The Qualitative Report

Volume 29 | Number 2 How To Article 13

2-9-2024

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Recommended APA Citation

Christou, P. A. (2024). Thematic Analysis through Artificial Intelligence (AI). *The Qualitative Report*, *29*(2), 560-576. https://doi.org/10.46743/2160-3715/2024.7046

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Abstract

Thematic analysis, a well-enforced qualitative analytic method, is likely to continue evolving with the adoption of AI technologies. This how-to report does not delve into the details of thematic analysis itself, as there are ample existing studies on the topic. Instead, it acknowledges the potential impacts, dynamics, and pitfalls of AI in thematic analysis while offering valuable advice, particularly for novice analysts, on how to incorporate and document AI tools in each phase of a thematic analysis. The author underscores the importance of not allowing AI to overshadow the analyst's critical evaluative and interpretive skills but instead supporting the use of AI as an aid in thematic analysis, enhancing the depth and breadth of analysis, provided certain criteria are adhered to. This approach ensures that AI serves as a complementary tool, augmenting rather than replacing human analytical inquiry.

Keywords

thematic analysis, artificial intelligence, AI, qualitative research

The Qualitative Report 2024 Volume 29, Number 2, 560-576
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Thematic Analysis through Artificial Intelligence (AI)

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Thematic analysis, a well-enforced qualitative analytic method, is likely to continue evolving with the adoption of AI technologies. This how-to report does not delve into the details of thematic analysis itself, as there are ample existing studies on the topic. Instead, it acknowledges the potential impacts, dynamics, and pitfalls of AI in thematic analysis while offering valuable advice, particularly for novice analysts, on how to incorporate and document AI tools in each phase of a thematic analysis. The author underscores the importance of not allowing AI to overshadow the analyst's critical evaluative and interpretive skills but instead supporting the use of AI as an aid in thematic analysis, enhancing the depth and breadth of analysis, provided certain criteria are adhered to. This approach ensures that AI serves as a complementary tool, augmenting rather than replacing human analytical inquiry.

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Introduction

Artificial intelligence (AI) is significantly transforming the landscape of research and analysis through the optimization of intricate processes, the handling of large volumes of information and data, the streamlining of processes associated with literature reviews and conceptual papers, and the identification of complex patterns (Dowling & Lucey, 2023; Dwivedi et al., 2023; Haman & Školník, 2023; Rubinger et al., 2023). Even so, the necessity for additional understanding regarding the appropriate integration of AI into the process of thematic analysis, one of the most widely used approaches in qualitative research, is of utmost importance, given the current state of a technological revolution in the field of qualitative research. It remains critical to fully understand how AI tools and human expertise could work together in order to get the most out of automation while still preserving the complex contextual nuances and sensitivity that are inherent in thematic analysis. Further understanding in this field has the potential to enhance the efficiency, validity, and relevance of thematic analysis if conducted via AI tools. Although AI has the potential to greatly impact the transformation of thematic analysis processes, there are still notable gaps and challenges that need to be addressed, such as the constrained capacity of AI tools to comprehend complicated, intricate connotations, deeper meanings, and emotional subtleties within qualitative data. The provision of specific guidelines for analysts on the optimal utilization of AI tools in the process of conducting thematic analysis holds significant value. Such guidelines may function as a crucial intermediary connecting qualitative research methodologies with the swiftly progressing realm of AI. Furthermore, such criteria and guidelines may offer a useful framework for researchers to facilitate the effective utilization of AI by analysts, and to effectively navigate potential biases and interpretational challenges without marginalizing the significant role of the evaluative, interpretive input and expertise of the analyst. Ultimately, this may enhance the progress of thematic analysis in a contemporary era heavily influenced by technological advancements, particularly in the realm of AI.

This how-to report is intended to address the above crucial issue. Although primary research and conceptual studies hold great importance in qualitative inquiry, how-to reports also serve as a valuable and complementary resource that can significantly enhance knowledge for researchers and analysts of all levels. These reports have a diverse range of purposes, providing valuable insights and practical guidance that can be advantageous to researchers and analysts in various ways (Aveling et al., 2015; Chenail, 2011, 2012; de Souza et al., 2016). Primarily, such reports serve as a valuable resource for researchers, given that they engage in an exploration of particular research methodologies, processes, or techniques, displaying their practical implementation while providing a solid theoretical basis. Also, such reports provide practical guidance that is highly valuable, especially for novice researchers (Bowen, 2005; Lee, 2014). They function as navigational tools for those who are in the early stages of their research endeavor, particularly if the topic is new and complex (such as, in this case, the nexus of AI and thematic analysis). This guidance serves to provide analysts with the necessary tools to navigate their research endeavors effectively, enabling them to steer clear of common pitfalls and make well-informed decisions. In addition, by adhering to the guidelines provided, researchers can uphold rigor and consistency in their work (such as their analysis process). In addition to their practical usefulness, such reports make a valuable contribution to the advancement of theoretical knowledge since they frequently serve to reconcile the disparity between theoretical concepts and practical application.

