Qualitative Research Methods: do digital tools open promising trends?

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Abstract:

Qualitative Research has gained greater scientific recognition in recent years, given the improvement of denser methodologies, more backed by knowledge from different areas of expertise. One of the factors that contributed to improving the quality of qualitative studies was incorporating a set of tools, most of them digital. Although these tools can support and reduce subjectivity, they must be aligned with the theoretical-conceptual-methodological frameworks of the research, which are the axes that give it coherence and cohesion. The researcher's skills are fundamental to guarantee the integrity and ethics of the research construction process, from project formulation to disseminating results. In this context, in the case of qualitative data analysis, tools based on Artificial Intelligence (AI) can help researchers identify patterns and trends through a large volume of data, generate visualisations and syntheses and even offer suggestions for other questions or research areas. On the other hand, this dimension implies that the researcher develops digital and multimodal literacies. This essay is expected to discuss the challenges to overcome in developing and using accurate tools.

Keywords:

CAQDAS; artificial intelligence; digital methods.

Métodos de Investigação Qualitativa: as ferramentas digitais abrem tendências mais promissoras?

Resumo: A Investigação Qualitativa tem ganhado, nos últimos anos, maior reconhecimento científico, dado o aperfeiçoamento das metodologias mais adensadas e lastreadas em saberes de diferentes âmbitos do conhecimento. Um dos fatores que contribuíram para a melhoria da qualidade dos estudos qualitativos foi a incorporação de um conjunto de ferramentas, boa parte delas digitais. Embora estas ferramentas possam fornecer suporte e reduzir a subjetividade, elas devem estar alinhadas com os marcos teóricos-conceituais-metodológicos da investigação, eixos que lhe dão coerência e coesão. As competências do investigador são fundamentais para garantir a integridade e a ética do processo de construção da investigação, desde a formulação do projeto até à divulgação dos resultados. Neste contexto, no caso específico da análise de dados qualitativos, as ferramentas baseadas em Inteligência Artificial (IA) podem ajudar os investigadores a identificar padrões e tendências através de um grande volume de dados, gerar visualizações e sínteses e até mesmo oferecer sugestões para outras questões ou áreas de investigação. Por outro lado, esta dimensão implica que o investigador desenvolva literacias digitais e multimodais. Neste ensaio, espera-se discutir os desafios a serem superados no desenvolvimento e uso de ferramentas acuradas.

Palavras-chave: CAQDAS; inteligência artificial; métodos digitais.

Metodos de Investigación Cualitativa: ¿Las herramientas digitales abren tendencias más prometedoras?

Resumen: La Investigación Cualitativa ha ganado, en los últimos años, mayor reconocimiento científico, por la mejora de metodologías más densas y respaldadas por conocimientos de diferentes áreas. Uno de los factores que contribuyó a mejorar la calidad de los estudios cualitativos fue la incorporación de un conjunto de herramientas, la mayoría de estas digitales. Si bien que estas herramientas pueden brindar apoyo y reducir la subjetividad, las mismas deben estar alineadas con los marcos teóricos-conceptuales metodológicos de la investigación, ejes que le dan la coherencia y cohesión. Las competencias del investigador son fundamentales para garantizar la integridad y la ética del proceso de construcción de la investigación, desde la formulación del proyecto hasta la difusión de los resultados. En este contexto, en el caso específico del análisis de datos cualitativos, las herramientas basadas en Inteligencia Artificial (IA) pueden ayudar los investigadores a identificar patrones y tendencias a través de un gran volumen de datos, de forma a generar visualizaciones y síntesis, incluso ofrecer sugerencias para otras cuestiones o áreas de investigación. Por otra parte, esta dimensión implica que el investigador desarrolle alfabetizaciones digitales y multimodales. En este ensayo, se espera discutir los desafíos que se deben superar en el desarrollo y uso de herramientas precisas.

Palabras clave: CAQDAS; inteligencia artificial; métodos digitales.

Méthodes de Recherche Qualitative: les outils numériques ouvrent-ils des voies plus prometteuses?

