The Scientific Temper (2025) Vol. 16 (9): 4815-4818
E-ISSN: 2231-6396, ISSN: 0976-8653
Doi: 10.58414/SCIENTIFICTEMPER.2025.16.9.14
https://scientifictemper.com/

REVIEW ARTICLE

Comparative study on Datafication and Digitization

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Abstract

In the era of digital transformation, the concepts of digitization and datafication are frequently raised yet often conflated, limiting theoretical clarity and practical application. While digitization refers to the conversion of analog information into digital formats, datafication extends beyond this process by translating human actions, interactions, and phenomena into quantifiable data. This paper undertakes a comparative study of these two concepts, highlighting their distinctions, interconnections, and implications across sectors such as education, healthcare, and commerce. Drawing on an interdisciplinary literature review, the study identifies critical gaps, including the lack of conceptual differentiation, insufficient exploration of sectoral effects, and limited attention to social and ethical dimensions. By addressing these gaps, the paper contributes a clearer conceptual framework and offers insights into the socio-economic opportunities and challenges arising from the growing reliance on digitization and datafication.

Keywords: Digitization, Datafication, Digital Transformation, Socio-Economic Impact, Education, Healthcare.
关键词：数字化、数据化、数字转型、社会经济影响、教育、医疗保健。

Introduction

In the current era, where technology's rapid march is reshaping the world, the integration of digital tools has transformed communication, interaction, and operations across industries (Zhao *et al*., 2020; Ahmad & Murray, 2019). Central to this transformation are the intertwined concepts of digitization and datafication, although they are often conflated or used interchangeably (Zhao *et al*., 2020; Liao *et al*., 2020). Digitization refers to the conversion of analog information into digital formats, facilitating improved storage, retrieval, and analysis (Reis *et al*., 2020; Vartolomei & Avasilcai, 2019). In contrast, datafication goes beyond this technical process, involving the translation of human actions, interactions, and organizational practices into quantifiable data points (Fischer & Wunderlich, 2021; Marjanovic & Cecez-Kecmanovcic, 2017; Chan *et al*., 2022; Walentek, 2021).

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How to cite this article: Akila, L. (2025). Comparative study on Datafication and Digitization. The Scientific Temper, **16**(9):4815-4818.
Doi: 10.58414/SCIENTIFICTEMPER.2025.16.9.14

Source of support: Nil

Conflict of interest: None.

Despite their pivotal roles in shaping the digital landscape, the boundaries between digitization and datafication are frequently blurred, limiting clarity in both theory and practice (Jarke & Breiter, 2019; Williamson *et al*., 2020). This lack of distinction has significant implications, as both processes underpin advances in education, healthcare, commerce, and smart city development (Walentek, 2021; Begkos *et al*., 2024; Cozza, 2024). Consequently, there is a pressing need to delineate their conceptual foundations and explore their combined implications for organizations and society.

Literature Review

Conceptual foundations

- *Digitization*

Digitization refers to the technical process of converting analog information into digital formats, which improves accessibility, storage, and analysis of data (Reis *et al*., 2020; Vartolomei & Avasilcai, 2019; Liao, Zhao, & Sun, 2020).

- *Datafication*

In contrast, datafication involves transforming human activities, interactions, and organizational practices into quantifiable data, enabling predictive insights and decision-making across domains (Fischer & Wunderlich, 2021; Marjanovic & Cecez-Kecmanovcic, 2017; Chan *et al*., 2022; Walentek, 2021).

Received: 05/09/2025 **Accepted:** 16/09/2025 **Published:** 23/09/2025

Gaps in Literature

Conceptual clarity missing

Despite their frequent use, digitization and datafication are often conflated, with limited work delineating their conceptual boundaries (Zhao, Liao, & Sun, 2020; Reis *et al*., 2020; Liao *et al*., 2020).

Interconnections unexplored

Research has examined their individual impacts, yet their interconnections across different sectors remain underexplored (Jarke & Breiter, 2019; Ahmad & Murray, 2019; Vartolomei & Avasilcai, 2019; Begkos, Antonopoulou, & Ronzani, 2024).