As the author of this paper, I refrain from exclusively engaging in a theoretical discourse regarding the nature of thematic analysis, as it has been extensively elucidated in other studies and writings. The emphasis is shifted towards the integration of thematic analysis and AI as a valuable and pragmatic tool for aiding researchers in the thematic analysis process. As such, this paper proceeds by offering a comprehensive elucidation of the concept of "analysis" while further exploring the importance and development of thematic analysis. The purpose of this is to establish a robust theoretical framework before delving into the examination of how AI can be integrated into the process of thematic analysis. Subsequently, a discourse ensues concerning the intersection of AI and analysis procedures, encompassing an exploration of the intricacies, ramifications, and potential risks associated with the integration of AI within the thematic analysis process. The paper concludes by providing an elucidation of the methodological steps for conducting thematic analysis in conjunction with AI tools. This is accompanied by the delivery of a practical table that outlines the potential applications of AI in each phase of a thematic analysis. Recommendations and criteria that must be adhered to throughout the entirety of the thematic analysis process via AI tools are also offered.

Thematic Analysis: Insights, Significance, and Evolution

"Analysis" as a term can be traced back to its etymological origins in the word *analyo*, which consists of the Greek prefix aná, meaning "up" or "back," and the verb lyo, meaning "to untie" (Douglas, 2023). In contemporary usage, the term retains its core significance, denoting the act of scrutinizing and comprehending an intricate entity by dissecting it into more feasible constituents. Within the realm of qualitative research, analysis can be understood as the methodical and rigorous scrutiny of textual, visual, or audio data with the objective of identifying patterns, themes, and significant insights (Onwuegbuzie et al., 2012). Analysis is a crucial process employed by analysts to derive significance and produce knowledge from a vast amount of information derived from qualitative research methods such as interviews, focus groups, observations, and textual documents.

Data reduction is a fundamental aspect of qualitative research analysis (Namey et al., 2008). The process converts large quantities of unprocessed data into "smaller," more comprehensible units that can be analyzed and understood. The process of reduction entails the

systematic organization and categorization of data, thereby enhancing its accessibility for the purpose of conducting in-depth analysis and examination. Moreover, the process of analysis involves the contextualization of data, wherein the researcher takes into account the wider social, cultural, or environmental factors that exert an influence on the phenomenon under investigation. Furthermore, the process of analysis facilitates the identification and understanding of recurring patterns and themes present in the dataset. Such observed patterns offer significant insights into the phenomena being examined (Braun & Clarke, 2012; Vaismoradi et al., 2013). Even so, the objectives of analysis in qualitative research extend beyond the mere reduction and organization of data. It serves multiple essential functions, including the revelation of complexity, the generation of insights, the provision of context, the support of validity and rigor, and the enrichment of research. In more detail, the process of analysis enables researchers to unveil the intricate nature inherent in qualitative data, which often deals with complicated phenomena such as, for instance, human experiences, perceptions, and behaviors (Hennink et al., 2020). This multifaceted nature of human experiences and behaviors necessitates the use of analysis to uncover the intricate aspects that may not be readily evident (Braun & Clarke, 2014, 2022; Teece & Baker, 2017). By means of rigorous examination, researchers are able to derive profound insights and comprehensions that transcend the superficial aspects of the data. In addition, the process of analysis plays a significant role in enhancing the credibility and robustness of qualitative research (Belotto, 2018). The process is characterized by its systematic and transparent nature, which enhances the reliability and credibility of the findings.

Thematic analysis is a commonly employed qualitative research approach that entails the identification, examination, and documentation of recurring patterns, or "themes." It is a commonly employed method to interpret data derived from a range of sources, such as interviews, focus group discussions, open-ended survey responses, diaries, videos, or other textual or visual materials (Brandau & Rebello, 2021; Ryan-Vig et al., 2019). Researchers may analyze such data to discern "themes" that offer valuable insights pertaining to the research question or objectives. Thematic analysis is a methodical and adaptable strategy that enables researchers to acquire a more profound comprehension of the inherent meanings, experiences, and perspectives that are intricately woven into their data (Lochmiller, 2021). It serves as a fundamental approach for the identification and interpretation of patterns and underlying meanings that are inherent within qualitative data. The versatility of this method renders it appropriate for investigating a diverse array of research inquiries and subjects. It is also utilized in a wide range of disciplines, encompassing psychology, sociology, anthropology, education, healthcare, management, marketing, tourism, and other fields (Berbekova et al., 2021; Braun & Clarke, 2023; Kiger & Varpio, 2020).

