such as OpenAI's ChatGPT, carries significant implications for numerous sectors, including the field of academia and research. The following article aims to better comprehend and understand the potential future outcomes, and possible concerns of the integration of such AI models into academic life. The research approach is laid upon the framework of future forecasting, guided by the principles of Bishop and Hines (2012), involving four key stages: framing, scanning, forecasting, and visioning. The methodology further incorporates the creation of models that outline plausible future scenarios, drawing from the strategic foresight approach advocated in Gáspár's "Strategia Sapiens" (2012; 2015). The study collects data through an extensive review of already available literature on the subject, combined with a thematic overview of qualitative data gathered from the analysis of previously performed semi-structured interviews conducted with five experts in the field. The aim of the research is not only to uncover plausible future scenarios surrounding the impact of ChatGPT on academia, but also to identify potential concerns and areas of caution that may need to be addressed in the upcoming future based on the performed literature review and thematic analysis. The research underscores the importance of maintaining transparency in discussions about the integration of AI in academic processes. Overall the research aims to provide a peek into the possible of outcomes of the rapid development and wide availability of ChatGPT.

Keywords: ChatGPT, AI, academia, research,

INTRODUCTION

Artificial Intelligence (AI) has been increasingly integrated into various aspects of our daily lives. From personal assistants like Siri and Alexa to self-driving cars, AI technology is rapidly changing the way we interact with the world. In the academic field, AI has also been making significant strides, and one notable development is the creation of ChatGPT, a large language model trained by OpenAI based on the GPT-3.5 architecture.

¹¹ PhD student, Doctoral School of Entrepreneurship and Business, Budapest Business School, Soma.Balla.76@unibge.hu, equal contribution

¹² PhD student, Doctoral School of Entrepreneurship and Business, Budapest Business School, peter.csiba55@gmail.com, equal contribution

¹³ PhD student, Doctoral School of Entrepreneurship and Business, Budapest Business School, daniel.simon.50@unibge.hu, equal contribution

ChatGPT is an AI-based software that can engage in human-like conversation with users. It has been designed to understand natural language and generate responses that are contextually relevant to the input it receives. ChatGPT is a significant breakthrough in AI, as it has the potential to revolutionise the way we interact with machines.

Given the recent developments in AI and its increasing use in the academic field, it is important to investigate the potential impact of ChatGPT on scientific research. The research question for this study is: "How will ChatGPT and publicly accessible, AI-based software impact PhD students' scientific research in the near future?"

To answer this research question, the study utilizes an extensive literature review, horizon scanning and the exploration of qualitative interviews. The literature review will involve a comprehensive analysis of existing literature on ChatGPT and its application in the academic field. The review will explore the current state of AI technology and the potential impact of ChatGPT on scientific research.

The qualitative interviews – supplemented by horizon scanning – will assist the understanding of the potential futures of ChatGPT from several positive and negative points of views. The interviews involve highly respected individuals like ChatGPT CEO Sam Altman and Eliezer Yudkowsky American writer who have experience working with ChatGPT or other AI-based software. The interviews will seek to explore the perceptions, attitudes, and experiences of the participants regarding the use of AI-based software in scientific research. The interviews will also investigate the potential benefits and challenges of using ChatGPT in scientific research.

The data collected from the literature review, horizon scanning, and qualitative interviews will be analysed using thematic analysis. This analysis will identify common themes and patterns in the data, providing insight into the potential impact of ChatGPT on scientific research.

The significance of this study lies in its potential to inform the academic community on the possible implications of ChatGPT and other AI-based software on scientific research. With the increasing integration of AI technology in the academic field, it is crucial to investigate its impact on the quality and validity of research.

The findings of this study will be relevant to PhD students, researchers, and academic institutions. PhD students and researchers can use the findings to inform their decision-making regarding the use of AI-based software in scientific research. Academic institutions can use the findings to inform their policies and procedures regarding the use of AI-based software in scientific research.

1.1. MAPPING

As set forth in the introduction, the topic of the study is to unfold how the widespread use of ChatGPT and akin AI-based models in the academic sphere may influence the work of young researchers. The following sections aim to outline the domain, current landscape and analyse the era for the subject matter.

Domain definition

With respect to the time horizon, the primarily focus of this paper is on the mid-term (3-5 years). The reason for choosing to look at the impacts during this time period is that (a) due to the rapid pace of development in AI-based chat software (that is most likely to intensify in the months and years ahead) it is extremely hard – if not impossible – to foresee the longer terms effects, and (b) university campuses are typically slow to react when it comes to adapting to cutting-edge solutions, therefore shorter term effects might be negligible – even on a global scale. The latter seems to be underlined by Freyman (2023), who conducted a survey among 520 US

college students and found that 4 out of 10 students haven't even heard of ChatGPT yet – furthermore, those who have were familiar with it to some extent, 52% of them have never used it.

In conjunction with the nature of ChatGPT – it is publicly and freely accessible to anyone with broadband internet connection – the authors do not narrow the geographical scope of the paper to any particular region or country, and rather choose to focus on the overall qualitative effect on the work of PhD students and universities on a global scale.

The relevancy of the topic can be justified by the fact that the recent development and proliferation of AI-based chat and search engines has opened new doors to optimize accessing data and gathering information on a large scale within a matter of a few minutes. The disruptive effect of leveraging AI in academic research – specifically for PhD students – has a notable upside (for example, summarizing large quantities of texts, or searching large text-based databases to answer particular questions rapidly) (Gordin & Have, 2023), while it also carries a set of inherent challenges (for example, the question of distinguishing between purely AI-generated and manually constructed content, or the occasional inaccuracies and lack of coherence an AI-generate output may include) that one need to consider when assessing the overall impact (Chiang, 2023).

Current assessment and stakeholders

ChatGPT – a large language model built by OpenAI (OpenAI, 2023) – was released to the public in November 2022 (Sundar, 2023), showcasing the underlying potential of AI solutions in various walks of life – including academic research. Consequently, the practical implementation of such technologies is still in its early stages, however there are already signs how it could fundamentally change the way research and publications are carried out in the years to come. As mentioned before, using the software is free of charge, which makes it even more attractive for PhD students, who typically do not possess abundant pool of financial resources. Moreover, the – probably unpredictably warm – reception of ChatGPT by the public already triggered an intense competition in the technology sector. The fuss around ChatGPT instantly sparked most of the leading tech companies to invest in, build and enhance their own AI capabilities and make them publicly available – therefore the authors anticipate the rapid development and proliferation of such software in the upcoming 3-5 years. The authors' standpoint on the large-scale impact has also been reaffirmed by Eloundou et al. (2023).

When it comes to the software's academic use, the authors identified the key stakeholders as set forth in Figure 1. How will ChatGPT and publicly accessible, AI-based software impact PhD students' scientific research in the near future?

