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The use of Generative AI in qualitative analysis: Inductive thematic analysis with ChatGPT

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Abstract

This article describes a methodological innovation in the analysis of qualitative data using Generative AI (GenAI) tools alongside traditional research methodologies to conduct inductive thematic analysis. The case study employs an integrative method that comprises two researchers conducting simultaneous analysis: one using manual and traditional research approaches to coding, analysis, and interpretation, and the other conducting the same analysis but with the support and assistance of GenAI tools, namely, the premium version of ChatGPT (GPT-4).

The key strengths of this approach include the enhanced capacity for data processing and theme identification offered by GenAI, along with the nuanced understanding and interpretative depth provided by human analysis. This synergy allows for a richer and more complex understanding of the themes present in the data. The challenges encountered include managing the inconsistencies and hallucinations of GenAI outputs and the necessity for rigorous validation processes to maintain research validity. The findings indicate a complementary relationship between GenAI and human researchers, where the use of such tools can expedite the analytical process without diminishing the essential role of the researcher's expertise and critical engagement.

Keywords: AI research methods; ChatGPT; Generative AI; inductive thematic analysis; qualitative analysis; research methodologies.

Introduction

The development of Generative Artificial Intelligence (GenAI) has had a major impact on a range of sectors, with the potential for significant reshaping of numerous sectors, from medical diagnostics (Caruccio et al., 2024) to financial services (Dwivedi et al., 2023). Academia currently finds itself at a crucial turning point as AI capabilities undergo exponential growth, doubling in intricacy every half-year (Pichai, 2023), with significant implications for how teaching and learning may occur in this new landscape with the existence of multiple paradoxes (Lim et al., 2023). In the context of educational research, the advent of foundation models (FMs) such as Gemini and GPT-4 signifies more than technological innovation; it is a transformative moment for academic research methodologies. Attracting a broad spectrum of stakeholders (Bowman, 2023), applications built on top of FMs such as ChatGPT (OpenAI, 2022), promise a potential for enhancing research capabilities. From aiding Non-Native English Speakers (NNES) in articulating complex academic ideas (Roe et al., 2023) to developing new methodologies in personalized learning research (Kasneci et al., 2023) and potentially improving opportunities for student-teacher collaboration and communication (Limna et al., 2023), their potential is vast. However, their very sophistication raises questions about academic authenticity and integrity (Abd-Elaal et al., 2022; Cotton et al., 2023; Köbis & Mossink, 2021; Perkins, 2023).

Furthermore, for academic researchers in education and social sciences, these GenAI tools offer a challenge to overcome. On one hand, they can expedite research processes and provide alternative perspectives through AI-generated content. However, they require a rigorous re-evaluation of methodological standards and research integrity, especially given the problems of discerning between AI-generated- and human-authored content (Anderson et al., 2023; Chaka, 2023; Elali & Rachid, 2023; Hassoulas et al., 2023; Perkins, Roe, et al., 2023; Weber-Wulff et al., 2023). As these tools improve in their capability, and new AI tools emerge and become central to academic research, a similar evolution is occurring at the student level. Students are increasingly using these tools, either to support their learning, or for the unethical completion of required academic assessments as an instrument of potential misconduct, sparking academic integrity concerns in higher education (Sullivan et al., 2023). Consequently, tools have been developed to detect AI-produced writing, but research has shown that these

are neither effective nor ready for deployment (Chaka, 2023). This underscores the need for academia to not only understand and integrate these tools responsibly but also to train students in their ethical and effective use to ensure the responsible propagation of GenAI tools in tomorrow's research landscape. To this end, new methods of integrating AI into education are emerging, such as AI-enabled assessment (Perkins et al., 2023) and encouraging open educational practices (Mills et al., 2023). In this context, it is important to find a balance between taking advantage of the powers of GenAI, and equally ensuring it is used responsibly and ethically, while being aware of both the risks and benefits of GenAI in research (Salah et al., 2023).

Using Foundation Models and ChatGPT for research purposes

As GenAI tools become more integral to the research process, there is a need to prepare the next generation of researchers to use these tools, which goes beyond tool familiarization. Further research is also needed to understand how scholars currently perceive the role of these tools, and empirical studies conducted so far have shown that opinions vary, ranging from 'changing the role of educators' to 'extending the human brain' (Firat, 2023). Institutions must ensure students grasp the ethical, methodological, and practical implications of GenAI integration into research (Foltynek et al., 2023). Such foundational knowledge will be instrumental as students transition to leadership roles in academic research. Such advancements empower researchers, offering tools that streamline everything from preliminary data explorations to intricate statistical model constructions(Baidoo-Anu & Owusu Ansah, 2023). Yet, with power comes responsibility; the nuances of these tools, their underlying biases, and potential pitfalls must be rigorously understood and navigated.