In regards to its process, thematic analysis is a methodical procedure that covers various essential phases (or stages), including becoming acquainted with the data, formulating initial codes, seeking out themes, evaluating themes, delineating and defining themes, and generating the final report (for further details and insights, refer to Braun & Clarke, 2006). The approach provides researchers and analysts with the opportunity to customize the methodology according to their unique research context and main objectives. Through the process of identifying and interpreting themes present in the data, researchers are able to effectively capture the intricate and varied nature of differing perplexed phenomena, such as human experiences. Besides, one notable advantage of thematic analysis lies in its capacity to offer a comprehensive and intricate comprehension of participants' experiences and perspectives. The level of understanding demonstrated is particularly advantageous when examining subjective phenomena, including emotions, attitudes, beliefs, and cultural practices (Haeyen et al., 2018; Herbstsomer & Stahl, 2021; Thomassin et al., 2019). Another notable advantage of thematic analysis lies in its inherent flexibility (Terry et al., 2017). The approach may be characterized by its non-

necessary dependence on intricate theoretical frameworks or predetermined theoretical assumptions. Furthermore, thematic analysis is a flexible method that can be applied to a range of data sources, encompassing qualitative and mixed-methods research designs. This renders it a versatile instrument within the qualitative researcher's repertoire. Overall, thematic analysis plays a significant role in producing comprehensive and contextually informed knowledge that can be utilized to advance theory, policy, and practice (Christou, 2022).

In recent times, thematic analysis has undergone various developments to cater to the evolving requirements of qualitative research. More specifically, thematic analysis has extended its scope beyond the confines of conventional social science fields. Currently, it is being utilized in diverse research contexts, including health sciences, education, business, and environmental studies, which demonstrates its versatility. Also, the increasing popularity of thematic analysis has prompted researchers to establish more precise guidelines and frameworks in order to improve its rigor and consistency. Guidelines for a well-documented thematic analysis, from Aronson (1994) to Braun and Clarke (2006) and afterwards Christou (2022), present analysts with a more explicit set of procedures and recommended methodologies for the implementation of thematic analysis, whether inductive or abductive in nature (Herrick et al., 2021; Thompson, 2022). Other advancements encompass the integration of technology, interdisciplinary applications, and the incorporation of reflexivity (Braun & Clarke, 2019; Gauthier & Wallace, 2022). Furthermore, thematic analysis is being utilized more frequently in research designs that incorporate mixed-methods, serving as a complementary and valuable approach to quantitative data analysis. Also, in recent years, thematic analysis has been a commonly employed method by researchers for the examination of visual data, encompassing various forms such as images, videos, and other visual artifacts (Bell, 2019; Herrick et al., 2021; Lowe-Calverley & Grieve, 2018; Ryan-Vig et al., 2019).

There has also been an increased prevalence of the utilization of qualitative data analysis software, which has proven to be beneficial for researchers in effectively managing and organizing extensive datasets (Castleberry & Nolen, 2018; Firmin et al., 2017). Such tools enhance the process of coding and categorizing data, thereby increasing the efficiency of the thematic analysis process. In regards to technological advancements, in recent years there has been a notable increase in the incorporation of AI into diverse research tasks. AI has the potential to significantly alter the process used for conducting thematic analysis, representing a notable technological advancement. However, the complete scope of its influence and the corresponding implications remain to be fully comprehended and applied. The convergence of AI and thematic analysis presents a complex and ever-changing connection that necessitates additional exploration while also requiring the establishment of precise guidelines and criteria to effectively leverage its potential, as discussed and presented in the following sections.

Thematic Analysis via AI: Opportunities and Risks

AI has become a significant catalyst for transformation in qualitative research, fundamentally altering researchers' methodologies for data analysis, interpretation, and extraction of valuable insights (Christou, 2023a; Longo, 2019; Tschisgale et al., 2023). AI encompasses a diverse array of technologies and algorithms that are specifically developed to facilitate the emulation of cognitive functions resembling those exhibited by humans (Jiang et al., 2022). The aforementioned functions embrace a range of processes, such as the acquisition of knowledge, logical thinking, resolution of complex issues, interpretation of sensory stimuli, comprehension of linguistic input, and selection of courses of action. AI systems undergo training to conduct data analysis, pattern recognition, and decision-making, often emulating human cognitive abilities. The transformative potential of AI resides in its capacity to efficiently process extensive datasets, discern intricate relationships within the data, and

automate tasks (Nalbandian, 2022). This capability holds significant relevance within the domain of qualitative research, wherein the comprehension and examination of complicated and subjective phenomena, such as human behaviors and perspectives, assume the utmost importance (Maxwell, 2012; Pérez et al., 2015).