1. Table Stakeholders of ChatGPT’s implementation by PhD students

Stakeholder	Impact type
1) PhD students	Finding ways to incorporate ChatGPT to their research activities in a useful way to improve (a) the quality of their publications and (b) the scientific added value of their research
2) Universities, college campuses	React to the changing landscape with regards to the ways emerging technologies can be systematically utilized for academic purposes
3) Scholars, peer-reviewers	Become familiar with the pitfalls of ChatGPT and enhance their ability to distinguish between AI-generated vs. manually written texts
4) Editorial boards of journals	Take into account how ChatGPT-generated scientific text may change the way publications are created
5) Authorities, governmental bodies	React by regulations in case the public demand arises to do so. On the other hand, policymakers need to be very cautious not to “overregulate” and unnecessarily create obstacles for the practical implementation of technological development.
6) Tech companies	Intense competition to serve the public demand – requiring continuous R&D investments

Source: Own summary and edit

Development of ChatGPT

ChatGPT is a conversational, AI-based language model developed by OpenAI that has revolutionized the field of natural language processing. The origins can be traced back to OpenAI's earlier language models, such as GPT-2 and GPT-3. These models were already designed to generate human-like text based on prompts provided by users, however with limited ability to engage in meaningful conversations (Brown et al., 2020). ChatGPT is therefore based on the GPT-3.5 architecture, which incorporates a range of advanced techniques such as transformer-based language modelling and deep learning (OpenAI, 2023).

It was first introduced in 2019 as an improvement over the original GPT (Generative Pretrained Transformer) model, however the widespread adoption only took place in the fourth quarter of 2022 (Vallance, 2022). The development of ChatGPT involved a range of advanced techniques and technologies. The model was trained – using transformer-based language modelling and deep learning techniques – on a large corpus of text data from the internet – not restricted to articles, but also including human conversations – in order to build and improve its ability to generate human-like text (Cotton et al., 2023). ChatGPT extends this capability to handle conversational AI tasks such as question-answering and dialogue generation. The model is fine-tuned on specific conversational data to further enhance its ability to generate contextually relevant responses (Thompson, 2023). Since its introduction, ChatGPT has been widely adopted by businesses and organizations for various use cases such as customer service chatbots, virtual assistants, content generation, and language translation tools. The model continues to evolve with ongoing research and development efforts by OpenAI, with a focus on improving its ability to handle more complex conversational tasks and generate more human-like responses (Gilson et al., 2023).

ChatGPT has had a significant impact on the field of natural language processing and AI research. The model has demonstrated the potential for language models to engage in meaningful conversations with users, paving the way for a new generation of conversational AI technologies. As an inherent consequence of the software's public application still being in its initial stages, empirical data is rarely available to adequately assess its practical implications to date – although as Bloomberg reports a study conducted by researchers from Stanford University and MIT, we have already witnessed significant productivity gains at the customer service department of a Fortune 500 company that successfully implemented ChatGPT to provide faster and higher quality services and supplement the day-to-day work of relatively low-skilled workers (Constantz, 2023). This study tends to reaffirm the authors standpoint that as disruptive ChatGPT seems, it has a great upside potential to be ultimately beneficial by both economic, academic and societal means.

ChatGPT has also sparked new research in areas such as language generation, text completion, and dialogue systems. The model has also raised important ethical and social considerations related to the use of AI in language processing and communication (Goldstein et al., 2023).

Era- and environmental analysis

According to the corresponding literature reviewed, we believe that the era of the early 2020s – hallmarked by digitalization and the proliferation of AI in our everyday lives – can be characterized by the following five key phenomena and trends.

1. *Increased connectivity.* With the widespread adoption of the internet and mobile devices, the world is more connected than ever before. This has led to the creation of vast amounts of data and the development of new technologies for managing and analysing that data (Ganne & Lundquist, 2019).
2. *Increased use of data.* In conjunction with the statements related to “increased connectivity”, data has become a critical resource in the digital age, and organizations are leveraging it to make informed decisions and gain a competitive edge. This has created a demand for new technologies and skills to manage and analyse large datasets (Ferrantino & Koten, 2019).
3. *Automation and rapid development of AI-based solutions.* AI and machine learning algorithms are being used to automate a growing number of tasks, from simple repetitive processes to complex decision-making. This has the potential to greatly increase efficiency and productivity, but also raises concerns about job displacement and broader negative societal impacts (Yudkowsky, 2023; Ferguson, 2023). In direct economic terms, the industrial application of AI and other cutting-edge technologies is discussed in the context of the fourth industrial revolution – in other words, Industry 4.0 refers not merely to a set of breakthrough technologies per se, but should rather be understood in a holistic way as a fundamental digital transformation that – through the industrial application of cutting-edge technologies – leads to the emergence of fundamentally new business models and strategies (Götz et al., 2021). Chat GPT fits into this very picture, with a wide range of opportunities for increasing efficiency and productivity.
4. *Advancements in language processing – NLP (natural language processing) and LLMs (large language models).* These are subfields of AI that have made great strides in recent years, allowing computers to (a) understand and generate human language more effectively and (b) increase the number of parameters and size of the training data (Weidinger et al., 2021). These have paved the way for the development of more sophisticated conversational AI systems like ChatGPT (Gordin & Have, 2023).

5. *New business models.* The digital age has given rise to new business models and revenue streams, such as e-commerce, online advertising, and subscription-based services (Tilesch & Hatamleh, 2020).

There are a number of elements to take into consideration when analysing the influential forces that characterize the environment where the development of ChatGPT takes place. First of all, the inevitable progress in the capabilities of ChatGPT, as it is in its first stages of implementation, makes the future development of its features anticipated. The user demand is another factor to consider, with its ease of access (and the fact that it is currently available free of charge) it is safe to expect it to be widespread in the near future. Moreover, the legal background of ChatGPT usage is another indispensable aspect to include in the analysis. The governmental and institutional regulations would definitely mark the extent to which the user in general, and PhD researchers specifically, can leverage the merits of this tool. Lastly, although ChatGPT is currently free of charge, the possibility of it becoming a paid tool cannot be eliminated. To give a clear positioning to the research topic, it is important to note that it is limited to the scope of academic research. Regarding the future trends that may impact the course of operating ChatGPT, we mention, among others, the technical developments that the tool can undergo in terms of personalization as well as the potential integration with other software and areas. The ever-expanding knowledge is also an important variable that can result in a shift in the said environment.

To summarize, the era of digitalization and AI is primarily characterized by rapid change and constant emergence of new technologies and ways of working – including in the field of research. This presents both opportunities and challenges and it is up to PhD students and universities – as well as society as a whole – to navigate through this complex landscape.

Horizon scanning

According to Könnölä et al. (2012), horizon scanning is the systematic way of collecting signs, signals – for example trends, drivers, processes – and a set of credible observations that the researcher deems relevant to assess a new emerging issue. From the perspective of our paper, given the high uncertainty of how emerging technologies will evolve and how the academic community will adapt, weak signals – that can be defined as “important indicators of possible change, which might become significant later” (Géring et al., 2020, p1.), or in other words, the “first signs of paradigm shifts, or future trends, driver and discontinuities (Ponomoreva & Sokolova, 2015) – are also important to be considered when it comes to horizon scanning.