Résumé: Ces dernières années, la Recherche Qualitative a acquis une plus grande reconnaissance scientifique, grâce à l'amélioration des méthodologies qui sont plus denses et plus approfondies sur les connaissances provenant de différents secteurs. L'un des facteurs qui a contribué à améliorer la qualité des études qualitatives, a été l'incorporation d'un ensemble d'outils, dont la plupart numériques. Bien que ces outils puissent apporter un soutien et réduire la subjectivité, ils doivent être alignés sur les cadres théoriques, conceptuels et méthodologiques de la recherche, qui sont les axes qui lui donnent sa cohérence et sa cohésion. Les compétences du chercheur sont fondamentales pour assurer l'intégrité et l'éthique du processus de recherche, dès la formulation du projet à la diffusion des résultats. Dans le cas spécifique de l'analyse de données qualitatives, les outils basés sur l'intelligence artificielle (IA) peuvent aider les chercheurs à identifier des modèles et des tendances dans un grand volume de données, à générer des visualisations et des synthèses et même à proposer des suggestions pour d'autres questions ou secteurs de recherche. Par ailleurs, cette dimension implique que le chercheur accroît des compétences numériques et multimodales. Dans cet essai, nous espérons discuter des défis à relever dans le développement et l'utilisation d'outils précis.

Mots clés: CAQDAS; Intelligence artificielle; Méthodes numériques.

Introduction

Qualitative research has gained greater scientific recognition in recent years, given the improvement of more robust methodologies supported by knowledge from different areas of expertise. The diversity of contexts, the use of unstructured and non-numerical data, the vast amount of data, the integration with quantitative methods (mixed methods), the complexity of data triangulation, the collaboration of multidisciplinary and international groups, greater demand for transparency and validation of processes and results, and the integration of digital tools in all stages of research are some of the challenges that qualitative research has overcome over the years.

The most recent challenge for qualitative research, specifically the methods and techniques that support it, involves digital tools developed with Artificial Intelligence (AI) algorithms. From defining the problem and conducting literature reviews to disseminating results, researchers can now explore and rely on digital devices that integrate AI algorithms. An example of this is the writing of this essay, in which a word processor is used simultaneously to write it, the Scopus database to consult the most recent publications on this topic, the Mendeley bibliographic reference manager to organise references, ChatGPT (OpenAI, 2021) to search for issues and cross-check articles explored in Scopus, and the webQDA qualitative data analysis software to analyse the metadata of selected papers. This essay discusses the advantages of using AI and its relationship with computer-assisted qualitative data analysis software (CAQDAS), considering limitations and potential risks.

2. A little characterisation – Let's start

In the 1990s, Miles & Huberman (1994) argued that a researcher who does not use software other than a word processor would be disadvantaged compared to those who do. The use of digital technology throughout a research project requires the researcher to develop computational skills (Brent, 1984). Many research tools and technologies have been developed with certain assumptions about the theoretical foundations of the research they are intended to support. This presupposes the researcher has already established a theoretical grounding before choosing and utilising a particular tool or technology.

With the increasing use of digital technology, qualitative research designs have become more diverse and have expanded beyond traditional methods. The Covid-19 pandemic accelerated and solidified this transition, facilitating data collection through online surveys, video conferencing, and social media analysis (Wa-Mbaleka & Costa, 2020). This has allowed researchers to reach a more extensive and diverse group of participants, leading to a more comprehensive understanding of the studied topic. It

has also enabled researchers to analyse qualitative data more efficiently and accurately through software tools (Freitas et al., 2022), like CAQDAS, that assist with transcription, coding, and visualisation (Andrade et al., 2021; Evers, 2011). These tools have made it easier for researchers to identify patterns, themes, and relationships in the data, leading to more robust and reliable findings. In addition, digital technology has allowed researchers to collaborate and share their results more easily through online platforms and networks, creating new opportunities for interdisciplinary and international research (Costa, 2016). In the case of visual methods, (Rodrigues et al., 2019) it can help researchers analyse non-text, such as images, videos and audio recordings. For example, computer vision algorithms can identify and classify visual elements of images and videos, such as objects, scenes, and emotions. In contrast, speech recognition algorithms can transcribe and analyse audio.