The advent of AI has precipitated a profound and far-reaching impact on numerous fields and contexts, including qualitative research. Traditionally, qualitative research encompassed labor-intensive methodologies for gathering data, transcribing information, coding data, and conducting thematic analysis, all of which have been executed by human researchers (Cypress, 2018). This is still the norm in many cases. Even so, the emergence of AI technologies has fundamentally reshaped the potential and efficiency of qualitative research, providing numerous transformative advantages. These advantages encompass streamlined data processing, automated coding, and data summarization, among others. One of the most evident effects of AI on qualitative research is the expeditious enhancement of data processing. For instance, the utilization of AI-powered Natural Language Processing (NLP) algorithms enables the rapid transcription of audio recordings and the conversion of unstructured data into a format suitable for analysis while overall aiding the qualitative research process (Cheligeer et al., 2022). The increased efficiency provided enables researchers to allocate more attention to the process of interpretation and reduce the time spent on other tasks, such as data preparation for the analysis. Also, AI algorithms have the potential to support researchers during the coding and thematic analysis stages. They possess the capability to autonomously detect and recognize keywords, phrases, or patterns within qualitative data, thereby expediting the initial coding procedure. Although human expertise continues to be essential in any analysis process, including thematic analysis (Christou, 2023a), AI can play a significant role as a useful research and analyst assistant by proposing potential "codes" for researchers to review and improve. Furthermore, text summarization models that utilize AI possess the capability to condense extensive qualitative documents into succinct summaries. This capability holds significant value in terms of efficiently comprehending the primary discoveries and patterns within a dataset, thereby expediting the process of decision-making and possibly proposition development.

Furthermore, AI exhibits capabilities that extend beyond the confines of text-based analysis. It has the capability to handle various forms of data, such as images and audio (D'Alfonso, 2020; Davenport & Kalakota, 2019; Dharmaraj & Vijayanand, 2018; England & Cheng, 2019). This presents numerous opportunities wherein AI can aid in the analysis of visual content as well as the transcription and interpretation process. Furthermore, the utilization of AI-driven tools can enhance the efficiency of researchers in their exploration and navigation of substantial amounts of qualitative data. Academic researchers have the ability to utilize differing systems that are powered by AI in order to uncover concealed insights, correlations, or patterns within their datasets. For instance, students, researchers, and analysts now have the opportunity to engage with language models, such as GPTs (Generative Pre-trained Transformers), in order to investigate hypotheses, pose inquiries, acquire more profound understandings from qualitative data, and write their reports (Huang & Tan, 2023; Qasem, 2023; Rospigliosi, 2023). In more detail, language models play a rather substantial role in qualitative research analysis by providing valuable assistance and introducing novel capabilities that greatly enhance the overall research process. Researchers have the ability to engage in dialogues with these models (Rospigliosi, 2023), allowing them to ask questions and explore data in a dynamic manner. Furthermore, language models demonstrate a high level of proficiency in extracting important keywords or phrases from textual data. The aforementioned capability holds significant value in qualitative research for the purpose of identification and categorization of recurring concepts, and eventually theme identification. More specifically, within the context of thematic analysis, a crucial component entails the coding procedure.

Language models have the capability to aid in the automation of the initial coding process. These models expedite the coding process by proposing possible codes derived from the content, thereby enabling researchers to further refine and modify the codes as necessary.

Overall, the incorporation of AI tools presents significant opportunities in the realm of qualitative research, yet they also give rise to specific risks, ethical concerns, and drawbacks (Lathrop & Johnson, 2023; Ray, 2023). For example, one potential issue with language models is the possibility of inheriting biases from the data they are trained on, which can result in biased analysis outcomes. In qualitative research, the handling of sensitive, cross-cultural, or personal data necessitates meticulous deliberation regarding data privacy and/or data translation (Ho et al., 2019; Staples et al., 2018). It is imperative for researchers to adhere to ethical standards when employing AI tools for the purpose of data analysis. The content produced and transparency of insights generated by AI are also of utmost importance to be monitored. Furthermore, the continued significance of human expertise and skills in qualitative research and analysis cannot be overstated. It is imperative for researchers to achieve a harmonious equilibrium between AI-driven analysis and human interpretation, thereby guaranteeing the preservation of rigor and contextual relevance in their research endeavors. Additionally, the primary concern when employing AI technology in thematic analysis is the potential over-reliance on frequently occurring words, terms, and phrases, where algorithms may prioritize quantitative data over nuanced thematic insights. As such, it may be argued that AI tools perform a "content analysis" instead of a thematic analysis. As Braun and Clarke (2006, note 5) clearly state, "Thematic analysis differs from this [referring to content analysis] in that themes tend not to be quantified (although sometimes they may be…) and the unit of analysis tends to be more than a word or phrase, which it typically is in content analysis." Overall, the decision of whether and how to integrate AI into our thematic analysis necessitates a meticulous examination of various pivotal inquiries concerning its limitations and drawbacks, as discussed below.

Thematic Analysis via AI: Considerations and Implications

Before delving into the discourse on the implementation and documentation of AI in thematic analysis, it is imperative to address pertinent inquiries, such as "What exactly are we aiming to achieve by using AI?" "Is there actually a need to use AI tools in our thematic analysis?" and "Which precise AI tools or programs that make use of AI technology should be used for our thematic analysis?"

