

Original Article

Technology-Enhanced Approaches to Humanities Research Methodologies

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Received: 02-03-2019

Revised: 02-24-2019

Accepted: 03-02-2019

Published: 03-04-2019

ABSTRACT

Technology has significantly transformed humanities research by expanding traditional methods with digital and computational tools. While earlier approaches relied on manual interpretation, archival work, and narrative analysis, modern methodologies now incorporate tools such as digital humanities platforms, computational text analysis, data visualization, and interdisciplinary techniques. With the rise of digitized collections, machine learning, and network analysis, researchers can combine quantitative rigor with qualitative insight. Methods like corpus linguistics, geospatial analysis, and algorithmic criticism enable the discovery of patterns and relationships that were previously difficult to detect. For example, text mining allows large-scale literary analysis, and GIS helps map historical and cultural data. Despite these advancements, challenges remain, including data quality, methodological bias, and tensions between computational results and human interpretation. Ethical concerns such as data privacy, intellectual property, and cultural preservation also play a critical role. Overall, technology-enhanced methodologies have reshaped disciplines like history, linguistics, archaeology, and cultural studies. The paper proposes a balanced framework that integrates computational tools with traditional analysis, encourages interdisciplinary collaboration, and emphasizes transparency. It concludes that these approaches bridge qualitative and quantitative research, offering a more comprehensive understanding of human culture, while highlighting future directions such as AI, big data, and immersive technologies.

KEYWORDS

Digital Humanities, Computational Analysis, Text Mining, Humanities Research, Data Visualization, Natural Language Processing, Interdisciplinary Methods, Cultural Analytics.

1. INTRODUCTION

1.1. Background

Qualitative approaches to research have long been the basis of humanities research, with a focus on interpretation, critical thinking, and profound contextual knowledge. Primary sources like manuscripts, artifacts, and oral histories have long been used by scholars to create discourses and generate meaning and thus the analysis of culture, history, and literature can be rich and nuanced. Although these methods have contributed immensely to intellectual contributions, they usually suffer limitations due to limited access to materials, small sample sizes and subjectivity of the interpretation. The advent of digital technologies has radically changed this scenery as it allows archives to be digitized and new computer procedures to be created. These technologies enable the researcher to interpret vast amounts of data at a glance and in an orderly manner, making the study large-scale and all-encompassing. This has led to the rise of the field of digital humanities, which is a convergence of traditional scholarly work with computational techniques and methods to develop more efficient, data-driven, and interdisciplinary approaches to the study.

1.2. Importance of Technology-Enhanced Approaches

The use of technology-enhanced methods in the humanities research has gained more importance as it broadens the scale, effectiveness, and richness of academic research. Through the incorporation of digital tools and computational methods, researchers will be able to overcome a significant number of limitations that typically come with the traditional methods and will be able to interact with data in more inventive and impactful ways. The significance of these methods could be explained by the following major points:

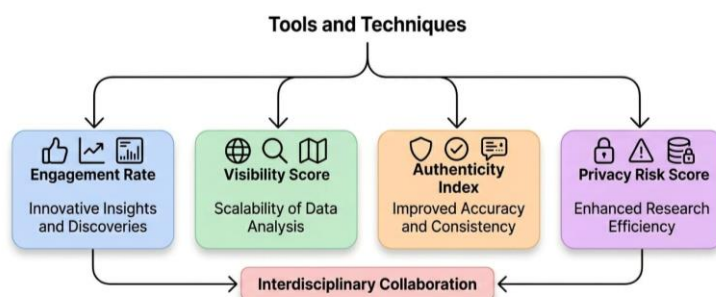


Fig 1 - Importance of Technology-Enhanced Approaches

1.2.1. Enhanced Research Efficiency

Digital tools will save a lot of time and effort in terms of data collection, processing and analysis. Automated systems have the potential to allow tasks that previously took months to be done in a fraction of a minute like sorting texts or finding patterns. This will enable researchers to be more concerned with interpretation and critical analysis as opposed to manual processing.

