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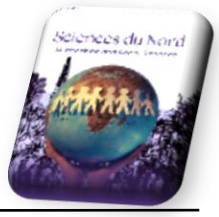

A Bibliometric Study on Job and Employment Transformation in the Digital Economy

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ABSTRACT

The transformation of jobs and employment structures in the digital economy is a critical area of inquiry amid rapid technological advancement and structural shifts in labor markets. This study conducts a bibliometric analysis to map the intellectual landscape of this domain using data extracted from the Scopus database. Utilizing VOSviewer for network and density visualizations, the analysis covers publication trends, author and country collaborations, citation patterns, and keyword co-occurrence between 2000 and 2024. The results reveal that employment is a central theme, strongly associated with concepts such as digital transformation, automation, artificial intelligence, and labor market restructuring. Two main research clusters are identified: one centered on technology-induced disruption and the other on skills development and labor adaptation. While the United States and China dominate the research landscape, emerging collaborations from Europe and Asia reflect growing global interest. The findings offer insights into the evolution of research priorities and point to future research directions, including interdisciplinary integration, ethical considerations, and inclusive digital workforce policies. This study contributes to a deeper understanding of how academic discourse is shaping responses to the changing world of work in the digital age.

Keywords: *Employment Transformation, Digital Economy, Automation, Labor Market, Bibliometric Analysis*

INTRODUCTION

The emergence of the digital economy has dramatically reshaped the global employment landscape. Driven by rapid advances in technologies such as artificial intelligence (AI), automation, big data, blockchain, and digital platforms, labor markets around the world are undergoing unprecedented transformation [1], [2]. These technologies are not only altering how work is performed but are also redefining the very nature of jobs and employment relationships. Traditional full-time employment is increasingly being supplemented or in some cases supplanted by flexible, freelance, and platform-based work structures, often referred to as the gig economy. In this context, understanding the structural shifts in employment patterns becomes crucial for governments, businesses, and workers alike [3], [4].

One of the key features of this transformation is job polarization. While high-skilled digital occupations are proliferating, middle-skilled routine jobs are declining due to automation and process digitalization [5]. Simultaneously, there is growth in low-skilled service work, which remains less susceptible to automation but often involves precarious conditions. These shifts reflect a broader trend in which digital technologies not only replace certain types of labor but also create new forms of employment, often with different skill requirements and employment terms [6]. Such polarization raises significant concerns about income inequality, labor market inclusion, and social protection frameworks, particularly for workers in vulnerable sectors.

Moreover, the COVID-19 pandemic has further accelerated the digitalization of work. Remote work, e-commerce, and digital service delivery surged during global lockdowns, reinforcing

the relevance of digital infrastructure and digital competencies in ensuring business and employment continuity [7]. This acceleration has intensified scholarly attention on the long-term implications of digitalization on labor markets, prompting questions around digital reskilling, telework regulation, and social safety nets for non-standard workers. These global disruptions have catalyzed new research on the resilience, adaptability, and sustainability of employment systems in the digital era.

The transformation of work in the digital economy is also deeply contextual, varying across regions, sectors, and policy environments. Developed economies tend to experience more rapid technology adoption and digital skills integration, whereas emerging economies often grapple with digital divides and informality in the labor force [8]. In some contexts, digital technologies serve as tools for inclusive development and entrepreneurship, while in others, they exacerbate exclusion and job displacement. This multifaceted impact makes it essential to adopt a comprehensive analytical framework that captures the diversity of experiences and outcomes in different labor markets.

Given the complexity and global scale of job transformation in the digital economy, a systematic synthesis of scholarly research is required to trace conceptual evolution, identify key themes, and map intellectual networks. Bibliometric analysis offers a powerful methodological tool for achieving this, by quantitatively analyzing large volumes of academic literature to uncover patterns in authorship, institutional affiliations, citation impact, and thematic trends (Donthu et al., 2021). Through bibliometric mapping, researchers can identify influential works, core journals, collaboration networks, and emerging research frontiers, thereby providing valuable insights into how the discourse on digital employment is developing over time.