Education sector underdeveloped

While studies acknowledge the role of digital tools in transforming education, few comprehensively address how digitization and datafication jointly influence pedagogy, equity, and student experience (Zhao *et al*., 2020; Jarke & Breiter, 2019; Williamson, Bayne, & Shay, 2020; Pangrazio, Selwyn, & Cumbo, 2023).

Socio-ethical issues neglected

Finally, although technical advancements such as big data and AI are widely studied, fewer works critically examine their socio-ethical implications, particularly concerning privacy, surveillance, and fairness (Mussgnug, 2020; Gstrein & Beaulieu, 2022; Cozza, 2024; De Mauro, Greco, & Grimaldi, 2015).

Research Agenda

To address the identified gaps, this study proposes a structured research agenda that builds on existing work while advancing conceptual and practical clarity.

Clarifying distinct characteristics

To resolve the persistent confusion between digitization and datafication, future research should undertake comparative analyses that synthesize perspectives from information systems, education, and organizational studies (Zhao *et al*., 2020; Reis *et al*., 2020; Liao *et al*., 2020). Such efforts can contribute to developing a precise conceptual framework that differentiates the two processes, ensuring their accurate application in research and practice (Fischer & Wunderlich, 2021; Marjanovic & Cecez-Kecmanovcic, 2017).

Unraveling interconnections and implications

Exploring the interplay of digitization and datafication across sectors remains essential. Cross-case analyses and interdisciplinary studies can illuminate how these processes co-evolve and influence knowledge work, education, healthcare, and commerce (Jarke & Breiter, 2019; Ahmad & Murray, 2019; Vartolomei & Avasilcai, 2019; Begkos *et al*., 2024). Such investigations would highlight both the synergies and tensions that arise when digitization enables access to digital resources while datafication drives predictive insights and automation (Chan *et al*., 2022; Walentek, 2021).

Exploring effects in education

Education remains an underdeveloped domain for examining the joint impact of digitization and datafication. Future studies should go beyond acknowledging digital tools in classrooms (Zhao *et al*., 2020; Williamson *et al*., 2020) to systematically analyze how student data collection, algorithmic assessment, and personalized learning environments reshape pedagogy, equity, and student agency (Jarke & Breiter, 2019; Pangrazio *et al*., 2023). This would provide evidence-based insights into both the opportunities and risks of educational datafication.

Addressing social and ethical dimensions

Finally, there is a need for critical engagement with the ethical and societal consequences of increasing reliance on data technologies. While datafication promises efficiency and innovation, it also raises concerns about privacy, surveillance, and fairness (Mussgnug, 2020; Gstrein & Beaulieu, 2022; Cozza, 2024). Future research should integrate perspectives from ethics, law, and philosophy to develop governance models and accountability frameworks that balance innovation with responsible data practices (Begkos *et al*., 2024; De Mauro *et al*., 2015).

By pursuing these four strands, the research agenda aims to advance conceptual clarity, strengthen sector-specific insights, and foster critical awareness of the socio-ethical dimensions of digitization and datafication.

Methodology

The methodology adopted in this study was designed to systematically address the research gaps identified in the literature. A qualitative, comparative approach was employed, drawing upon interdisciplinary sources from computer science, education, sociology, philosophy, and organizational studies. References were collected from peer-reviewed journals, conference proceedings, and academic databases including Scopus, Springer, and IEEE Xplore, covering the period 2015–2024. In total, 45 publications were reviewed, of which 17 were selected as core references for their direct relevance to digitization and datafication.

Clarifying Distinct Characteristics

To differentiate digitization from datafication, a comparative literature analysis was conducted, synthesizing definitions and conceptualizations from prior studies (Zhao *et al*., 2020; Reis *et al*., 2020; Liao *et al*., 2020). This involved mapping similarities and differences in their usage across technical, organizational, and educational domains (Fischer & Wunderlich, 2021; Marjanovic & Cecez-Kecmanovcic, 2017).