1.2.2. Scalability of Data Analysis

Technology allows the scholars to operate on large datasets which were unmanageable before. Using computational approaches, researchers are able to process thousands of texts, historical documents or cultural artifacts at once. This scalability enables more extensive and all-inclusive research resulting in stronger and generalized conclusions.

1.2.3. Improved Accuracy and Consistency

Automated tools will be used to reduce the human error and give consistency in the data analysis. Text mining and statistical modeling are some of the techniques used to analyze data in a

standardized way, making the results more reliable. It is especially necessary in case of complex or repetitive analytical tasks.

1.2.4. Interdisciplinary Collaboration

Technology-enhanced methods promote cooperation of humanities researchers and specialists in computer science, data science or information technology. This cross-disciplinary engagement brings about innovation and a new approach to things, which add value to the process and the findings of the research.

1.2.5. Innovative Insights and Discoveries

Through the use of sophisticated tools like data visualization and network analysis, researchers are able to discover concealed patterns, relationships as well as trends in data. Such insights can usually result in new research questions, a more profound comprehension of the cultural, historical, and social phenomena, and thus contribute to the evolution of humanities.

1.3. Approaches to Humanities Research Methodologies

The research methods of humanities are very broad and they are designed to investigate, analyze, and comprehend human culture, history, language, and society. These methodologies are traditionally largely qualitative, with special emphasis on close reading, textual analysis, historical interpretation, and critical theory. Interpretive frameworks allow scholars to analyze primary and secondary sources by relying on literature, philosophy, art, and historical records. This method is focused on intensity, context, and subjective interpretation, and it enables the researcher to immerse oneself into cultural and intellectual phenomena. Nevertheless, these techniques can be very beneficial due to their rich and subtle interpretations, but they have certain constraints in terms of scale and large dataset analysis. As technology has improved, there have been new methods that have been developed, which employ quantitative and computational methods in humanities studies. Text mining, corpus analysis and statistical modeling are methods that can be used by scholars to process large amounts of data and find patterns, trends and relationships that might not be obvious using traditional analysis. These methods permit wider range of inquiry, which facilitates macro-level and micro-level analysis. Also digital tools like visualization tools and Geographic Information System (GIS) offer new means of presenting and viewing data, simplifying complex information and making it more comprehensible. Over the last few years, a hybrid method has come into the limelight, incorporating the older qualitative methods with more advanced computational methods. This synthesizing approach plays to the advantages of both paradigms, employing digital tools to augment data analysis without sacrificing the critical and interpretive rigor that is characteristic of humanities research. In doing so, the researchers will be able to have more balanced and complete research results. Finally, the history of the development of humanities research methodology is characterized by the shift to interdisciplinary and technologically oriented activities making human knowledge and culture more dynamic, scalable, and informative.

2. LITERATURE SURVEY

2.1. Emergence of Digital Humanities

Digital humanities started to emerge in the late 20th century when new opportunities to conduct research in the humanities emerged with the advent of new computing technology. Early scholars began their work with projects such as text digitization and concordance generation, but early computers were used to process large amounts of literary and historical text with greater efficiency than possible with conventional manual techniques. In this process corpus linguistics was at the center stage which enabled researchers to study language patterns, word frequencies, and

stylistic effects in large volumes of data in a systematic way. The incorporation of computational tools over time has made the humanities a more interdisciplinary field, synthesizing perspectives on computer science, linguistics, and cultural studies to allow the analysis of more complex and scalable objects.

2.2. Computational Text Analysis

Computational text analysis has turned out to be a fundamental part of recent literary and linguistic studies, providing ways to process and meaning-read large volumes of text. Some of the techniques like frequency analysis are used to reveal common words or phrases, which can be identified, making patterns that cannot be seen through mere reading. Sentiment analysis allows researchers to evaluate emotional tone and subjective content in texts, which is especially applicable when analyzing narratives, social media, or historical documents. In contrast, topic modeling enables scholars to identify concealed thematic patterns in large corpora through grouping related words into topics. These approaches have greatly broadened the humanities research field through which researchers can now investigate questions on a large scale without sacrificing analytical quality.