Despite a growing body of research on job transformation in the digital economy, there is limited understanding of how this field has evolved in terms of intellectual structure, key contributors, and thematic orientations. Existing studies tend to be fragmented, often focusing on specific sectors (e.g., platform work), regions (e.g., Global North), or policy debates (e.g., universal basic income), without providing a holistic view of the scholarly landscape. There is a need for a comprehensive bibliometric synthesis to organize this rapidly expanding literature, identify research gaps, and inform future directions for academics and policymakers. Without such a synthesis, there is a risk of duplication, conceptual confusion, and missed opportunities for interdisciplinary collaboration. This study aims to conduct a bibliometric analysis of global academic literature on job and employment transformation in the context of the digital economy.

METHOD

This study employed a bibliometric analysis to systematically map and evaluate the scientific literature on job and employment transformation in the digital economy. Bibliometric analysis is a quantitative research method that utilizes statistical and visualization tools to assess the structure, development, and trends in a given body of academic literature [9]. It enables researchers to identify key contributors, influential publications, thematic clusters, and intellectual structures within a specific research domain. For this study, bibliometric techniques were applied to data retrieved from a reputable academic database, and the analysis was conducted using VOSviewer—a leading software tool for constructing and visualizing bibliometric networks [10].

Data Source and Search Strategy

The data for this study were extracted from the Scopus database, which is recognized for its extensive and multidisciplinary coverage of peer-reviewed journal articles, conference proceedings, and book chapters. Scopus was chosen due to its high-quality indexing and comprehensive metadata, which is suitable for bibliometric mapping. To capture the breadth of research on job and employment transformation in the digital economy, a search query was carefully designed using a combination of relevant keywords and Boolean operators. The final query included terms such as:

TITLE-ABS-KEY ("digital economy" OR "platform economy" OR "gig economy" OR "automation" OR "AI and work") AND ("job transformation" OR "employment change" OR "future of work" OR "labor market" OR "workforce transition"). The search was restricted to publications in English, with the document type limited to articles, reviews, and conference papers to ensure scientific rigor. The publication period was set between 2000 and 2024, covering a 25-year window to trace the evolution of the field over time.

Data Screening and Export

Following the initial search, all retrieved documents were subjected to a manual screening process to ensure relevance to the study topic. Duplicates, irrelevant results (e.g., unrelated to employment or digitalization), and non-scholarly records were excluded. The final dataset comprised N = 900 documents. Bibliographic information such as author names, titles, abstracts, keywords, publication years, sources, and citations was exported in CSV format for further processing in VOSviewer.

Bibliometric Tools and Techniques

To perform the bibliometric analysis, this study used VOSviewer (version 1.6.x), a widely adopted tool for visualizing bibliometric networks. Three main types of analysis were conducted such as co-authorship analysis, citation analysis, and keyword co-occurrence analysis. The VOSviewer software uses natural language processing and clustering algorithms to group related items into clusters and visualize them through density maps and network diagrams. Only items that met a minimum threshold (e.g., authors with at least 5 publications, keywords occurring at least 10 times) were included to ensure clarity in visualization.