Unraveling Interconnections and Implications

A cross-sectoral synthesis was undertaken to explore how digitization and datafication intersect in practice. Case-based literature from education, healthcare, commerce, and governance was examined (Jarke & Breiter, 2019; Ahmad

& Murray, 2019; Vartolomei & Avasilcai, 2019; Begkos *et al*., 2024). Interdisciplinary perspectives were incorporated to highlight complementarities, tensions, and implications for knowledge work, organizational performance, and policy (Chan *et al*., 2022; Walentek, 2021).

Exploring Effects in Education

For the education sector, studies focusing on digital classrooms, student data analytics, and personalized learning environments were critically reviewed (Zhao *et al*., 2020; Jarke & Breiter, 2019; Williamson *et al*., 2020; Pangrazio *et al*., 2023). The analysis focused on identifying both opportunities (e.g., improved learning outcomes, personalization) and risks (e.g., surveillance, reduced autonomy).

Addressing Social and Ethical Dimensions

To investigate the broader ethical and societal concerns, philosophical and legal literature was analyzed (Mussgnug, 2020; Gstrein & Beaulieu, 2022; Cozza, 2024), alongside applied studies in healthcare and welfare systems (Begkos *et al*., 2024). This provided a foundation for reflecting on issues of privacy, surveillance, fairness, and accountability in a datafied society (De Mauro *et al*., 2015).

In summary, this multi-layered methodology combined comparative analysis, sectoral synthesis, and interdisciplinary perspectives to provide a holistic understanding of digitization and datafication. The approach not only clarified conceptual distinctions but also illuminated their implications across sectors and their broader socio-ethical impact.

Discussion

The comparative analysis of digitization and datafication reveals that their roles in digital transformation are complementary yet distinct. Digitization primarily addresses the technical conversion of analog information into digital formats, improving storage, retrieval, and accessibility (Reis *et al*., 2020). In contrast, datafication extends this process by translating human activities and organizational practices into quantifiable data, thereby enabling new forms of analysis, prediction, and value creation (Walentek, 2021). This distinction is critical because conflating the two may lead to oversimplified strategies in sectors such as education, healthcare, and commerce (Begkos *et al*., 2024).

The findings further suggest that digitization often produces immediate operational efficiency, whereas datafication generates long-term strategic opportunities while simultaneously raising complex ethical and social challenges. For instance, in education, digitization enhances access to digital content and teaching resources (Jarke & Breiter, 2019), while datafication enables performance tracking, personalization, and predictive analytics (Williamson *et al*., 2020). However, these benefits raise concerns regarding surveillance, student autonomy, and data privacy (Gstrein & Beaulieu, 2022). Similarly, in healthcare, digitization supports efficient medical record management and interoperability (Vartolomei & Avasilcai, 2019), while datafication enables predictive diagnostics and resource allocation (Begkos *et al*., 2024), but risks patient surveillance and algorithmic bias (Cozza, 2024).

This dual perspective underscores the need for balanced approaches that maximize the efficiency and innovation enabled by digitization and datafication while minimizing risks related to privacy, ethics, and equity (De Mauro *et al*., 2015). Conceptually, this study contributes to the literature by framing digitization and datafication not as interchangeable terms but as interdependent processes that jointly shape digital transformation. Nonetheless, the current analysis remains primarily theoretical; future research should expand through empirical case studies across sectors to validate these insights and further examine their socio-economic and ethical implications.

Conclusion

This study has clarified the conceptual distinctions between digitization and datafication, emphasizing that while digitization focuses on the migration of information into digital formats, datafication captures the transformation of human and organizational activities into quantifiable data. By addressing four major gaps—conceptual clarity, interconnections across sectors, implications for education, and social-ethical dimensions—the study provides a more comprehensive understanding of how these processes collectively shape digital transformation. The findings underscore that the benefits of digitization and datafication extend across multiple domains, enabling efficiency, personalization, and innovation, but also pose risks related to privacy, surveillance, and ethical use of data. For researchers, this work offers a framework for future investigations into sector-specific applications and ethical considerations. For practitioners and policymakers, it highlights the importance of balancing technological opportunities with safeguards that ensure fairness, accountability, and trust. Future studies could expand this work by conducting empirical investigations and case analyses to validate and contextualize the conceptual insights presented here.

Acknowledgements

The author is grateful to the management of Krupanidhi Degree College for the encouragement and support for the study.

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