It is imperative to establish the desired outcomes we aim to accomplish through the utilization of AI tools in thematic analysis. An important question that we should consider is, "What is the anticipated result of the analysis?" AI offers several benefits, as discussed earlier, such as improved speed and scalability, which can be particularly advantageous in managing large datasets. Another question that we should consider is, "Can the integration of an AI system or tool be deemed essential in expediting our thematic analysis process"? The utilization of an AI-led system for the sole purpose of creating an illusion of proficiency with technologically advanced tools for our readers or potential reviewers is not advisable. Furthermore, it is crucial to consider the incorporation of artificially intelligent-generated insights within the wider context of our thematic analysis methodology with further questions: "Is the incorporation of AI tools crucial for the examination of our research outcomes? At which junctures of our thematic analysis will AI systems be utilized?" Thematic analysis often involves an iterative procedure of manual coding and subsequent interpretation of the gathered data. Therefore, it is crucial to carefully consider the potential of AI-generated findings in relation to their capacity to enhance or complement traditional manual analysis.

The field of AI is characterized by its extensive scope which encompasses a wide range of tools and models that can be effectively utilized in various applications. Examples of such tools and models include ChatGPT, a chatbot based on language models (Dwivedi et al., 2023); Claude, a large language model developed by Anthropic; BERT (Bidirectional Encoder Representations from Transformers), another language model; and InfraNodus, a tool that combines text network visualization with GPT AI-based text generation. These examples serve as illustrations of AI-driven systems that will undergo ongoing development. Additionally, there are a multitude of other AI tools and systems that will consistently provide noteworthy capabilities, particularly in the context of research and analysis procedures. Despite such AI tools, qualitative data analysis software companies like NVivo, MaxQDA, and Atlas-ti have integrated AI into their programs to enhance the efficiency and effectiveness of qualitative research by assisting with coding and pattern recognition. More specifically, Atlas-ti introduced AI tools to bridge human expertise with AI efficiency, with features like Intentional AI Coding, which allows researchers to guide the AI in coding documents according to their intent. An additional Conversational AI feature enables researchers to extract key insights from documents through natural conversation, while their use of OpenAI's GPT model for automatic AI Coding, understands natural language at a human-like level, thus reducing coding and analysis time. Furthermore, MaxQDA's AI Assist feature leverages AI to support qualitative data analysis by creating automatic summaries. The feature allows the summarization of multiple text segments that were coded with the code to help analysts explain common themes across their codings. Other capabilities include the creation of automatic code summaries for a number of coded segments, the automatic generation of suggestions for sub-codes, and the automatic transcription of audio and video files.

It is crucial to engage in comprehensive research and exercise informed judgment when selecting any AI tools for our analysis while taking into account certain criteria, including the precision of the model, its applicability to our analysis process, and its user-friendliness, although it should be acknowledged that most of these models or programs are specifically designed to be easily usable. In more detail, when researchers and analysts are choosing an AI tool or program for thematic analysis, certain features and capabilities become essential. The AI tool should possess capabilities for processing and analyzing substantial quantities of textual data. Regarding this matter, features such as Natural Language Processing (NLP), sentiment analysis, and entity recognition are considered important. The AI tool or AI-assisted program should also possess the capability to encode data and enable analysts to both create and modify codes and eventually themes as deemed necessary. Providing visual depictions of data, such as thematic maps, can be helpful. Features that facilitate collaboration and enable concurrent work on a shared dataset while keeping a record of modifications by analysts are also advantageous. Furthermore, an interface that is easy to use is especially beneficial for researchers who may lack advanced technical proficiency.

Documenting and Justifying the Process of Conducting Thematic Analysis via AI

In other conceptual papers, I have provided supportive arguments for why and how researchers should document the use of AI tools in their studies and how to progress theoretical knowledge via AI (Christou, 2023b, 2023c). Even so, we need further insights on how to implement and justify the use of such tools in specific important research tasks, such as the case of thematic analysis. In this regard, scholars have identified distinct stages that must be adhered to when conducting and documenting a thematic analysis. Braun and Clarke (2006) introduced six distinct phases in their exploration of thematic analysis. Building upon this framework, Christou (2022) expanded on these key phases by proposing the incorporation of conceptual diagrams and theory development. The proposed stages encompassed becoming

acquainted with the research data, generating preliminary codes, conducting a search for and reviewing themes, defining said themes, constructing conceptual diagrams, engaging in theory-building (which may be optional), and ultimately producing the final report. I strongly encourage, particularly novice researchers, to first equip themselves with the fundamentals of thematic analysis by referring to the above-mentioned studies before considering whether and how to use AI tools in their thematic analysis.