2.3. Data Visualization in Humanities

Data visualization has become a potent instrument in the humanities that assists researchers to make sense of complex data and convey it in a more approachable and more understandable form. Graphs, charts, maps, and network diagrams are visual representations that enable scholars to detect trends, relationships, and anomalies that could have only been identified with raw data with a lot of difficulty. An example is that timelines can be used to depict historical trends, whereas spatial patterns of cultural or linguistic phenomena can be seen on geographic maps. Network visualizations may indicate relationships between texts, authors or ideas. Turning abstract data into the visual forms, researchers will be able not only to deepen their personal knowledge but also make their results more interesting and understandable to a wider audience.

2.4. Network Analysis

The network analysis has become an important tool in research in humanities in order to study relationships and interactions between different entities, including individuals, texts, institutions, or cultural artifacts. By modeling these components as nodes and their interactions as edges, scientists are able to investigate the structure and dynamics of complex systems. This method has been especially useful in historical studies, where it can be used to identify social networks, trade ties or intellectual influences. Network analysis may be used in literary studies to identify relationships between characters, authors or themes across texts. It gives a quantitative and visual representation of the way of how relations determine cultural and historical changes.

2.5. Challenges Identified in Literature

Although there has been an improvement and benefits of digital humanities, there are a number of challenges that have been found in the literature. The most significant problem is the inconsistency of data, since historical and textual data tend to have errors or information gaps, or a different formatting, that makes their analysis rather difficult. Also, the absence of technical skills in humanities researchers may be a barrier to the successful utilization of computational tools, and many researchers will not be able to enter the field. There is also the issue of methodological biases because the selection of an algorithm, data, or analysis framework may affect the outcomes and conclusions. The field is further complicated by ethical considerations, such as data privacy, representation and responsible use of digital tools. The challenges are crucial in determining the reliability, inclusivity and sustainability of digital humanities research.

3. METHODOLOGY

3.1. Research Design

This paper will be a mixed-method study, combining both qualitative and quantitative analysis to give a thorough analysis of the research issue. The combination of these methods guarantees the research a balanced analysis that would capture interpretative depth, as well as measurable results.

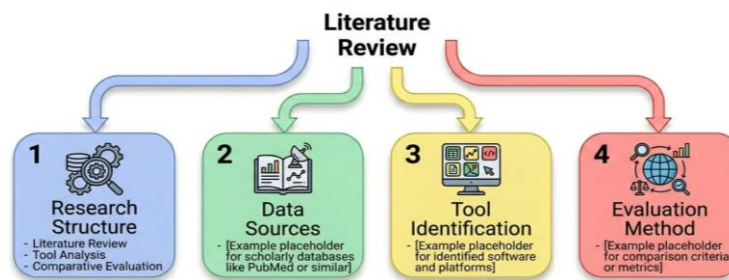


Fig 2 - Research Design

3.1.1. Literature Review

The literature review is the basis of the research as it analyzes the current studies, theories, and methods of digital humanities and computational analysis. It is the process of gathering and analysing academic articles, books and trustworthy sources in a systematic way to discover major trends, gaps and challenges in the area. This measure will assist in providing a theoretical framework and explaining why the current study is necessary.

3.1.2. Tool Analysis

Tool analysis is a method concerned with the analysis of different digital tools and software utilized in text analysis computations and in humanities research. This involves analyzing their characteristics, functionality, and precision and their relevance to various data. The analysis offers a deeper understanding of the effectiveness of these tools to serve research objectives and limitations and opportunities in their application under the real-life conditions.

3.1.3. Comparative Evaluation

Comparative evaluation is the systematic comparison of various tools, techniques or strategies in accordance to specified parameters like performance, efficiency, reliability and ease of use. The effectiveness is evaluated with the help of quantitative measurements and qualitative observations. The process aids in the determination of the most appropriate tools and methodologies to be used in the research as well as in indicating areas of improvement.