Currently, FMs act as the foundation for a variety of GenAI applications. ChatGPT by OpenAI was one of the first GenAI tools to gain widespread recognition, largely owing to its fluency in language capabilities and intuitive chatbot style instruction. Initially designed for tasks such as text generation and dialogue, the tool's capabilities were expanded to include additional analytical functions with the introduction of Advanced Data Analysis mode (OpenAI, 2023), formerly known as Code Interpreter. This enhanced functionality allows ChatGPT to perform additional tasks beyond simple text-based interactions, such as data analysis, complex problem solving, and code generation. These capabilities make ChatGPT an important tool for academic inquiry across various disciplines (Perkins & Roe, 2024; Salah et al., 2023) because of its capacity to swiftly review extensive datasets, discern patterns, and provide nuanced interpretations complemented by traditional human-centric analytical approaches (Bowman, 2023). Such synergy between machine and researcher can lead to richer insights and more comprehensive interpretations. However, challenges are present. The stochastic nature of these tools can pose hurdles to result replicability, which is a key foundation for research validity and integrity. Additionally, the requirement to create effective prompts requires dual expertise from researchers: command over the subject matter and a nuanced understanding of AI-driven analyses (Roe et al., 2023). Significant ethical implications must also be addressed, as they relate to publication of ChatGPT supported publications (Lundgren et al., 2018; Rahimi & Abadi, 2023; Xames & Shefa, 2023).

Using Foundation Models for qualitative data analysis in educational research

These tools have been demonstrated to streamline processes, from supporting in interviews (Chopra & Haaland, 2023), translating content (Chen, 2023) and manuscript preparation (Xames & Shefa, 2023; Zhai, 2022). Some researchers have highlighted the limitations that GenAI tools have with regard to supporting with the literature review process (Haman & Školník, 2023), but newer versions of these tools are significantly more capable of achieving this task. In the classroom setting, for example, GenAI could support the conversion of spoken feedback sessions into a structured textual form, freeing researchers from transcription burdens or supporting the classification and categorization of responses from students.

In this article, we report on the use of ChatGPT as a key methodological innovation when analyzing leading academic and educational publishing house policies regarding the use of ChatGPT in authoring research (Perkins & Roe, 2024). The aim of this article is to highlight a specific use case in which ChatGPT and other GenAI tools can help offer greater depth in the analysis of textual data, leading to deeper insights and interpretations. This exploration offers readers an understanding of the methodological nuances, the synthesis of AI-generated outputs with human interpretations, and the challenges and advantages of embedding GenAI tools in qualitative research. Simultaneously, we offer a roadmap for others who wish to conduct educational research using an integrative approach that balances manual analysis with Gen-AI-assisted analysis and explores the ramifications of using GenAI for qualitative data analysis in the field of education, given the current limitations of these tools.

Through a case study approach, we share our firsthand experiences with GenAI tools, notably ChatGPT, in the context of inductive thematic analysis.

We focus specifically on two questions:

1. How can GenAI tools be used to support qualitative data analysis in educational research?

2. Given the unpredictable nature of GenAI outputs, what implications have emerged for consistent and replicable research if we integrate GenAI tools into methodologies?

Case study: Inductive thematic analysis with ChatGPT

To explore the possibilities of GenAI in supporting qualitative research, we designed a method that integrates traditional inductive thematic analysis with the advanced data processing capabilities of GenAI tools. This choice

was a conscious strategy to obtain a deeper analysis than might otherwise be obtained by a single method alone. We were interested in exploring the differences between the approaches taken in a manual and GenAI-supported methodology while simultaneously cross-checking the validity of each approach.

The methodology employed in this study involved conducting a comprehensive web search to collect and classify policies related to the use of AI tools in academic research from various publishers' websites, which were then combined to form a master list. This was edited to remove any known or suspected instances of publishers of predatory journals and then supplemented with web searches including terms such as 'AI/ChatGPT journal/publisher policies' to identify specific journals, publishers, or publishing-related groups/ institutions that had policies related to the use of GenAI tools. This resulted in a master list of 107 entities for review. We then conducted manual searches on the websites of all entities to explore whether a policy was in place relating to the use of Generative AI tools. From this manual search, we identified 36 entities that had an AI policy, eight of which were replicas. Replicas were due to either the use of wording from other entities, such as The Committee of Publication Ethics (COPE), or because the publishing houses were imprints of broader publishing groups and therefore did not have their own policy. This resulted in a final list of 28 unique policies for analysis.