As mentioned earlier, qualitative data analysis software programs such as NVivo, MaxQDA, and Atlas-ti have integrated AI technology to enhance the efficiency and effectiveness of qualitative research by assisting with various tasks, such as coding and pattern recognition. Furthermore, language models, such as ChatGPT, have the potential to aid in multiple stages of thematic analysis. These stages include generating codes, identifying potential themes within a dataset, providing contextual information on themes to aid in their interpretation, and assisting researchers in locating and reviewing pertinent literature to compare and contrast their findings with existing knowledge. Researchers or analysts who utilize language models are well aware of the simplicity involved in incorporating a command into such models, such as instructing the model to "generate codes" for a given dataset. However, it is crucial to underscore that these valuable tools and AI-assisted programs should not serve as a substitute for human expertise and judgment. Besides, researchers advocate for exercising the utmost caution when employing any AI tools in the context of research (Hill-Yardin et al., 2023; Qasem, 2023; Zheng & Zhan, 2023). It is imperative for researchers to engage in a thorough and meticulous evaluation and validation of the outcomes produced by the tool in order to ascertain the high standard and precision of the thematic analysis. AI tools should be regarded as valuable additions to the researcher's repertoire, serving as complementary aids rather than complete substitutes for a thematic analysis. Besides this, the compilation of comprehensive documentation regarding the AI-assisted thematic analysis process holds significant importance. The promotion of reproducibility can be accomplished through the implementation of transparent reporting and comprehensive documentation, which facilitate the understanding and accurate replication of a study's analysis and conclusions by others.

In addition, the precision and dependability of the findings are pivotal factors to be taken into account in the context of AI-assisted thematic analysis. Hence, it is crucial to conduct a comprehensive evaluation and verification of the precision of the AI tools that we plan to utilize. In a more specific manner, AI models possess the capacity to produce preliminary insights. Of course, there are AI-led programs that can even "produce" themes directly once the dataset has been uploaded to the system. When researchers choose to employ an AI system for the purpose of eventually generating themes, it is crucial for them to thoroughly consider the methodologies they will utilize in order to validate the findings produced by the AI. This task is characterized by a high level of demand and inherent complexity. In more detail, an AI system utilizes discrete tasks or algorithms to reach conclusions (such as delivering "themes"). Nevertheless, it can be argued that the utilization of an "automatic action" of theme generation constrains the analyst's capacity to demonstrate evaluative and interpretive skills. One possible solution involves the validation of AI-generated themes through the implementation of a comparative analysis alongside a manual analysis. Of course, one may reasonably question, "Why is there a need to make use of a particular AI tool if the researcher intends to manually carry out the stages of thematic analysis?" The response to this question can be divided into two distinct responses. On one hand, the utilization of advanced technology, such as AI-assisted tools, can offer various advantages, as previously discussed. It is reasonable to consider employing these tools (yet, not to automatically come up with "themes"), as they have the potential to uncover additional insights within our dataset that may have been overlooked by the researcher. On the other hand, the utilization of AI-assisted tools for generating codes and

themes does not negate the importance of the human factor, as it still encompasses the expertise and evaluative abilities of the analyst. Overall, even if there is no additional "manual" thematic analysis conducted, analysts ought to critically evaluate the extent to which the initial codes and/or themes generated by the system effectively capture and communicate noteworthy characteristics of the data in a methodical manner throughout the entirety of the dataset. In this context, it is imperative for the researcher to thoroughly examine the codes and themes generated by the system. They may use their critical and evaluative skills founded on strong thematic analysis principles and stages (as in Braun & Clarke 2006; Christou, 2022) and avoid the presentation of such results (i.e., themes) that do not actually allow researchers to understand and interpret the central ideas and insights within the dataset.

This report does not include specific "prompts" for analysts to use while interacting with AI tools or programs that make use of AI technology, for a thematic analysis, for the following reasons: i. There are multiple AI tools and programs that incorporate AI available for analysis, each operating in a similar but distinct manner. ii. Some programs that utilize AI technology do not rely on prompts but instead on specific functions that can be activated simply with the press of a button. iii. The rapid and ongoing development of AI tools and programs incorporating AI technology necessitates regular updates by researchers and analysts. Even so, given the aforementioned considerations and dilemmas, Table 1 is presented as a point of reference for analysts seeking to incorporate AI tools into their thematic analysis process (see Table 1). The table illustrates the various phases involved in thematic analysis, starting with becoming acquainted with the research data and culminating in the creation of the ultimate report. While there may be a debate regarding the necessity of employing AI tools at any stage of the thematic analysis, it is important to highlight the potential benefits that arise from their utilization. The table provided in this context illustrates the various opportunities that arise when utilizing AI tools during each stage of a thematic analysis. In addition, researchers are provided with an inventory of key risks and drawbacks associated with the utilization of AI during the course of their thematic analysis. These risks should not be underestimated, and it is imperative for analysts to possess the capability to effectively tackle them. While previous studies have offered valuable insights on the application of AI in qualitative research, this table outlines specific criteria that analysts should follow when incorporating AI technology into any phase of their thematic analysis. These suggestions are not only valuable for providing justification for the utilization of such technology but also for mitigating or reducing any potential risks and limitations associated with the implementation of AI in the thematic analysis process.