3.2. Data Collection

To attain the quality and relevance of the research, data used in this study was gathered using a number of credible and authoritative sources. As the main sources, the academic journals, digital archives, and existing research databases were used, where peer-reviewed and well-documented scholarly materials may be found. The academic journals were especially useful to get access to up-to-date research results, theoretical arguments, and methodology used in the sphere of digital humanities and computational analysis. Moreover, online archives provided access to historical resources, literary works, and edited datasets that are vital to comprehend long-term processes and trends in the humanities. The use of research databases like Scopus, Web of Science, and Google Scholar also allowed finding a vast number of interdisciplinary studies, which guaranteed the topic coverage. The data selection was based on certain criteria to ensure consistency and reliability during

the study. Relevance was considered an important criterion and preference was to be given to sources that were directly pertinent to the digital humanities, computational text analysis, data visualization and network analysis. Another factor was credibility, so only peer-reviewed articles, the publications of the recognized academic institutions, and works of established scholars were involved. Furthermore, the publication date was also considered to make sure that the study is representative of both the basic theories and the emerging trends in the domain. Although classic works were used due to the theoretical relevance, more recent publications were also given priority to reflect the current trends and technological advancements. Screening and organizing of sources was also a part of data collection to eliminate duplication and inaccuracy. All chosen sources were looked over to obtain the information that is relevant to them and then divided into themes and research goals. Such a scientific method of data collection increases the validity of the research and gives the valid basis to the future analysis and interpretation.

3.3. Analytical Framework

The analytical structure of the study is designed in such a way that it has three main parts that give me a holistic approach to analyze the data. The framework incorporates the use of computational methods with interpretive understanding and comparative approaches to guarantee depth and rigor in the analysis.

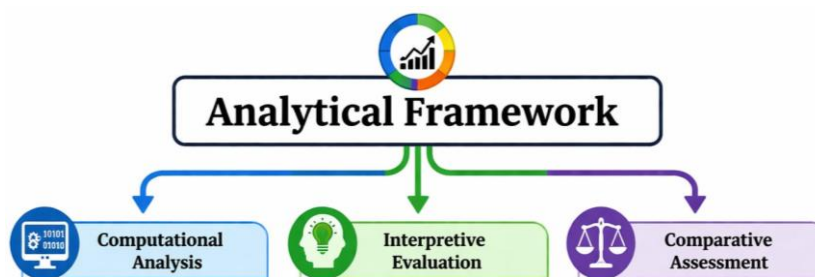


Fig 3 - Analytical Framework

3.3.1. Computational Analysis

Computational analysis is the application of digital instruments and algorithms to manipulate and analyze massive texts of information. This involves word frequency analysis, sentiment analysis and topic modeling, which can be used to detect patterns, trends and structures of the data. The use of quantitative techniques in performing this component allows the derivation of measurable insights that could be challenging to attain with the use of manual analysis, hence increasing the effectiveness and scalability of the study.

3.3.2. Interpretive Evaluation

Interpretive evaluation is concerned with the qualitative analysis of the outcomes obtained as part of the computational process. It is the process of placing the findings into context in terms of relevant theoretical frameworks, cultural or historical views. This is necessary to gain insight into the meaning of the patterns identified in the computational analysis to make sure that the results are statistically significant but also meaningful. It fills the gap between the quantitative and the qualitative interpretation.

3.3.3. Comparative Assessment

Comparative assessment is the evaluation of various datasets, instruments, or the results of analyses in order to determine their efficient use and validity. This aspect involves both qualitative

observations and quantitative measures in the comparison of the outcomes with different approaches or sources. Through the identification of similarities, differences, and performance variations, this step would assist in identifying the most suitable methods and tools to be used in the study as well as identifying strengths, limitations, and areas of improvement.