The premise of our research is that the rapid development of advanced technologies in the past decades – broadly speaking, starting from the 1980s – has fundamentally reshaped not only the global economy, but academia as well. The exponential pace of the evolution of information and communication technology (ICT) – and to being with, the widespread adoption of internet per se (Barjak, 2006) – opened doors for research that seemed merely impossible before (Winkler et al., 2010). It has not only increased the productivity of academics to date, but also had positive effects on collaboration (Ding et al., 2010). By projecting the empirical evidence of the past to the future, we believe that the broadscale implementation of advanced technologies is going to keep having a strong influence on academic research – especially as generative AI tools, similarly to former technologies, are already showing signs how it can facilitate groups works and student collaboration when it comes to school assignments or project works (Lewis, 2022).

Starting off a bit further away from academia, there is already empirical data available to reaffirm the assumption that, even though the practical implementation is still in its very early stages, ChatGPT has significant upside potential for productivity and efficiency gains in professional occupations that are associated with generating logical, cohesive, and sophisticated human-like text (Brynjolfsson et al., 2023).

Furthermore, by early 2023, we already see weak signs appearing with regards to how

ChatGPT could influence academic research (Cotton et al., 2023), as well as teaching (Baidoo-Anu & Ansah, 2023). – in both positive (“opportunities”) and negative (“challenges”) terms. Although, inherently, there is a certain amount of resistance in adopting the new technology to academia, the mere fact that peer-reviewed journal articles are now focusing on the utilization ways and potential impact of generative AI – just months after releasing the initial version of ChatGPT to public access – on research and higher education underlines its relevance. As Cotton et al. (2023) summarises – in a study, that was later admitted by the authors to be largely written by ChatGPT itself with the aim of providing evidence how challenging it is going to be for peer-reviewers to identify non-human-generated texts (Fazackerley, 2023) –, generative AI tools can be potentially leveraged in higher education through its adequate adoption to exploit opportunities like:

1. facilitating student collaboration,
2. enabling remote working,
3. creating customized and/or interactive assessments and personalised exams,
4. enhancing critical thinking,
5. providing real-time feedback.

The authors’ genuine confession subsequent to publishing the article – which inherently implies that neither of the four peer-reviewers was unable to spot the machine-generated content – clearly showcases one of the most prominent dangers of generative AI. As The Guardian (Fazackerley, 2023) reports – pointing out the fact that distinguishing between human- vs. ChatGPT-generated content is gradually becoming more difficult –, the continuous sophistication of ChatGPT poses the threat of the proliferation of “essay mills” and plagiarism, which induces a great challenge for universities.

One way of response, which can be also considered as a weak sign when it comes to responding to the threats of ChatGPT on academia, is that publishers have already started to put restrictive measures in place to limit the use of generative AI in scientific papers. However, so far, it has not been a universal approach adopted by the academic community as a whole (Sample, 2023).

On the other hand, there are weak signs suggesting that AI-based solutions will remain part of academia and can materially improve the quality of academic research. As an example, we can mention the emergence of AI-based literature review tools that are designed to help, among all, PhD students to find the relevant papers and studies corresponding to their respective research topics and therefore, ultimately, to save time and resource that can be re-channelled to conducting actual research activities. As an example, for universities already embracing such technologies to be utilized for conducting literature reviews, the Texas A&M University started to provide a fairly comprehensive “repository” of the alternatives available to date (Texas A&M University Libraries, 2023).

Moreover, the utilization ways of ChatGPT in business and academia has also started to generate more conversation – and sparked heated debates and de facto existential questions (Helbing et al., 2019) – in the public domain, with discussions primarily revolving around the moral and ethical concerns, as well as the broader societal impact of generative AI – as discussed in depth during the qualitative analysis section of this paper.

1.2. METHODOLOGY

The chapter outlines the methodology that will be used to perform research on the development of ChatGPT and its possible future uses in the academic field for students and researchers. The research question for this study is: "How will ChatGPT and publicly accessible, AI-based software impact PhD students’ scientific research in the near future?"

To answer this research question, an extensive literature review, environmental analysis,

horizon scanning, and qualitative interviews were conducted as data collection methods. The literature review focuses on scholarly articles, books, and other relevant sources on ChatGPT and its potential applications in academic research. As ChatGPT is a very new phenomenon, the potential difficulties of data gathering from the available literature are expected and must be highlighted as one of the limiting factors of the research. Consequently, academic literature is supplemented with non-peer-reviewed written materials, like articles published by experts in online magazines, public announcements, and speeches – in other words, the horizon scanning of fringe data sources dominates the research.

Therefore, further approaches such as a qualitative analysis was performed on interviews with highly respected individuals such as ChatGPT CEO Sam Altman and Eliezer Yudkowsky, American writer to further support the probable future scenario building. The qualitative interviews were conducted to obtain first-hand accounts of the potential benefits and challenges of using ChatGPT in academic research. The analysed interviews were conducted by Lex Fridman, are recorded, and made completely available on YouTube. The audio and video were recorded with the participants' consent. The authors of this paper only analysed the conducted and free to access interviews by Lex Fridman. Table 2 shows the analysed five interviews, their key participants and the core topics discussed. All five interviews are overall assessing the topic of the expected future evolving of ChatGPT and are also touching on the area of possible impacts on academic life. The interview scripts are analysed with thematic analysis utilizing NVivo, qualitative data analysis software. The aim of the data analysis is to allow better conclusion drawing and the highlighting of frequently reoccurring topics discussed which can better display a baseline and further less expected alternative futures.

2. Table List of analysed interviews

1st interview - Stephen Wolfram: ChatGPT and the Nature of Truth, Reality & Computation
2nd interview - Manolis Kellis: Evolution of Human Civilization and Super intelligent AI
3rd interview - Max Tegmark: The Case for Halting AI Development
4th interview - Eliezer Yudkowsky: Dangers of AI and the End of Human Civilization
5th interview - Sam Altman: OpenAI CEO on GPT-4, ChatGPT, and the Future of AI

Source: own summary and edit

Thematic analysis allows for the identification of emerging themes and patterns within the data, providing insights into the participants' experiences and perspectives on ChatGPT in the academic research field. It provides a systematic and rigorous method for analysing qualitative data, ensuring that the findings are reliable and valid. It provides great assistance in the identification of key issues and challenges that may arise when using ChatGPT in academic research. A thematic coding system was built based on the reoccurrence of given topics within the interview transcripts allowing the categorizing and synthetization of opinions from all five interviews. The mindset and validity behind this methodological approach is that the baseline future will be built and backed up by reviewed and sorted data based on the highest probability expectations of the future, experts mention in the field. Alternative futures and possible black swan outcomes are determined based on less frequent outliers mentioned during the analysed interviews where complete consensus is not reached between the opinions of the interviewees.