The mode of analysis chosen was inductive thematic analysis (TA) based on the guidelines presented by Braun and Clarke (2006). This particular approach to thematic analysis has become a mainstay in educational research when working with qualitative data, owing to its simplicity, flexibility, and propensity for generating deep insights into different types of data. Furthermore, TA is not theoretically bounded, as is the case with other types of qualitative research frameworks, such as grounded theory.

The methodological innovation that we pioneered in this research project was combining both GenAI and traditional manual analysis of qualitative data using an inductive thematic analysis framework at the semantic level. Epistemologically, this research method was employed from a realist perspective (Braun & Clarke, 2006). As the data collected is related to academic policies, and we wished to explore the nature and framing of the policies, in this case the data was more explicit and 'to the point' than may be found in other domains, for example, in long-form interview data. Consequently, this approach may be applicable only to certain datasets. Given the limitations of current FMs, latent TA may not be suitable for use at the present time with a Gen-AI tool if the researcher expects to analyze more complex forms of meaning expression, such as sarcasm or humor.

To develop this research method, we first decided that both researchers should maintain a separate dataset and not communicate with one another regarding findings until the individual analyses were complete, thereby increasing the objectivity of the results. We followed a step-by-step process for TA, as shown in Table 1.

Table 1: Comparison of traditional versus ChatGPT supported analysis.

Step	Traditional analysis	ChatGPT-assisted analysis
Data familiarization	Collection of data and re-reading of data, noting down initial ideas in word processing software.	
Generating initial codes	Systematic coding of data using traditional software (MaxQDA).	Structuring data into a tabular form, suitable for importing into the GenAI tool.
Searching for themes	Researcher collates codes into prospective themes.	Writing and re-writing prompts to instruct the GenAI tool what is required from the output.
Reviewing themes	Inspecting the themes and reviewing their relation to the codes and dataset.	Inspecting the themes given by the GenAI tools and cross-referencing themes with specific examples from the data for validation purposes.
Defining and naming themes	Continuing analysis and specification of each theme.	Re-running the analysis at different points in time to enhance validity of themes
Combining and Contrasting results	Results are compared by both researchers side by side and areas of congruence are identified in the themes and dataset, final set of themes are produced.	
Producing the report	Creating the scholarly output of the paper.	

Strengths and weaknesses of the research method

Overall, the method helped to generate two different sets of insight into this data and was productive in answering our research question. We identify several specific strengths associated with this method, namely increased objectivity, efficiency, and additional cognitive support for the researcher. However, the weaknesses of the method include its viability for more complex datasets and the additional time invested in developing necessary GenAI-related skills to produce the desired output.

One of the most interesting aspects of our study is the experience of combining AI-derived insights with manual analysis. Each method brought its strengths to the table. GenAI tools, with their rapid processing capabilities, can sift through vast amounts of data and provide initial themes much more quickly than a traditional analysis, along with a higher number of themes, demonstrating the ability to extract a higher level of granularity from the themes. However, the depth, context, and the subtle nuances were better captured through manual scrutiny. The final synthesis of themes required collaboration, debate, and a deep understanding of both methods. Matching the GenAI themes with those identified in the traditional analysis became a challenging yet revealing process, demonstrating the unique lenses through which humans and AI perceive data.

Engaging with ChatGPT as a research tool, however, has brought its own set of challenges. At times, the tool tended to produce 'hallucinations', generating quotes or data that did not exist in the original dataset. Such anomalies necessitated continuous cross-referencing with our primary data to ensure the integrity of our findings. Furthermore, creating the right prompts for ChatGPT to produce the required output was an iterative and often frustrating process. We realized that obtaining the desired responses from the tool required fine-tuning of our queries. This experience underscored an important facet of using GenAI tools: while they can automate certain processes and offer unique insights, they cannot eliminate the need for human involvement. An additional concern here is one of replicability – GenAI tools are stochastic in nature, and it is unlikely that repeating the prompts used in our analysis

would result in obtaining the same outputs from the tools. The frequent and unclear updates to the underlying GPT4 model further complicate this.

Upon completion of the individual analyses, synthesizing the results was the next challenge. When we compared the insights from the traditional approach with those from the AI-assisted method, we found both overlaps and unique perspectives in the analyses that required significant debate between the researchers regarding which themes were more or less valid for the dataset. This phase involved extensive discussion and collaboration to identify the final set of themes (cf. Perkins & Roe, 2024), and to ensure they were both comprehensive and grounded in the data. It became evident that while the GenAI tool used had strong capabilities in identifying themes for further exploration, a deep understanding of the intricacies and potential pitfalls of using this software was essential to obtain the best possible results and avoid AI hallucinations. This analysis also underscores the importance of human touch in research. While GenAI tools can facilitate, assist, and expedite processes, they cannot replace the unique human ability to interpret, contextualize, and provide depth to findings. Our experience mirrored a broader academic sentiment: GenAI tools are transformative, but they serve best as co-pilots, enhancing and complementing human capabilities rather than replacing them.