Table 1. Thematic analysis via AI: Steps, Opportunities, Risks, and Criteria

Stage of thematic analysis	**Description**	**Opportunities created via AI tools in each stage of the thematic analysis**	**Risks involved if use AI tools in the thematic analysis process**	**Suggestion/ Criteria to adhere to while using AI tools in thematic analysis**
Familiarization with the research data	Phase involving transcription, reading and re-reading the data and noting initial ideas (Braun & Clarke, 2006; Christou, 2022).	**Automated Transcription**: AI-driven speech recognition tools. **Summarization:** AI-driven tools generating summaries, helping researchers quickly understand the content of a document. **Search and retrieval:** retrieval of specific keywords or phrases in large datasets, allowing researchers to focus on specific sections during initial readings. **Automated note-taking:** AI-powered tools assisting researchers in capturing their initial ideas or insights as they read and re-read their data.	**- Content analysis instead of thematic analysis and emphasis on quantification and numbers:** AI can be biased toward developing themes based on terms that prevail (in terms of occurrences). "Thematic analysis differs from this [referring to content analysis] in that themes tend not to be quantified (although sometimes they may be…) and the unit of analysis tends to be more than a word or phrase, which it typically is in content analysis." (Braun and Clarke, 2006, note 5). **- Loss of human element and interpretation:** Over-reliance on AI may lead to a loss of the human evaluative and interpretative element, potentially missing important insights. **- Lack of creativity:** AI systems follow predefined algorithms and patterns, which may make them less capable of creative thinking. **- Over-automation:** Over-automation can lead to a loss of researcher control, making it challenging to adapt to unexpected insights or emerging themes that AI	***1: <u>Justification of the use of AI tools</u>*** Determine the necessity of employing AI tools in specific phases of the thematic analysis process. Additionally, it is important to choose AI tools that are appropriate for the intended purpose, with a preference for those that are well-established, thoroughly documented, and have undergone rigorous testing to ensure accuracy and mitigate potential biases. The field of AI technology is experiencing rapid advancements, leading to the development of newer and more sophisticated tools that may potentially offer enhanced capabilities, including the reduction of biases. Provide a rationale for the utilization of the selected AI tools in your report. Clearly articulate the value and significance of these tools in any of the phases of the thematic analysis. ***2: <u>Customization of AI models</u>*** There are pre-designed and developed AI tools that restrict analysts from following a systematic and comprehensive approach to the process of thematic analysis. When feasible, it is advisable to customize or refine AI models to suit the particular research context and analysis requirements. If it is unattainable or if one lacks the requisite knowledge, it is advisable to
Generation of initial codes	Phase involving the coding of interesting features of the data in a systematic manner across the entire data set, while collating data relevant to each code (Braun & Clarke, 2006; Christou, 2022).	**Code identification:** AI tools may automatically identify and highlight text segments relevant to specific codes. **Code suggestion and auto-coding**: AI can suggest potential codes based on the content of the text. Some AI systems can even perform auto-coding. **Identification of relationships:** AI can identify relationships between words and concepts, helping researchers generate codes that capture the underlying meaning and context of the data set. **Grouping:** AI can cluster similar text segments together, which can be the foundation for generating codes that represent common features within the data set. **Collaborative coding:** AI-powered platforms can facilitate collaborative coding efforts by allowing multiple researchers to work on the same dataset simultaneously.		