RESULT

Co-Authorship Analysis

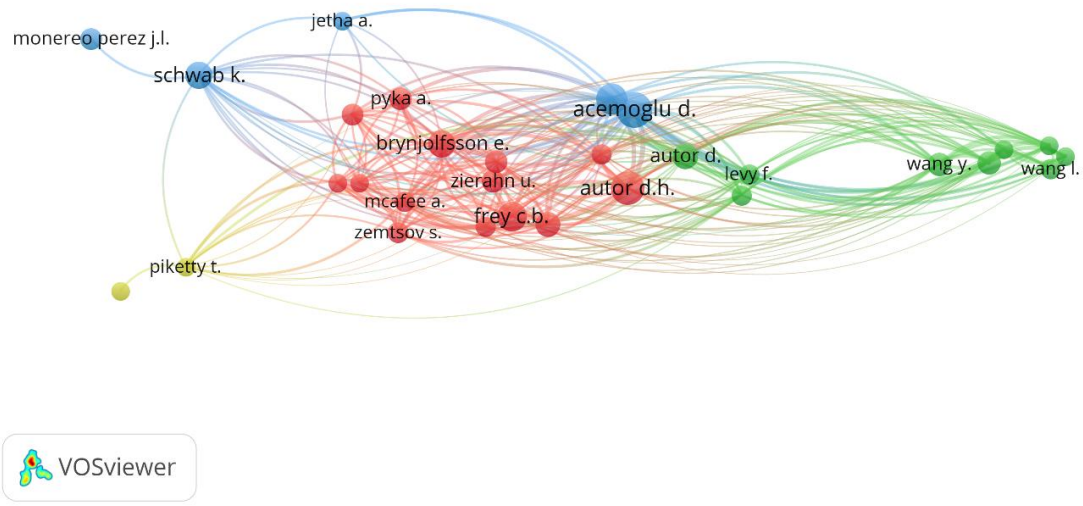

Figure 1. Author Visualization
Source: Data Analysis

The network visualization illustrates the co-authorship or co-citation relationships among influential authors in the field of job and employment transformation in the digital economy. The map is structured into four main clusters, represented by different colors. The red cluster, which is

the most densely interconnected, includes prominent authors such as Brynjolfsson E., Frey C.B., McAfee A., and Zierahn U., indicating a strong intellectual focus on automation, digital disruption, and the future of work. The green cluster, centered around Wang Y. and Wang L., appears to represent a different regional or thematic orientation, possibly focusing on employment changes in Asian contexts or alternative methodological approaches. The blue cluster, with authors like Schwab K. and Monereo Perez J.L., may relate to policy-oriented or conceptual discussions, potentially linked to global frameworks like the Fourth Industrial Revolution. Notably, Acemoglu D. and Autor D., placed at the intersection of the red and green clusters, act as bridging figures, indicating their widespread influence across different research strands. The yellow node (Piketty T.) is relatively peripheral, suggesting less integration with the main discourse but still connected through shared citations.

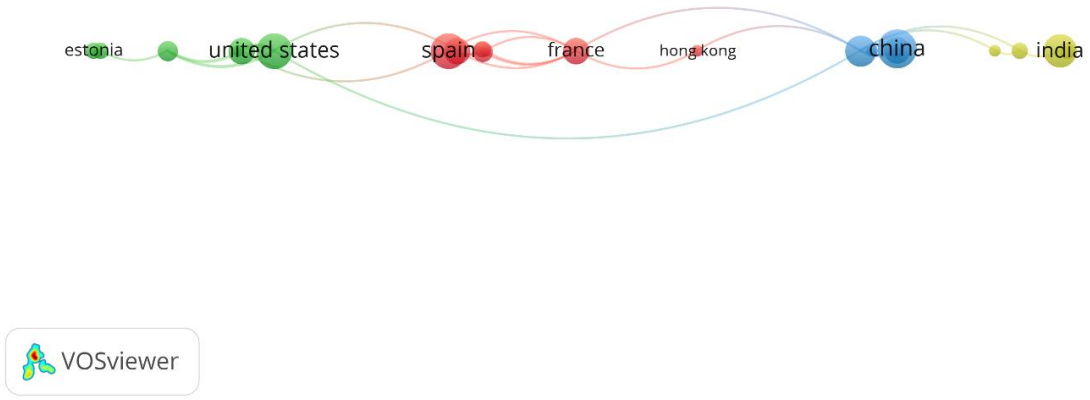

Figure 2. Country Visualization
Source: Data Analysis

The visualization above presents a country-level co-authorship network, highlighting international collaboration in the field of job and employment transformation within the digital economy. The map reveals several prominent clusters based on geographic and research linkages. The United States, shown in green, emerges as a central hub, with strong connections to both European countries such as Spain, France, and Estonia, and Asian countries like China and India. This underscores the United States' pivotal role in facilitating cross-regional research. The red cluster groups Spain and France, indicating close collaborative efforts, likely driven by shared EU research frameworks. China, visualized in blue, forms its own significant node with ties to Hong Kong and international partners, suggesting a rapidly growing contribution from East Asia. The yellow cluster comprises India, which, although slightly peripheral, maintains links with China and the broader network.