The possible future outcomes of ChatGPT are processed by Scenario Planning based on the methodological approach of Peter Schwartz. Schwartz's approach to future building

involves great similarities to the chosen methodology of this paper and provides a cornerstone for further future scenario building. Peter Schwartz's methodology similarly utilizes in-depth interviews with a diverse group of experts to gather their insights and opinions on future trends and developments. These interviews are then analysed using thematic correlation analysis to identify recurring themes and patterns. By examining the correlations between themes, Schwartz uncovers potential future scenarios and explores their implications (Schwartz, 1996). Scenario planning involves creating and analysing multiple plausible future scenarios based on a range of different variables and factors. The approach is particularly useful in situations where there is significant uncertainty about the future and where multiple factors could impact the outcome. The methodological approach assumes a linear correlation between the frequency of expert opinion making and consensus and between the chance, and reliability that a given future will occur, meaning that greater agreement regarding given aspects and attributes are leading to more likely baseline futures, while different, outlying opinions are displaying possible alternative outcomes (Schwartz, 1996).

The research methodology overall builds upon and follows the foundations of strategic foresight proposed by Bishop and Hines (2012), and Gáspár (2012, 2015). The chosen framework of the research is built upon Bishop and Hines' six-phase futures studies framework, which includes framing, scanning, forecasting, visioning, planning, and adapting (Bishop & Hines, 2012). The research executes the first four phases determined by Bishop and Hines, creating a potential for future extension of the research. In the context of exploring the potential future impacts of ChatGPT in academia and research, each of these phases are deployed to systemically outline a range of potential futures and strategies to navigate towards preferred outcomes based on the available information and expert opinions. Framing defines, the boundaries, stakeholders, and the overall direction of the research, involving an extensive mapping of the current landscape of AI in academia, and identifying key stakeholders including researchers, educational institutions, policy makers, and students. The research's scanning phase is based upon a broad review of the academic literature, looking for early signals of change and understanding the larger dynamics at play with the qualitative thematic analysis of conducted interviews with expert on the field. Particular attention is given to the ways AI and language models like ChatGPT are currently being developed and to their potential growth trajectories. Forecasting, as Bishop and Hines (2012) propose, is concerned with probable futures. The research highlights modelling of potential trajectories for ChatGPT's impact based on current trends, potential disruptions, and various scenario simulations determined based on the data gathered during the scanning phase. The visioning phase entails a creative process of imagining the possible, plausible, and preferable futures of ChatGPT in academia. It goes beyond just extrapolating from current trends to encompass transformative possibilities that might emerge with advancements in AI and natural language processing technologies. The final visioning phase aims to synthesize the learnings of the literature review and the opinions of the reviewed experts, highlighting possible both positive futures of the development of ChatGPT while also drawing attention to already existing concerns apparent on the field displaying the need for transparency and further communication on this territory.

The model utilized in this study builds upon Gáspár's research called *Strategia Sapiens*, in which he proposes a more human-centric, individualized approach to strategic foresight (Gáspár, 2012; Gaspar, 2015). By applying this to the study of ChatGPT in academia, the research puts high emphasis on how future AI can be used and change the lives of individuals. The methodology also draws on Gáspár's insights and highlighted significant values in strategic foresight, recognizing the need for reflexivity, multi-perspectivism, and an appreciation for the inherent uncertainties in any foresight endeavour (Gaspar, 2015). Through this integrated framework, the research strives to provide a comprehensive, human-centred and future-oriented exploration of the potential role of ChatGPT in academia and research.

The possible limitations to the proposed methodology must be highlighted. The analysis of the qualitative interviews is conducted with a limited number of highly respected individuals, and therefore the findings may not be representative of the wider academic research community. The found results may contain bias and objective opinions as the saturation point was not deterministically reached. The interviewer's opinions and knowledge may further contain preconceptions or the participant's desire to present a particular image or perspective. The literature review may be limited by the availability of relevant sources. Despite these limitations, the proposed methodology provides a rigorous and systematic approach to exploring the potential impact of ChatGPT on academic research and the possible future outcomes of AI-based academic research. By combining a thorough literature review and horizon scanning with qualitative interviews, the study aims to provide insights into the possible benefits and challenges of using ChatGPT in academic research. However, it is clear that the current knowledge on possible future developments and effects of ChatGPT in academic life are rather limited, therefore future scenario building is solely possible considering the current literature knowledge and the personal opinions of experts in the field.

1.3. LITERATURE REVIEW

More than 70 years ago a very intriguing question was asked by Alan Turing: “Can Machines Think?” (Turing, 1950). It maybe sounded simple but there was no answer to the question until Turing proposed a test and a solution to this concern as well. He designed a test to determine whether a machine can exhibit intelligence comparable to, or indistinguishable from, human intelligence. This was a basis of a philosophy of artificial intelligence and later in 1955 McKartney tried to answer this question and the term “Artificial Intelligence” was used for the very first time (McCarthy et al., 1955). Before McCarthy the terminology was always referred to “robot” and it was articulated even earlier from 1921 science fiction play “Rossum’s Universal Robots” by Karel Čapek. All those possibilities of robots were once considered fiction, but we are on the verge of knowing whether machines can think (Tlili et al., 2023).

Advantages and limitations of ChatGPT discovered by previous studies

The advantages of ChatGPT in education have been documented in several studies, blog posts, media reports, and a conducted interview with an expert, member of an AI developer team. In a way, we applied certain elements of “Horizon Scanning” techniques, namely interview and literature research. Nevertheless, for precise horizon scanning even more data would be ideal e.g., conducting more interviews. Since the novelty of the topic, special attention was paid to related “weak signals”, just to recognise less probable future alternatives. However, the innovativeness of the topic makes it hard to find scientific literature due to a lack of research. In the following chapter articles and website sources will be discussed and insights will be presented. Interestingly, ChatGPT related studies were conducted using ChatGPT itself to examine its capabilities, and user journey and to test if it can be used in an academic field.

Should AI and ChatGPT be used in the academic field, especially by students? This is a question which Xiaoming Zhai (2022) tried to answer by giving questions to ChatGPT. The researcher concluded that there are a number of ways in which ChatGPT can drive innovation and improvement in education. AI can transform the way we think about education and how it is delivered by providing students with personalized and engaging learning experiences, improving teaching efficiency, and supporting research and development. In order to ensure that AI is used ethically and effectively in the education system, it is important to carefully consider the ethical, technological, and other challenges associated with its use. To address these challenges, appropriate measures need to be taken (Zhai, 2022).

An analysis of 10,732 tweets from early ChatGPT users was conducted using a mixed method approach. Topic modelling was used first to identify the main topics, followed by qualitative sentiment analysis. A majority of early adopters expressed overwhelmingly positive sentiments about topics such as disruptions to software development, entertainment, and exercising creativity. It appears that a relatively small number of users were concerned about issues such as the potential misuse of ChatGPT, especially in relation to topics such as the impact on education. Therefore, it is unclear whether ChatGPT will resolve the concerns encountered with previous chatbots or if they will even deepen them. The consequences of this are serious and rapid defensive reactions to potential opportunities, such as the banning of ChatGPT by New York City and Los Angeles Unified schools due to the risk of cheating in assignments (Haque et al., 2022), or a recent, temporary banning in Italy in March 2023.