Technology has significantly impacted our qualitative research designs, making data collection and analysis more efficient, enabling greater collaboration (Costa & Costa, 2017) between researchers, and facilitating access to relevant data sources. Despite the many advantages that technology offers researchers, some limitations must be considered. Bias is one of the problems associated with qualitative research, and it can remain when resorting to a CAQDAS. For example, online interviews can limit understanding of a respondent's nonverbal cues, and data analysis tools can misidentify patterns in data.

Not all researchers have access to the most recent and efficient technologies due to a lack of financial resources or technical knowledge, which creates inequalities between researchers and limits access to essential data. Furthermore, exploring technology to build and use in qualitative research designs can raise ethical issues like participant privacy and data security. Researchers must acknowledge these issues and comply with ethical requirements. For instance, the General Data Protection Regulation (GDPR), a Regulation in EU law on data protection and privacy in the EU and the European Economic Area, is quite demanding, leading many researchers to increasingly write papers based on article analysis (for example, systematic literature review, integrative review and scoping review). Some authors (Lietz et al., 2006; Morrow, 2005) also discuss the validity and reliability of qualitative data. This dimension can be bridged with data triangulation and multiple data collection methods.

While technology offers many advantages for qualitative research designs, researchers must be aware of its limitations and work to mitigate its adverse effects (García-Horta & Guerra-Ramos, 2009).

3. AI and the Qualitative Research Methods

AI can enhance qualitative research methods in several ways. For example, in text analysis, AI tools such as Natural Language Processing (NLP) can help researchers analyse large volumes of unstructured and non-numerical data, such as interview transcripts, open-ended responses, and social media posts. NLP algorithms can identify and extract themes, sentiments, and patterns from text data, providing researchers with valuable information and reducing the time and effort required for coding. In the article "Empowering Qualitative Research Methods in Education with Artificial Intelligence", Longo (2020) describes how AI empowers qualitative research methods (Figure 1), including knowledge presentation, automated learning, automated reasoning, planning, and natural language processing.