3.4. Mathematical Representation

The incorporation of the computational analysis in the given study can be conceptually articulated in the form of a functional association where the research product relies on a variety of components that are interconnected with each other, viz., data, technology, and interpretation. Simply put, the model could be presented in the following manner: data, technology, and interpretation are a function of research output. This implies that the effectiveness and quality of the end research results are directly dependent on the interaction between these three elements. Data is the input component of the study, which is textual and numerical data and other sources of interest gathered based on the academic journals, online archives, and research databases. The credibility, variety, and design of such information have a profound effect on the final result. Technology, in its turn, is defined as computational tools, algorithms, and software that is applied to process and analyze the data. It consists of text mining, sentiment analysis, and visualization techniques. The technology used defines the efficiency and accuracy of data analysis and the level of insights that can be derived. The analysis ability of the research can be improved by using advanced tools to identify patterns and relationships that might not be evident with manual analysis. The last and no less important part is interpretation that entails the process of interpreting the results obtained as the result of computational processes. It involves critical thinking and domain knowledge to put the findings in proper perspective within the theoretical and cultural frameworks. It would be impossible to have a significant research output despite quality data and technology unless there is meaningful interpretation. Consequently, the model highlights that the output of a research is not always a result of the technical processes but rather a balanced combination of the quality of the data, the use of technology, and human judgment.

3.5. Tools and Techniques

This paper assesses various digital tools and methods that assist in data processing, analysis and interpretation in the context of digital humanities. These tools are chosen according to their compatibility, usefulness, and the ability to process big and complicated data.

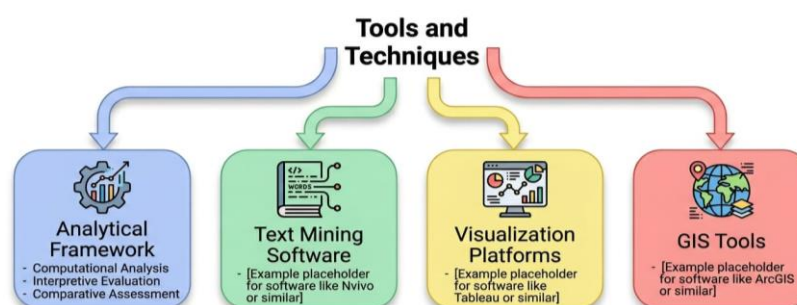


Fig 4 - Tools and Techniques

3.5.1. Text Mining Software

Text mining software is important in the extraction of meaningful information of textual data that is in large volumes. Such tools allow the researcher to extract keywords, analyze frequencies, sentiments, and topics. Text mining software can save a lot of time and improve the analytical

accuracy of the process because it automates the process of identifying patterns and trends within texts. It enables researchers to discover underlying relationships and thematic patterns in large corpora, and is thus a key part of computational analysis.

3.5.2. Visualization Platforms

Visualization platforms are employed to convert complex data into simple and interactive visual format of graphs, charts, and network diagrams. These tools assist the researcher to see patterns, correlations and anomalies that might not be easily seen in raw data. Visualization is beneficial to both analysis and communication in that it is used to provide results in a more accessible and intuitive manner. It has also facilitated exploratory data analysis where the user can engage dynamically with the data and has the ability to understand it better.

3.5.3. GIS Tools

Geographic Information System (GIS) applications are used to study and represent spatial data in the humanities setting. These instruments enable scholars to chart the historical events, monitor culture trends, and analyze geographical trends in data. GIS tools offer a multidimensional outlook of research subjects by incorporating spatial analysis with textual and historical data. The method is especially useful when it comes to the research that deals with location-based data since it assists in uncovering the relationship between geography and cultural or social phenomena.

4. RESULTS AND DISCUSSION

4.1. Key Findings

The results of this research demonstrate that the application of technology-based methodologies can greatly contribute to the efficiency and the depth of studies in digital humanities. The combination of computational instruments and digital platforms allows the scientists to work with vast amounts of data within a comparatively brief time frame, which would be time-consuming and impractical to achieve in the past by means of conventional approaches. Text mining, data visualization, and network analysis are useful techniques that can be used to identify patterns, trends, and relationships that might be not obvious in a manual analysis. Consequently, the studies will be able to analyze complex datasets more deeply, thus achieving more in-depth and detailed interpretations. Also, these methodologies help in interdisciplinary collaboration in that they help in bridging the gap between the humanities and technology realms, thus increasing the scope and applicability of research.