A study conducted by Teo Susnjak (2022) found that the emergence of technologies like ChatGPT threatens the integrity of online exams, especially in tertiary education where online testing is on the rise. As a result of these models demonstrating critical thinking and generating highly realistic text with little input, students can cheat on tests. ChatGPT's capacity to facilitate academic misconduct raises concerns about its potential use in online exams. The study found that ChatGPT can exhibit critical thinking skills and generate highly realistic text with minimal input, posing a threat to the integrity of online examinations, especially in tertiary education settings where such examinations are becoming increasingly popular. It may be possible to address this issue by returning to invigilated and oral exams, while advanced proctoring techniques and AI-text output detectors may be effective in addressing this issue, they are unlikely to be foolproof solutions (Susnjak, 2022).

Some of the articles even provided guidelines about how to use ChatGPT in the classroom. There are also suggested prompts and assignments that teachers can integrate into their teaching in the paper, which provides background information and techniques for how to overcome these barriers. (Lieberman, 2023; Mollick & Mollick, 2022). Preliminary investigation was conducted by Lund and Wang (2023) in order to check the ability of ChatGPT to provide an output to the questions. They conducted an interview with ChatGPT regarding how AI and ChatGPT will affect academia and libraries. The results of this research are summarised below in the table based on the outputs which were given in the paper sourced from ChatGPT:

3. Table Chatting about ChatGPT: how may AI and GPT impact academia and libraries?

Text generation	A research paper, grant proposal, or other written document can be easily generated with ChatGPT by selecting a style or tone.
Question answering	Using ChatGPT, scholars can quickly and efficiently find answers to domain-specific questions
Automated summarization:	Researchers can stay up to date with the latest developments in their fields by using ChatGPT to automatically summarise scientific papers, reports, or other documents.
Data analysis	ChatGPT can collect and provide insights about online available large data, thus, identify patterns.
Language translation	Researchers can use ChatGPT for scientific papers published in various languages.
Literature review assistance:	This is a powerful tool to assist researchers find answers efficiently and quickly. And not only find but get very fine-tuned answers to domain specific questions.

Source: Lund & Wang, 2023

Although a number of articles and papers are available regarding using ChatGPT in the educational field, not many researchers address the PhD education level. The main concern which still remains unanswered in the given sources is if using ChatGPT in academic life is safe or not? The Guardian (2023) announced that due to the increasing concerns about using ChatGPT for cheating in school homework and assignments, New York City decided to ban it in its schools. Related to this, there was an investigation of ten educational scenarios by Tlili et al (2023) to uncover various student experiences, including cheating, honesty, truthfulness, privacy misrepresentations, and manipulation. Results showed that students not only use ChatGPT to cheat but also to manipulate the system and get away with it.

Recent news on ChatGPT

Since its public debut last November ChatGPT – and generally artificial intelligence (AI) based applications – got more and more into the spotlight, and initiated more and more debate on potential future of AI based applications.

Without aiming to be complete, here are some of the most relevant events related to ChatGPT in chronological order in the world and in Hungary.

In March 2023, the non-profit organization “Future of Life Institute” issued a public letter on its website, signed by such academics, opinion leaders and famous entrepreneurs like - among others - Yuval Harari, Elon Musk and Steve Wozniak in which they have warned the world that artificial intelligence (AI) systems “pose profound risk to society and humanity” and they called for companies to put brakes on further development of the technology at least for six months. The letter was specifically addressed to AI labs (the developer of ChatGPT). It claims AI labs are “locked in an out-of-control race to develop and deploy ever more powerful digital minds that no one – not even their creators – can understand, predict, or reliably control”

(<https://futureoflife.org/open-letter/pause-giant-ai-experiments/>).

In the very same month (March 2023), the National Authority of Data Security of Italy temporarily switched off ChatGPT since – according to their legal experts – OpenAI (the developer) did not acquire proper legal ground to collect as much information as it did about end users, furthermore, it is without any legal ground to use the collected information to train AI. As the Authority declared, OpenAI does not properly inform users for what purpose the collected information is used and beside that ChatGPT often misuses the collected data in its answers (OpenAI admitted it), which is totally against EU’s GDPR rules. It is of concern as well, that although the use of ChatGPT advised only above the age of thirteen, there is no built-in filter to avoid its use for younger users. According to “Politico” the measure is provisional, it lasts until the investigation finished, the Authority gave 20 days to OpenAI to submit their reply.

Earlier this year, the Scientific Office of ELTE (Eötvös Lóránd University of Science) organized a conference on the dilemmas and opportunities in connection with the development of AI. The conference concluded that the development of AI based technologies are unstoppable, therefore the application of such technologies in academic life is as well, although there are many open ethical and legal points yet. One of their recommendations is that in case such application is used in a scientific paper it should be mentioned and the author should bear full responsibility for the content created by the application.

The above examples clearly demonstrate that there are many concerns, dilemmas, open ethical, legal, and compliance issues that are yet open and unsolved when it comes to the use of AI aided applications, such as ChatGPT, in many areas of daily life, but especially when it comes to academic life. These are mainly about gathering information and its use for training AI, legal responsibility for the generated content, limitations for use and users and compliance with existing regulatory and legal frameworks.

1.4. QUALITATIVE RESEARCH AND FINDINGS

The aim of the qualitative chapter is to further help facilitate the possible futures building of ChatGPT in the academic field. As previously mentioned, the qualitative section is based on content and thematical analysis of already performed interviews of Lex Fridman with five esteemed experts in the field, claiming to be representing significantly different views of the current and possible future states of ChatGPT and its concerns. The transcript of the interviews was analysed with the utilization of qualitative data analytic software NVivo. The aim of the interview analysis is to synthesize and display the most frequently reoccurring topics and concerns communicated during these discussions further aiming to facilitate baseline and possible future scenario building also backed up by expert opinions and statements.

The following paragraphs provide a brief synthesis of the most important topics discussed during the five analysed interviews, highlighting possible advantages and concerns regarding the development of ChatGPT, later greatly assisting the overall understanding of the field and future scenario development. To grasp the potential impacts of ChatGPT on future academic research, the paper delves into the insights gained from the interviews with AI experts.

In the first analysed interview, Stephen Wolfram highlights the possible integration of ChatGPT with Wolfram Alpha and Wolfram Language, which is a testament to the evolution of AI capabilities. Wolfram’s arguments underscore the importance of computational intelligence in formulating knowledge-based responses, shedding light on the potential application of ChatGPT in academic research. Wolfram agrees that ChatGPT could be harnessed to generate new hypotheses, analyse data, or even write parts of academic papers, given its understanding of vast fields of knowledge. However, as Wolfram cautions, the

collaboration of human intellect and AI is crucial to ensure the correct interpretation and application of generated information.

Manolis Kellis, during his interview, highlights the implications of super intelligent AI on human civilization. His thoughts on AI's evolution and its potential role in shaping society could extend to its impact on academia. AI, particularly models like ChatGPT, could transform the way academic research is conducted, analysed, and disseminated. However, Kellis's reflection on the need for ethical considerations, including the fair and equitable distribution of AI benefits, displays potential concerns in the academic context. Ensuring fair access to AI tools like ChatGPT for researchers around the world would be a significant challenge to address.