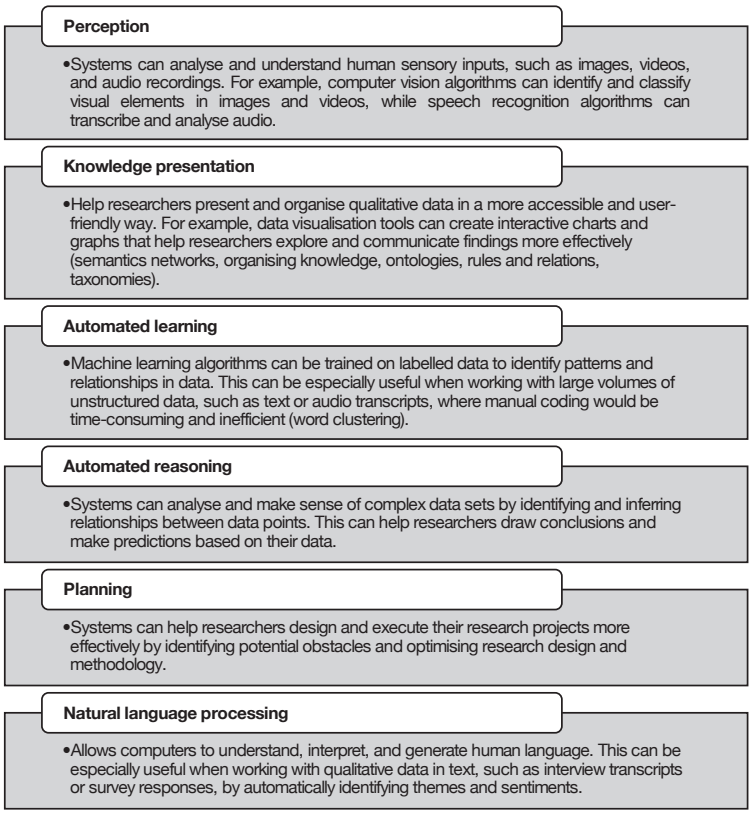

Figure 1
Empowering qualitative research methods

Overall, AI can help researchers in qualitative research by making data analysis more efficient, effective, and accurate. However, it is essential to note that AI-powered research methods also present some limitations and potential risks, such as ethical concerns related to data privacy and confidentiality, interpretability of algorithmic results, and possible biases in training data or algorithmic decision-making (Mittelstadt et al., 2016). Therefore, it is essential for researchers to carefully consider the benefits and risks of using AI-powered research methods and to use AI as a tool to support and enhance rather than replace human expertise and insights. On the advantages, limitations and potential risks of using AI in the Analysis of Qualitative Data (table 1), the chatbot ChatGPT (Dwivedi et al., 2023; OpenAI, 2021) was used. This type of tool implies that the researcher has prior knowledge of the area, relating computational skills with theoretical, conceptual, and methodological frameworks and developing critical thinking given the results presented.

Table 1
Advantages, Limitations and Potential Risks of AI in Qualitative Data Analysis

Advantages	Limitations	Potential Risks
Efficiency: AI can analyse extensive data quickly and accurately, saving researchers time and resources.	Data quality: AI relies on high-quality data for accurate and reliable results. Researchers must ensure their data is appropriately collected and cleaned before using AI-powered tools.	Overreliance on AI-generated insights: Researchers may be tempted to rely too heavily on AI-generated results without fully understanding the underlying algorithms and processes used.
Consistency: AI can analyse data objectively and consistently, reducing the risk of human bias in the research process.	Interpretation: AI-generated results may be easier to interpret with a thorough understanding of the algorithms and processes used. Researchers must be careful to avoid overreliance on AI-generated insights.	Data privacy and security: AI-powered tools may involve collecting and storing sensitive data, and researchers must ensure that appropriate measures are taken to protect the confidentiality and security of their participants.
Innovation: AI can help researchers to uncover new insights and perspectives that may not have been possible using traditional research methods alone.	Cost: Using AI-powered tools may require significant financial investment, and researchers must weigh the potential benefits against the costs involved.	Bias: AI algorithms may reproduce and even amplify biases in the data used to train them, potentially leading to biased research results.
Customisation: AI-powered tools can be customised to meet individual research projects needs and requirements.	Ethical considerations: Researchers must be mindful of ethical concerns related to the use of AI in research, such as data privacy and security issues.	Lack of transparency: The complexity of AI algorithms may make it difficult for researchers to understand and explain their methods, potentially leading to a lack of transparency in the research process.

Source: Generated by ChatGPT (April 17, 2023)

Qualitative approaches emphasise the researcher's active role throughout all stages of the research process. In Table 1, efficiency is presented as an advantage of AI because it can "analyse" (perhaps code) a large volume of data. However, an excessive amount of data, which is often unnecessary, can compromise the in-depth data analysis (presented in Table 1 as a disadvantage). These potential risks were identified before CAQDAS developed automated routines. Additionally, consistency is an important consideration, and the researcher must carefully consider reliability and ethical issues throughout the analysis process.

It is essential to understand that all these dimensions must be configured in the methodological design of the study. This implies that the researcher defines and justifies the choice of method (or methods), data collection, and analysis techniques that allow answering the research questions and objectives. When analysing qualitative data using software, Woods, Macklin & Lewis (2016) relate two types of behaviour: the method and the software. When software behaviour can dominate method behaviour by determining the methods adopted by researchers or influencing analytical outputs, such as when the parameters of CAQDAS programs drive research designs, it demonstrates that the researcher did not develop the necessary skills, specifically in digital and multimodal literacy, essential in the configuration of non-structural and non-numerical data analysis, to select and understand which CAQDAS is more suitable for their study. Making an analogy would be accepting the results of Table 1 without exercising any reflection and critical thinking. Davis & Meyer (2009) suggest that it is essential that the researcher learns to explore the software before using it in the project and that the researcher cannot be separated from the program. The researcher decides which features and capabilities to use and when and where to apply them. The importance of CAQDAS is that they help us to determine the subjective experience of the informants, especially those that are based on the phenomenological method. In this way, we will be able to analyse stories and trace theoretical categories of a substantive and formal nature to explore, describe, interpret, and seek strategies to improve the research problems posed (García-Peñalvo et al., 2018).