Searching for themes, and reviewing themes.	Collating codes into potential themes, gathering all data relevant to each potential theme. Furthermore, reviewing themes, involving the generation of a thematic "map" of the analysis (Braun & Clarke, 2006; Christou, 2022).	**Automated theme identification:** AI can identify potential themes within the coded data set and suggest themes that researchers may not have initially considered. Researchers can then review and refine these. **Data retrieval for themes:** AI can help gather all the data relevant to each potential theme. It can retrieve and compile text segments associated with specific themes. **Thematic map generation:** AI can assist in creating a thematic map or visual representation of the analysis that illustrates the relationships between themes and their associated codes. **Collaborative theme development:** AI-powered collaboration platforms can facilitate the joint effort of researchers in developing themes. **Thematic evolution analysis:** AI can track the evolution of themes over time if the data set covers multiple time periods.	produces. Also, researchers may find it hard to change, explain, or justify automated-produced themes by AI tools. - **Misinterpretation:** AI models may misinterpret human aspects, including sarcasm, humor, or idiomatic expressions, potentially leading to incorrect categorization. - **Cost and accessibility:** Though there are many open-access and free AI tools available, some can be expensive or may require a monthly or annual subscription. - **Training:** Most AI tools are very user-friendly. Yet, using AI effectively for thematic analysis may require training and expertise, which can be a barrier for researchers who are not familiar with specific AI models and technologies. **- Ethical considerations:** The use of AI in research may raise ethical issues, such as the responsible use of AI, transparency, and accountability. **- Validation and reliability constraints:** Researchers need to validate AI-generated results and ensure the reliability of AI-assisted thematic analysis, as AI may produce errors or inconsistencies.	utilize AI tools that facilitate researchers and analysts in comprehending the process employed to generate themes, as well as those that offer adaptability for introspection and enhancement of said themes. ***3: Addressing AI limitations*** It is important to acknowledge and comprehend the constraints associated with AI tools and endeavor to mitigate them to the greatest extent feasible. Be prepared to elucidate in your report the measures taken to address these limitations. ***4: Human oversight*** It is imperative to incorporate and thoroughly document human oversight throughout all stages of the thematic analysis process. It is advisable to refrain from utilizing AI tools that "automatically" generate themes without offering comprehensive justification of the process followed or limiting the researcher's or analyst's ability to oversee the various stages of the thematic process. ***5: Demonstration of interpretative and evaluative skills*** The utilization of AI tools may restrict the opportunity for researchers and analysts to display their individual capacities for interpretation and evaluation when it comes to formulating and defining themes and drawing conclusions. Analysts are highly encouraged to exhibit these
Theme definition	Phase involving an ongoing analysis to refine the specifics of each theme and generating clear definitions for each theme (Braun & Clarke, 2006; Christou, 2022).	**Automatic naming:** AI tools may automatically generate definitions per theme. **Feedback:** AI systems can facilitate ongoing feedback that allows researchers to continuously refine and modify theme definitions as the analysis progresses. **Comparative analysis:** AI can compare theme definitions across themes to identify commonalities or discrepancies, which can aid in ensuring clarity and coherence. **Collaborative theme definition:** AI platforms can facilitate collaborative theme definition efforts, allowing multiple researchers to refine and generate clear definitions. **Visualization tools:** AI can assist in visualizing the structure of themes and their relationships, assisting researchers to refine theme definitions.		

Creation of conceptual diagram and/or theory-building (may not be necessary/can be omitted)	The process of creating new insights and understandings that can be delivered in the form of a conceptual diagram. Also, the process of creating new knowledge in the form of a theory. Note: A stage that can be omitted in thematic analysis (Christou, 2022).	**Concept mapping:** AI can assist in creating concept maps that visually represent the relationships between themes and sub-themes, while this may help researchers identify the structure of possible emerging theories. **Visual Representations:** AI can generate visual representations of the thematic analysis which can be useful in developing and presenting a conceptual diagram. **Pattern Recognition:** AI can help identify patterns within the data that may not be immediately apparent, aiding in the development of a theory or/and conceptual framework. **Data integration:** AI can assist in integrating data from various sources, helping researchers build a more comprehensive theory by considering a broader range of data. **Proposition generation:** AI can suggest propositions, allowing researchers to explore potential explanations. **Data-driven theory building:** AI can guide researchers in building theories or conceptual frameworks that are firmly rooted in the data and supported by evidence.		skills consistently across all stages of the thematic analysis process. Merely providing a basic overview of the AI tool and its associated algorithms, no matter how intricate they may appear, does not suffice as evidence for the completion of a profound, comprehensive, and reliable thematic analysis.
Producing the final report	The selection of compelling extract examples, relating back of the analysis to the research question and literature, and producing a report (Braun & Clarke, 2006; Christou, 2022).	**Extract selection:** AI can automatically identify and extract compelling text segments or examples that best represent each theme. **Summary generation:** AI can provide brief summaries of each theme to be included in the report. **Visualization:** AI can generate data visualizations, which can be incorporated into the report. **Checks and proofreading**: AI-driven writing assistants can review the report for grammar, punctuation, and style errors. Also, AI can assist in proofreading the report, identifying and correcting typos and other errors.		

Conclusion

Thematic analysis is a form of analysis that has grown in popularity over the past few decades and is recognized as being one of the most widely used types of analysis. As a result of the expanded opportunities it offers as a method in the field of qualitative research, it is highly likely that analysts will continue to make use of it in the foreseeable future. Given the various technological advancements in current days, it is reasonable to anticipate that the proliferation of AI technology and analysts' use of it will have an effect on the manner in which thematic analysis is carried out. This paper does not provide a detailed account of thematic analysis. There have been numerous studies and reports that have provided a comprehensive view of what thematic analysis entails. Nonetheless, it does provide helpful guidance, especially for novice analysts, on how researchers can incorporate and document AI tools in their process of conducting thematic analysis. As a final note, as the author of this paper, I emphasize once more that AI tools should not marginalize the analyst's evaluative and interpretive skills in any research task, including thematic analysis. Instead, I support the fact that AI can assist in the process of thematic analysis and offer increased opportunities for a thorough form of analysis, as long as certain criteria are adhered to.

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Article Citation

Christou, P. A. (2024). Thematic analysis through artificial intelligence (AI). *The Qualitative Report*, *29*(2), 560-576. https://doi.org/10.46743/2160-3715/2024.7046