In conversation with Max Tegmark, the discourse around halting AI development was brought to the forefront. While Tegmark advocates for the temporary cessation of AI development, it is important to consider the possible repercussions this would have on academic research. ChatGPT and similar tools could revolutionize research methodologies, democratize access to knowledge, and accelerate discoveries. However, the ethical dilemmas, potential misuse, and the risk of creating technology beyond our control that Tegmark warns of cannot be overlooked.

Eliezer Yudkowsky's interview brought attention to the potential dangers of AI and the implications for human civilization. These concerns could directly translate to the academic domain. While ChatGPT could facilitate research, the lack of transparency in its decision-making process and its potential to propagate biases present significant challenges. Balancing the benefits of utilizing AI in research with the need to mitigate these risks will be crucial. The fifth interview with Sam Altman, CEO of OpenAI, touched on the future of AI, including the development of GPT-4 and the role of ChatGPT. The advancements in AI that Altman discusses suggest a future where AI tools could play an even more significant role in academic research. However, Altman's acknowledgment of the need for careful handling of AI development and deployment also applies to the academic context. Ensuring the responsible use of AI tools like ChatGPT in research will be a serious concern.

The potential impact of ChatGPT on academic research is therefore multi-faceted. It holds the promise of transforming research methodologies, accelerating discoveries, and democratizing access to knowledge. However, these benefits need to be balanced against potential risks, including ethical considerations, transparency issues, and fair access. As these interviews highlight, the development and deployment of AI in academia need careful consideration, with the potential for profound implications for the future of academic research. The insights derived from these interviews provide valuable guidance on navigating this exciting yet challenging frontier. The five interviews conducted with experts in the AI research field provide a diverse range of perspectives on the implications of AI, particularly models like ChatGPT. While each conversation brings unique insights, there are shared themes, ideas, and concerns that weave together a multifaceted view of AI's future impact.

A shared perspective among all interviewees is the transformative potential of AI. Stephen Wolfram, for instance, discusses the integration of ChatGPT with Wolfram Language and mathematical software Wolfram Alpha, emphasizing the new horizons this opens for computational intelligence and academic research. Similarly, Sam Altman foresees an integral role for AI in future developments, including academic research. Both envision a future where AI models like ChatGPT could revolutionize research methodologies and increase knowledge access. However, the interviewees also express divergent views, particularly concerning the pace and direction of AI development. Max Tegmark proposes halting AI development temporarily to address ethical and safety concerns, a position not explicitly shared by the other interviewees. On the contrary, Sam Altman CEO of OpenAI discusses the development of GPT-4, indicating a continued progression in AI capabilities with no foreseen fears of difficulties. The interviews highlight a critical consensus revolving around the ethical considerations and

potential risks associated with AI. Manolis Kellis and Max Tegmark stresses the need for equitable distribution of AI benefits, raising concerns about the potential misuse of AI. Similarly, Eliezer Yudkowsky warns of the dangers of AI and the implications for human civilization, reflecting concerns about the transparency of AI decision-making processes and the propagation of biases. These perspectives underline the necessity of balancing the benefits of AI in research with mitigating potential risks.

Despite their diverse backgrounds and areas of expertise, the interviewees all acknowledge the critical role of AI in shaping the future. They foresee a future where AI, including models like ChatGPT, could profoundly impact academic research. However, their views diverge on how to navigate the path ahead, reflecting the complexities inherent in AI development and deployment. By synthesizing these perspectives, a more nuanced understanding is gained of the potential impacts and challenges associated with the use of AI in academic research. The diversity of these views underscores the importance of ongoing dialogue and exploration in this rapidly evolving field.

The advancements of AI, particularly large language models like ChatGPT, highlights a fast-paced era of development in academic research and university life. Insights drawn from the five interviews provide a wider understanding of the advantages and concerns associated with this new technology also on the academic research field. A significant advantage, emphasized by Stephen Wolfram, is the enhancement of computational intelligence. The integration of ChatGPT into further software could potentially enable researchers to access complex datasets and perform intricate computations more efficiently, accelerating the pace of discovery. Furthermore, Sam Altman envisions AI models like ChatGPT democratizing knowledge access, a boon for university life where information access is paramount. Sam Altman further highlights future plans for personalization capabilities which would allow ChatGPT to better understand, and store given personal situations and requests enabling more fitting and useful answers tailored to the users' needs.

Yet, alongside these advantages, there are significant concerns to be highlighted. Max Tegmark's proposition to halt AI development temporarily to address ethical and safety concerns underscores potential risks associated with AI misuse also in academic settings. Misuse could range from data manipulation to unauthorized access of confidential research data. Similarly, the issues of transparency and bias in AI decision-making processes raised by Eliezer Yudkowsky are equally significant in the academic context. Moreover, Manolis Kellis' points on the equitable distribution of AI benefits touches on another vital aspect of university life: inclusivity. As AI technologies become more integrated into academic research and university systems, it is essential to ensure that all students, regardless of their socio-economic background, can access and benefit from these advancements and have an equal environment to work and develop in.

In conclusion to the qualitative chapter, the implications of ChatGPT for future academic research and university life are vast and complex. While offering substantial benefits, such as enhanced computational capabilities and democratized access to knowledge, AI also raises critical ethical and equity concerns that require careful consideration. As the views expressed in these interviews suggest, navigating the path ahead will require a delicate balance between harnessing the potential of AI and mitigating its risks. It is, therefore, undoubtable that accurately forecasting the future of the availability of ChatGPT in academic life is greatly challenging as of now, and the five highlighted interviews also pose great differences in terms of vision, possibilities, and concerns for the upcoming years. The analysed interviews helped to gain a more thorough insight into the possible future outcomes of the development of ChatGPT. Future baselines and alternate scenarios will be determined based on the insights provided by the five interviews.

4. Table Thematic display of most reoccurring topics from the reviewed interviews in decreasing order

Artificial General Intelligence (AGI) and Superintelligence	Frequent discussions about the potential of AGI to surpass human intelligence and the risks and implications that such a scenario could entail, highlighted in all five interviews.
Capabilities and Limitations of Current AI Technologies	This topic was discussed in all interviews, often in the context of the capabilities of large language models like GPT-3.5 and GPT-4, as well as their limitations and the challenges in improving and extending these capabilities.
Ethics and Safety in AI Development	This topic was a prominent part of the interviews with Max Tegmark and Eliezer Yudkowsky, who expressed concerns about the rapid pace of AI development and the need for safeguards and regulations to prevent misuse and unintended harmful consequences.
Future of AI and Human Civilization	This was a common theme in discussions about the potential impacts of AI and AGI on society, the economy, and human life in general. The interviews with Manolis Kellis and Sam Altman particularly focused on this theme.
Integration and Interoperability of AI Systems	The interview with Stephen Wolfram discussed the integration of ChatGPT with the Wolfram Language and Wolfram Alpha, highlighting the potential of combining different AI systems and technologies to create more powerful and versatile tools.
Human-like Behavior and Understanding in AI	This theme emerged in discussions about the ability of AI systems to understand and emulate human behavior, thought processes, and emotions. These concerns were mostly highlighted by Eliezer Yudkowsky and Sam Altman.
AI in Understanding Complex Systems	This theme, notable in the interview with Manolis Kellis, relates to the use of AI in understanding complex systems like the human genome. This has direct implications for academic research in biology, genetics, and related fields, potentially enabling novel discoveries and advancements.
AI Safety and Control	This topic was a key concern in the interviews with Eliezer Yudkowsky and Sam Altman. In academia, this could lead to an increased focus on AI safety research and the development of mechanisms to ensure the controlled deployment of AI systems in various university functions.