Limitations and future research areas

The advent and integration of GenAI tools in academic research have the potential to bring about a transformation in research methodologies and data analysis. However, the potential of these tools is not without challenges. The stochastic nature of GenAI tools, which can lead to varied outputs even with the same inputs, presents a major challenge for research replicability. Moreover, the rapid pace of technological evolution and updates to these tools may risk making certain methodologies or analyses obsolete. This was seen throughout the course of the research being discussed, in which the specialist ChatGPT mode of Code Interpreter/Advanced Data Analysis was folded into the overall ChatGPT Plus package. These rapid changes can complicate longitudinal studies or any attempts to compare new results with past data. Additionally, while these tools promise efficiency and depth, there is a growing concern about over-reliance on AI by both researchers and students, which might eclipse the essential human insight in the research process.

In terms of future research directions, there's a pressing need for comparative studies. Such studies should aim to discern the efficacy of GenAI tools against traditional research methods in various academic fields. By understanding how the benefits of these tools can enhance the research process, the academic community can harness their strengths more effectively while simultaneously limiting the potential negative impacts of their challenges and weaknesses. Furthermore, as the role of GenAI in research becomes more pronounced, a deeper consideration of the ethical considerations surrounding these tools cannot be avoided. Issues related to data privacy, potential AI-generated biases, and the broader societal implications of AI-driven research warrant further exploration and debate. Given the delays demonstrated in integrating the considerations of GenAI into academic integrity policies (Perkins & Roe, 2023), it is important that clear policies and guidelines on how to effectively and ethically integrate GenAI tools into research activities are provided to both faculty and student researchers.

Although the current research focuses on qualitative analysis, a further area for investigation is how GenAI tools can be integrated into quantitative research methodologies. With their ability to simplify complex data tasks, GenAI tools, especially in multimodal form, can produce visual analytics to support pattern identification. Pairing GenAI with Python libraries that enable more advanced quantitative analysis techniques also democratizes the research process, helping researchers without extensive technical backgrounds to engage in advanced analyses. For instance, tasks such as regression analysis, previously reserved for those with specific expertise, can now be approached through simple language prompts to GenAI tools.

Conclusion

The integration of GenAI tools into the academic realm signifies more than just technological advancement; it embodies a true paradigm shift in how research is conceptualized and executed. These tools can act as co-pilots: augmenting the capabilities of human researchers rather than seeking to replace them. With the assistance of GenAI tools, researchers can explore large volumes of data using natural language prompts, and without specialized software, therefore democratizing the research process and deriving insights that might have remained obscured in traditional methodologies. Although GenAI tools can support academic research, they do not yet have the ability to replace it. The same can be said for educational processes. Research has shown that in tasks such as generating educationally aligned assessment items, the technology fails to match human performance (Khademi, 2023); therefore, a high degree of criticality needs to be applied when planning to use these tools in unchartered territory. While they bring new benefits to research processes, it is the human researcher's intuition, expertise, and interpretative skills that breathe life into data, transforming it into meaningful knowledge. As we move forward, we should consider this a form of symbiosis, with GenAI tools and human researchers collaborating to amplify the other's strengths, thereby pushing forward what would otherwise be possible in academic research.

In summary, our case study provides a microcosm of the larger challenges inherent in integrating GenAI tools into academic research. The challenges we face, from AI hallucinations to theme synthesis, are key identifiers that, as yet these tools are not ready to stand by themselves in research workflows. However, the possible benefits, from rapid data processing to diverse insights, demonstrate their potential as helpful co-pilots for enhancing the effectiveness and efficiency of research results. The key lies in understanding, adapting, and striking the right balance between human expertise and AI capabilities.

AI usage disclaimer

This study used Generative AI tools to analyze data, create preliminary themes, produce draft text, and revise wording throughout the production of the manuscript and accompanying research note. Multiple modes of ChatGPT over different time periods were used, with all modes using the underlying GPT-4 Large Language Model. The authors reviewed, edited, and take responsibility for all outputs of the tools used in this study.

Data availability statement

The underlying data that is referred to in this research note has been published and is publicly available on Figshare at the following link https://doi.org/10.6084/m9.figshare.24124860.v1.

This project contains the following underlying data:

- Gen AI policies Academic Publisher .xlsx. (All data related to AI policies including full policies as downloaded and URLs).

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