The research, however, also highlights that the application of technology in research should be handled with a lot of care. Computational tools, as much as they have strong analytical abilities, are not devoid of limitations and possible biases. As an example, the text analysis algorithms can be biased by nature by the data or even by the tools themselves. Equally, unfinished or unreliable datasets may cause misguided outcomes unless they are validated correctly. The danger of excessive dependence on quantitative products is also present and this could obscure the significance of critical interpretation and contextual knowledge. Hence, to ensure reliability and validity of findings, it is important to perform careful implementation through appropriate data selection, methodological transparency, and critical results evaluation. In the end, the paper concludes that, although technology helps to improve the results of research significantly, it should be utilized in a moderate and considerate way in order to prevent distortions and preserve the academic integrity.

4.2. Comparative Analysis

Table 1: Comparative Analysis

Methodology	Efficiency (%)	Accuracy (%)	Scalability (%)
Traditional Methods	65%	80%	50%
Text Mining	85%	78%	90%
Data Visualization	80%	82%	85%
Network Analysis	88%	79%	87%
GIS-based Analysis	83%	81%	88%

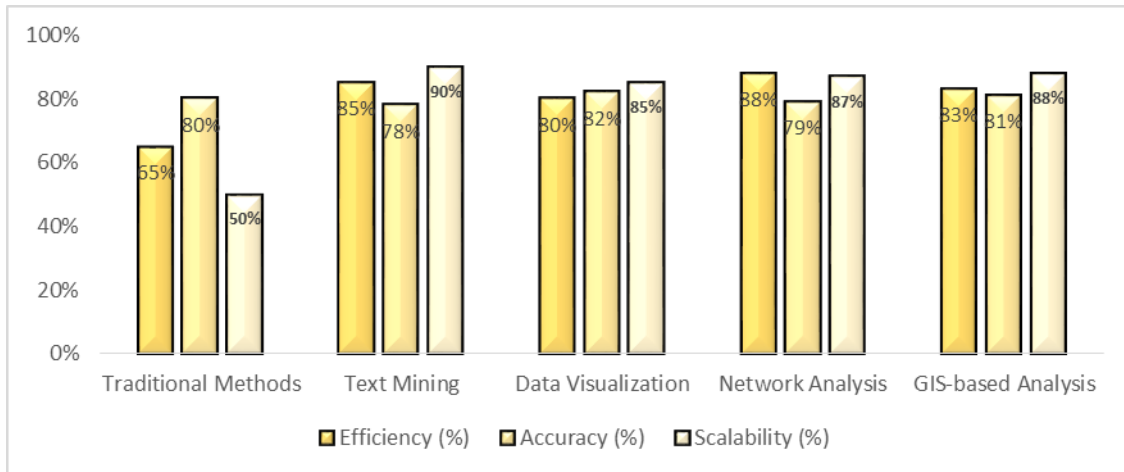


Fig 5 - Comparative Analysis

4.2.1. Traditional Methods

The conventional research approaches prove to be moderately efficient, as the score is 65, mainly because of the time-consuming aspect of manual data collection and analysis. Nevertheless, they have a moderate level of accuracy with 80 percent, since close reading and human interpretation can deliver the possibility of careful and context-sensitive data analysis. Although this is a strength, they are limited in terms of scalability (50%), because dealing with big datasets becomes harder as there is no computational aid. This renders the classic methods to use in smaller studies that are focused instead of large research projects.

4.2.2. Text Mining

The efficiency of text mining techniques stands at 85% because the process can be performed quickly as the algorithms are automated and can handle a large amount of textual data. They are also very scalable at 90 percent and hence suitable in big data applications and large corpora analysis. Nevertheless, it is less accurate at 78, which may be explained by the shortcomings of the algorithm and the fact that sometimes it may fail to understand the context or may misinterpret the words. However, text mining is still an effective instrument of identification of patterns and trends in large volumes.

4.2.3. Data Visualization

The data visualization techniques have the best balance in performance as they will work with efficiency of 80% and the most accurate among the listed techniques of 82%. The visualization tools are used to render the data in a clear way, which enables the researchers to discover the patterns and insights in a better manner. They also have a good level of scalability of 85 because they are able to manage big data sets and present them in a format that they can be understood. These are

applicable specifically in communicating complicated findings and in justifying exploratory data analysis.