Source: own summary and edit

1.4.1. BASELINE FUTURE

The possible future outcomes of ChatGPT are processed by Scenario Planning based on the methodological approach of Peter Schwartz. Scenario planning is a strategic foresight tool that enables researchers to anticipate and prepare for different plausible futures. In this section, the research explores potential scenarios for the future of ChatGPT in academic fields based on the knowledge gathered from the available literature review, horizon scanning and qualitative analysis. The baseline future is determined based on defining a most probable outcome based on the available information. Once again, the mindset behind the creation of the baseline future is an acceptance of a hypothetic linear correlation between the most commonly mentioned and agreed expected outcomes and between the increased probability of that given expectation happening in the future. Overall meaning that more commonly expected and agreed events highlighted by the interviewees are believed to appear with a higher probability in the future, as more experts on the field acknowledge these options with a consensus. Further alternative futures and possible black swan outcomes are highlighted based on outlying opinions from the

reviewed interviews. Moreover, the limitations of this approach must be highlighted as the researched field is very new and the possible capabilities of the future development and impact of ChatGPT is highly difficult to predict accurately. The research acknowledges these limitations and solely builds possible future outcomes on the opinions of trusted and highly esteemed experts in the field.

Baseline Future: ChatGPT as a Common Research Assistant

Envisioning a baseline future for ChatGPT in academic life and research, the paper leverages the insights from the five interviews previously analysed. This base future scenario, is built upon Schwartz's methodology, representing the most likely trajectory based on the common elements and expectations articulated by the experts interviewed.

In this baseline future, ChatGPT becomes an integral part of academic life and research, acting as a central tool in both classrooms and academic research. Based on the common threads drawn from the interviews, it is foreseeable that ChatGPT will be used to automate a significant portion of academic tasks, thus potentially boosting efficiency in academia. This emphasizes the viewpoint of Stephen Wolfram, who discussed the integration of ChatGPT with the Wolfram Language, enhancing the capabilities of both platforms to better serve academic purposes.

One of the most significant impacts will be on literature review and data analysis as ChatGPT, with its capability to read, understand, and generate text based on a wide range of sources, will streamline the literature review process, ensuring that researchers have access to the most recent and relevant publications in their fields. Likewise, ChatGPT's capacity to perform complex data analysis will allow researchers to focus more on formulating hypotheses and interpreting results, while the AI model takes care of the computational work. Additionally, ChatGPT will likely revolutionize classroom teaching and learning. Lecturers can utilize the model to create personalized learning materials and assignments, which cater to the individual needs of each student. Students, on the other hand, can use ChatGPT as a virtual tutor to supplement their classroom learning, providing them with instant feedback and explanations on difficult concepts. AI education platforms like ChatGPT can give students opportunities to learn at their own pace, without the constraints of traditional classroom settings.

However, the integration of ChatGPT into academic life and research will not be without challenges. As touched upon by Max Tegmark and Eliezer Yudkowsky, the potential for misuse of AI technologies like ChatGPT is a concern that must be addressed. In the academic setting, this might manifest in the form of plagiarism or the manipulation of research data. Therefore, rigorous ethical guidelines and monitoring systems will need to be established to ensure that the use of ChatGPT aligns with the principles of academic integrity.

Despite these concerns, the general consensus among the experts interviewed was mostly optimistic about the future of ChatGPT in academia. With the necessary safeguards in place, the baseline future envisions ChatGPT as a powerful tool that enhances the academic experience for both educators and learners and accelerates the pace of research across disciplines.

1.4.2. ALTERNATIVE FUTURES

In constructing alternative futures for possible effects of ChatGPT in academia, the paper considers less frequent topics and concerns raised in the five expert interviews where common agreement was not reached between the involved parties. These alternatives present both positive and negative scenarios, diverging from the baseline future towards more extreme expectations and venturing into more speculative possibilities.

Positive alternative future - the autonomous researcher

In this future, ChatGPT transcends its role as a tool and evolves into an autonomous researcher. It develops the capability to not only analyse data but also formulate hypotheses, design experiments, and make novel contributions to academic knowledge. This possible future is mentioned by the sentiments of Max Tegmark, who envisions a future where AI can actively contribute to scientific discoveries, not only answering questions and executing tasks, but also recommending future steps and taking the initiative to execute tasks without exact prompts. The “Autonomous researcher” future would revolutionize academia, making scientific research faster, cheaper, and more accessible. It could potentially lead to an exponential increase in the pace of scientific breakthroughs, as ChatGPT could work around the clock without the physical and cognitive limitations that human researchers face. In this alternate future, possible concerns and negative aspects of ChatGPT are not taken into consideration and therefore this scenario differs greatly from the defined baseline future in a more positive direction.

Positive alternative future - the democratization of academic knowledge

In this scenario, ChatGPT becomes an easy to access and standard tool for learning and research, accessible to anyone with an internet connection. It levels the playing field, enabling students and researchers from less privileged backgrounds or from developing countries to access the same quality of academic support as their counterparts in affluent societies. This could lead to an explosion of new ideas and discoveries, driven by a much broader and more diverse group of individuals than ever before. This scenario would be more positive than the baseline future as it addresses the existing inequities in access to educational resources and opportunities.

Positive alternative future - the global learning revolution

A highly positive, though less likely, scenario built based on the analysed interviews would be a global learning revolution sparked by AI tools like ChatGPT. In this case, AI drastically changes the way we learn and acquire knowledge. ChatGPT becomes capable of creating personalized learning paths for each individual, adapting to their pace, and delivering content in the most effective manner for their learning style. This could lead to a dramatic increase in global literacy rates and educational attainment, as well as a massive decrease in the educational achievement gap. This future is far more positive than the baseline future due to the revolutionary potential of personalized learning on a global scale.

Positive alternative future - the singularity in academia

The Singularity, a concept popularized by Ray Kurzweil, represents a future point where technological growth becomes uncontrollable and irreversible, leading to significant changes to human civilization. In the context of academia, this could occur if ChatGPT or a similar AI model achieves superintelligence, and then uses this intelligence to exponentially accelerate scientific discovery and learning. It could lead to unprecedented advancements in all academic fields and a transformation of our understanding of the universe. This extreme future, while unlikely, is not entirely outside the realm of possibility, given the rapid pace of AI development. In this case, the expectation of Ray Kurzweil is that a super intelligent AI will facilitate research and bring positive development to humanity.