The advances in digital tools based on AI algorithms, as is the case with some CAQDAS, include mechanisms for automatic recognition and transcription of audio, video, and image data into the text; dynamic import of bulk data from various sources; parallel aggregation of multimedia data (audio, video, and image) with their respective automatic transcription excerpts; mass analysis code creation and respective automatic coding mechanisms; procedures for comparing coding by different users within one or more coding systems; generation of qualitative or quantitative visualisation to support decision-making in the process of comparing classification and coding by various users; and functionalities that promote interaction between researchers.

4. Let's finish… for now

As mentioned above, technological tools such as those based on AI algorithms present potential risks in addition to their advantages and limitations. One such risk is the Dunning-Kruger Effect (1999), which occurs when a person's lack of knowledge and capabilities in a given area makes them overestimate their competence. On the other hand, this effect also makes those who excel in a particular area think that the task is simple for everyone and underestimate their relative abilities. AI is expected to help researchers with tasks that consume much time. In the 1980s, Cuilenburg, Kleinnijenhuis & Ridder (1988) stated that content analysis technique involves tedious tasks and that computers could facilitate the coding phase.

Researchers will increasingly need to know how to use current and future technological tools and appropriate them to their research goals. This task may seem "romantic" in its implementation, as it requires acquiring various skills beyond the period of a researcher's doctorate, for example. In this context, digital technologies have shortened paths. Researchers should invest time in creating networks that allow them to involve experts with different backgrounds at different stages of the research project.

Advanced AI technologies, such as Generative AI (Emenike & Emenike, 2023), are self-learning algorithms that create code, text, video, and audio content suitable for the data collected in qualitative research methods. What is controversial about generative AI is the ambiguity surrounding copyright, the lack of truthfulness and accuracy, and the increased potential for misuse and bias. Additionally, researchers may believe that by applying infinite computing power to a limited amount of imperfect data, they can learn something new that they did not previously know. Just as word processing programs have become common tools to increase productivity, digital tools incorporating AI will become standard for researchers, like a superpower that democratises content creation. It will not replace researchers' tasks but transform and reshape them.

References

Andrade, L. R., Nunes Linhares, R., & Costa, A. P. (2021). Estratégias para o uso de representações visuais na análise de dados qualitativos em QDAS. *Práxis Educacional*, *17*(48), 1–22. https://doi.org/10.22481/praxisedu.v17i48.8807

Brent, E. (1984). Qualitative computing: Approaches and issues. *Qualitative Sociology*, *7*(1–2), 34–60. https://doi.org/10.1007/BF00987106

Costa, A. P. (2016). Cloud Computing em Investigação Qualitativa: Investigação Colaborativa através do software webQDA. *Fronteiras: Journal of Social, Technological and Environmental Science*, *5*(2), 153–161. https://doi.org/10.21664/2238-8869.2016v5i2.p153-161

Costa, E. P. da, & Costa, A. P. (2017). The collaborative work supported by technologies: the example of qualita? ve research // O trabalho colaborativo apoiado pelas tecnologias: o exemplo da investigação qualitativa. *Educação a Distância e Práticas Educativas Comunicacionais e Interculturais*, *17*(2), 61–69. https://seer.ufs.br/index.php/edapeci/issue/view/v17.n2.2017

Cuilenburg, J. J. van, Kleinnijenhuis, J., & Ridder, J. A. (1988). Artificial intelligence and content analysis - Problems of and strategies for computer text analysis. *Quality and Quantity*, *22*(1), 65–97. https://doi.org/10.1007/BF00430638

Davis, N. W., & Meyer, B. B. (2009). Qualitative data analysis: a procedural comparison. *Journal of Applied Sport Psychology*, *21*(1), 116–124.