4.2.4. *Network Analysis*

Network analysis proves to be the most efficient with an efficiency of 88, because it is effective in modeling relationship and interaction within data sets. It is also highly scalable at 87% to allow researchers to study complex systems of many interconnected components. But it has an accuracy of 79 which can change with the quality of the input data as well as the assumptions used in the creation of networks. Nonetheless, network analysis is very useful in the study of relational patterns in social, cultural and historical situations.

4.2.5. *GIS-based Analysis*

GIS-based analysis offers good overall functionality, the performance is 83 and the accuracy was 81. It is highly scalable with 88% higher and thus it will most effectively be used with large spatial datasets. GIS tools enable researchers to combine geographical data with any other data type to provide a multidimensional view of the research problems. It is particularly useful in the research where the spatial patterns are studied to disclose the relationship between place and other social or cultural phenomena.

4.3. Discussion

The findings of this paper significantly point out to the fact that computational approaches are important in improving the scalability and efficiency of research operations in the field of digital humanities. With the help of text mining, network analysis, and data visualization, researchers can process massive data sets in a relatively short time and locate patterns that would have been challenging to identify in the course of a manual analysis. This enhanced efficiency enables a wider scope of research and the capability to work with complex and large-scale data, which makes computational methods of research very useful in contemporary research settings. Moreover, such approaches promote consistency and reproducibility because automated processes minimize the risk of human error and provide the possibility to perform an analytical procedure in a standardized manner. Nevertheless, the results also imply that excessive dependence on the computational methods can result in the decrease of the interpretive richness. Algorithms are more useful in detecting patterns and trends, but they can be weak in terms of context and critical thinking, which humans have. This may lead to shallow or incomplete analyses especially in handling subtle cultural, historical or literary information. Computational results can also be biased by the data or the structure of algorithms, which additionally points to the importance of critical analysis and situational interpretation of outcomes. Hybrid methodologies, in this case, are the most efficient solution that will unite the advantages of both computational and traditional solutions. Quantitative analysis combined with qualitative interpretation can help the researchers gain a better insight into their research topic. Patterns can be discovered with the help of the computational tools and insights can be created, whereas the traditional methods will make sure that such findings are critically analyzed and meaningfully interpreted. Such a moderate course of action not only increases the trustworthiness and validity of the research findings but also maintains the depth and richness the humanities scholarship needs.

5. CONCLUSION

Technology-based practices have radically altered the way humanities are researched through the introduction of computational methods, data-driven methods, and interdisciplinary paradigms that fill the divide between traditional and current approach to technology. These methods have

allowed researchers to transcend the constraints of manual analysis and interact with large scale data, which create new opportunities to explore and discover. Text mining, data visualization, network analysis, and GIS-based analysis are some of the methods that enable scholars to analyze large volumes of information efficiently and to uncover patterns and relationships, and give insights which were previously hard or impossible to find out. Consequently, the humanities have seen an increase in the dynamism, scalability and analytic strength of research, enabling macro-level analysis as well as novel types of inquiry. Simultaneously, a number of significant challenges are also being introduced with the introduction of such methodologies that should be properly considered. The main issue is the risk of losing interpretive depth since computer tools are likely to miss out on contextual nuances, cultural peculiarities, and subjective meanings that are core to humanities research. Also, data quality and consistency problems may compromise result reliability, especially in cases of incomplete or heterogeneous data. Ethical aspects are also very important, particularly when we speak about data privacy, representation and responsible use of algorithms. Moreover, some of the scholars may lack technical skills, which will pose an obstacle to the successful use of advanced tools, which makes the development of skills and collaboration across disciplines essential. Considering these opportunities and challenges, the research finds that the future of humanities research is in the careful combination of both traditional and technological methods. The hybrid methodologies provide a moderate structure, which integrates the advantages of computational effectiveness and the richness of human interpretation. Through digital means of determining patterns and trends, followed by critical and contextual analysis of the results, researchers are able to gain more detailed and significant results. This integrative method makes research both more credible and of better quality, as well as maintains the fundamental values of humanities including critical thinking, cultural awareness and interpretive richness. Finally, the adoption of a hybrid approach will help scholars utilize the power of technology to the fullest extent without losing the intellectual richness characteristic of humanities research.

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