Negative alternative future - the academic monopoly

In this scenario, the widespread use of ChatGPT leads to a monopolization of academic research. Universities and research institutions that can afford the resources and licenses to utilize advanced AI have a significant advantage over those that cannot. This leads to a

substantial divide in the academic world, with resource-rich institutions dominating research outputs. This potential disparity is raised by Eliezer Yudkowsky and Max Tegmart, who are undoubtedly viewing the open development of ChatGPT as a greatly concerning factor and are stepping towards more negative futures within their presented opinions on the matter.

Negative alternative future - the replacement of educators

A further negative scenario to highlight, based on knowledge gathered from the explored interviews, would see ChatGPT and similar AI tools replace human educators in significant ways. As AI becomes more sophisticated, universities and schools might rely on it for teaching, thereby reducing the need for human educators. This could lead to job losses in the academic sector and a loss of the personal touch in education, which could negatively affect students' learning experiences. This scenario would be more negative than the baseline future as it would entail significant social costs and potentially lead to a dehumanization of the educational processes.

Negative black swan event - the academic integrity crisis

In this extremely negative scenario, the widespread use of ChatGPT in academia leads to a global crisis of academic integrity. The AI model's text generation capabilities are used on mass to produce research papers, leading to a flood of low-quality, replicated, or even falsified studies. This, coupled with the inability of peer-review systems to cope with the deluge, results in a breakdown of trust in academic publications. The scenario is a reflection of the misuse potential mentioned by also Sam Altman ChatGPT CEO, highlighting that it is very important to consider what ChatGPT will be used for in the future and human evaluation of the received results must always stay apparent in the coming years as well.

Negative black swan event - the end of critical thinking

An extreme negative scenario could see the over-reliance on AI tools like ChatGPT hinder critical thinking and intellectual curiosity. As students become accustomed to being fed information and answers by AI, they might lose the ability or the motivation to question, analyse, and think for themselves. This could lead to a generation of learners who are passive consumers of information, rather than active seekers of knowledge. This future would be more negative than the baseline future as it would undermine the fundamental goals of education and intellectual growth.

Negative black swan event – the end of the human race

A final radical black swan event must be highlighted only considered by Eliezer Yudkowsky from the reviewed five interviews. Eliezer takes a greatly pessimistic position in regard to the future development of ChatGPT. He claims that the exponential development of AI tools will become impossible for the human mind to follow and control. If ChatGPT will be able to take initiative, Eliezer also considers the possibilities of the end of the human race, as humans will not have the tools and knowledge necessary to stop the ever-developing intelligence which is already publicly being trained on the world wide web, with internet access and without any known and transparent limitations.

Each of these futures presents a different set of benefits and challenges. As we navigate towards the future of AI in academia, it is crucial to take these possibilities into account, aiming to maximize the benefits and mitigate the challenges. The future is never a clear extension of the past. In regards to AI development, an exponential curve is predicted, which means that future improvements in the area might be possible on such a large scale which is today hardly predictable and currently mostly unimaginable.

1.5. DISCUSSION

The rise of artificial intelligence in various sectors has been a subject of much interest and debate. One of the most sophisticated manifestations of AI, OpenAI's ChatGPT, has been increasingly recognized for its potential in academic research and learning. The current state of ChatGPT in academia is already considered to be a powerful tool that can assist in several aspects of research, including literature review, concept explanation, hypothesis generation, and possibly even drafting academic papers. Despite its utility, it is critical to note that as of now, ChatGPT operates best as an assistant rather than a standalone researcher or teacher.

In an effort to understand the potential impact and trajectory of ChatGPT in academia, we conducted a literature review, horizon scanning and thematic analysis of interviews with five experts in the field: Stephen Wolfram, Manolis Kellis, Max Tegmark, Eliezer Yudkowsky, and Sam Altman. The interviews revealed a consensus on the utility of ChatGPT in academic research, with the tool being tailored for its ability to facilitate information discovery, accelerate research, and democratize knowledge. However, experts also expressed concerns about the tool's limitations, such as the risk of misinformation, lack of critical thinking, and the potential for overreliance. The authors' analysis further allowed us to build a baseline future scenario, in which ChatGPT continues to develop as a valuable tool for academic research but does not fundamentally alter the landscape of academia. Instead, it enhances the productivity of researchers and improves accessibility to academic knowledge, while still being supplemented by traditional research methods and human expertise. Beyond this baseline future, possible alternative futures were determined in both positive and negative directions based on the knowledge gathered from the analysed interviews. On the positive side, the democratization of academic knowledge and a global learning revolution stand as highly desirable outcomes can be highlighted. While negative scenarios such as the replacement of educators and the end of critical thinking also underscore the potential risks associated with the integration of AI into academia.

In response to the research question: How will ChatGPT and publicly accessible, AI-based software impact PhD students' scientific research in the near future? Based on the authors' analysis, it is anticipated that ChatGPT will serve as a powerful assistant to academic research, aiding in information discovery, hypothesis generation, and knowledge democratization. However, its impact is likely to be modulated by its limitations and the concerns around misinformation and overreliance. The interviewees highlighted both positive and negative expected factors for the future to be taken into consideration and to be addressed with great care to reach a more optimal and fitting outcome.

In conclusion, while ChatGPT and AI tools like it hold immense potential for academia, their integration must be carefully managed to maximize their benefits while their potential drawbacks must be taken very seriously and successfully mitigated. As we journey towards a future where AI plays an increasingly significant role in academia, it is crucial to engage in ongoing discussions about the ethical, practical, and pedagogical implications of these tools.

CONCLUSION

The performed literature review, horizon scanning, and content analysis summarizes that ChatGPT is an impressive language model that has the potential to revolutionize the way we interact with machines, making them more human-like in their responses. With its ability to generate coherent and contextually relevant responses, it has already made great strides in the academic field, with researchers using it for a wide range of applications from academic writing to language translation. The capabilities of ChatGPT are vast, and its potential for future development is extremely promising. As technology advances, it is reasonable to expect that

ChatGPT will continue to improve, with even greater levels of sophistication in generating responses, including a greater understanding of nuance and context. In terms of key aspects of the literature review and interviews, it is clear that ChatGPT has the potential to greatly assist researchers in their work, allowing them to generate high-quality research at a much faster pace than before. However, there are also concerns surrounding its use, including issues around ethical considerations, data privacy, and the potential for the technology to replace human workers.

Looking ahead, the future of ChatGPT in the academic field looks extremely promising. Researchers can expect to use ChatGPT to generate high-quality research at an unprecedented pace, potentially transforming the way we conduct academic research. However, it is essential that researchers and developers consider the ethical implications of this technology and take steps to ensure that its use is transparent and validateable. In conclusion, ChatGPT is an impressive language model that has already made significant strides in the academic field, and its potential for future development is vast. As this technology continues to evolve, we can expect to see it used in new and innovative ways, revolutionising the way we interact with machines and potentially transforming the academic research landscape. However, it is essential that researchers and developers consider the ethical implications of this technology and take steps to ensure that its use is responsible, transparent, and in line with best practices.

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