Dwivedi, Y. K., Kshetri, N., Hughes, L., Slade, E. L., Jeyaraj, A., Kar, A. K., Baabdullah, A. M., Koohang, A., Raghavan, V., Ahuja, M., Albanna, H., Albashrawi, M. A., Al-Busaidi, A. S., Balakrishnan, J., Barlette, Y., Basu, S., Bose, I., Brooks, L., Buhalis, D., … Wright, R. (2023). "So what if ChatGPT wrote it?" Multidisciplinary perspectives on opportunities, challenges and implications of generative conversational AI for research, practice and policy. *International Journal of Information Management*, *71*. https://doi.org/10.1016/j.ijinfomgt.2023.102642

Emenike, M. E., & Emenike, B. U. (2023). Was This Title Generated by ChatGPT? Considerations for Artificial Intelligence Text-Generation Software Programs for Chemists and Chemistry Educators. *Journal of Chemical Education*. https://doi.org/10.1021/acs.jchemed.3c00063

Evers, J. C. (2011). From the past into the future. How technological developments change our ways of data collection, transcription and analysis. *Forum Qualitative Sozialforschung*, *12*(1). https://www.scopus.com/inward/record.uri?eid=2-s2.0-84926300062&partnerID=40&md5=e3d488b391670af5f57dfca8f5ee8b93

Freitas, F., Costa, A. P., & Moreira, A. (2022). In the Wonderful World of Computer-Assisted Qualitative Data Analysis Software (CAQDAS). In A. Rosario & S. Wa-Mbaleka (Eds.), *The SAGE Handbook of Qualitative Research in the Asian Context* (pp. 477–491). Sage Publications.

García-Horta, J. B., & Guerra-Ramos, M. T. (2009). The use of CAQDAS in educational research: Some advantages, limitations and potential risks. *International Journal of Research and Method in Education*, *32*(2), 151–165. https://doi.org/10.1080/17437270902946686

García-Peñalvo, F. J., Moreno López, L., & Sánchez-Gómez, M. C. (2018). Empirical evaluation of educational interactive systems. *Quality & Quantity*, *52*(6), 2427–2434. https://doi.org/10.1007/s11135-018-0808-4

Kruger, J., & Dunning, D. (1999). Unskilled and unaware of it: How difficulties in recognizing one's own incompetence lead to inflated self-assessments. *Journal of Personality and Social Psychology*, *77*(6), 1121–1134. https://doi.org/10.1037/0022-3514.77.6.1121

Lietz, C. A., Langer, C. L., & Furman, R. (2006). Establishing Trustworthiness in Qualitative Research in Social Work. *Qualitative Social Work*, *5*(4), 441–458. https://doi.org/10.1177/1473325006070288

Longo, L. (2020). Empowering Qualitative Research Methods in Education with Artificial Intelligence. In *Advances in Intelligent Systems and Computing* (pp. 1–21). https://doi.org/10.1007/978-3-030-31787-4_1

Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis: An expanded sourcebook* (2nd ed.). SAGE Publications Inc.

Mittelstadt, B. D., Allo, P., Taddeo, M., Wachter, S., & Floridi, L. (2016). The ethics of algorithms: Mapping the debate. *Big Data & Society*, *3*(2), 205395171667967. https://doi.org/10.1177/2053951716679679

Morrow, S. L. (2005). Quality and trustworthiness in qualitative research in counseling psychology. *Journal of Counseling Psychology*, *52*(2), 250–260. https://doi.org/10.1037/0022-0167.52.2.250

OpenAI. (2021). *ChatGPT* (GPT-4). https://openai.com/blog/chatgpt-3-400-billion-parameters/.

Rodrigues, A. I., Costa, A. P., & Moreira, A. (2019). Using CAQDAS in Visual Data Analysis: A Systematic Literature Review. In A. P. Costa, L. P. Reis, & A. Moreira (Eds.), *Computer Supported Qualitative Research* (pp. 235–247). Springer International Publishing. https://doi.org/10.1007/978-3-030-01406-3_20

Wa-Mbaleka, S., & Costa, A. P. (2020). Qualitative Research in the Time of a Disaster Like COVID-19. *Revista Lusófona de Educação*, *48*, 11–26. https://doi.org/10.24140/issn.1645-7250.rle48.01

Woods, M., Macklin, R., & Lewis, G. K. (2016). Researcher reflexivity: exploring the impacts of CAQDAS use. *International Journal of Social Research Methodology*, *19*(4), 385–403. https://doi.org/10.1080/13645579.2015.1023964

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