Citation Analysis

Table 1. Most Cited Article

Citations	Author and Year	Title
157	L. Caruso	Digital innovation and the fourth industrial revolution: epochal social changes?

138	A. Ellmeier	Cultural entrepreneurialism: on the changing relationship between the arts, culture and employment1
123	O. Kolade, A. Owoseni	Employment 5.0: The work of the future and the future of work
108	H. Aly	Digital transformation, development and productivity in developing countries: is artificial intelligence a curse or a blessing?
91	F. Bertani, L. Ponta, M. Raberto, A. Teglio, S. Cincotti	The complexity of the intangible digital economy: an agent-based model
83	A. Pyka	Dedicated innovation systems to support the transformation towards sustainability: Creating income opportunities and employment in the knowledge-based digital bioeconomy
78	J.E. Fountain	Constructing the information society: Women, information technology, and design
69	A. Aloisi, V. De Stefano	Your boss is an algorithm: Artificial intelligence, platform work and labour
66	B.E. Duffy, B. Schwartz	Digital "women's work?": Job recruitment ads and the feminization of social media employment
58	A.J. Means	Learning to save the future: Rethinking education and work in an era of digital capitalism

Source: Scopus, 2025

Keyword Co-Occurrence Analysis

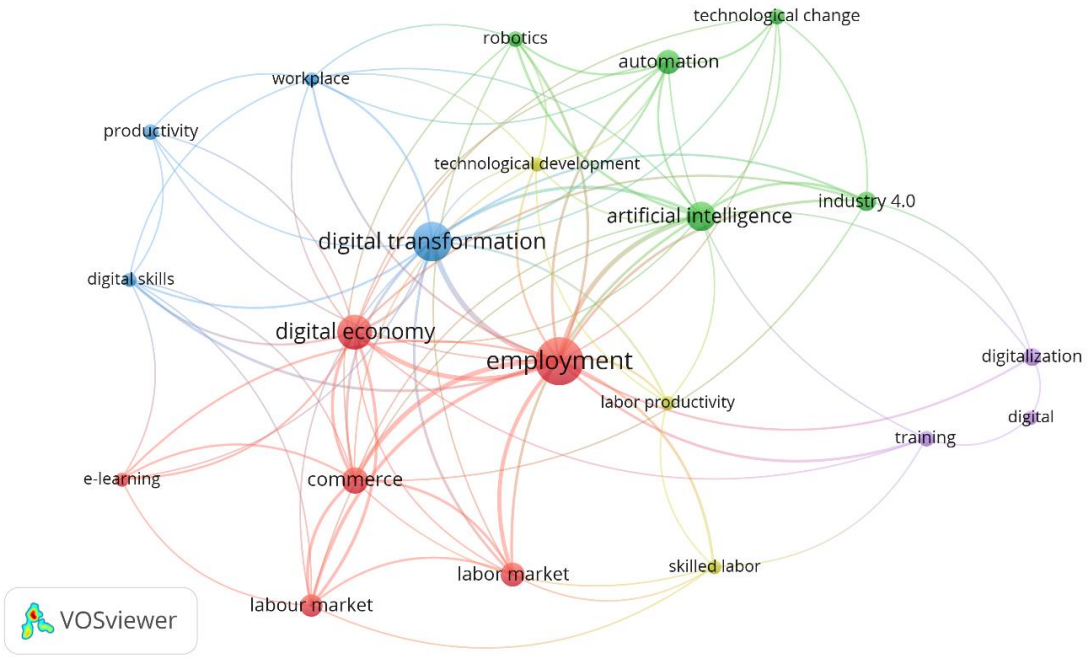

Figure 3. Network Visualization
Source: Data Analysis

The keyword co-occurrence map presented above illustrates the intellectual structure of the research landscape concerning job and employment transformation in the digital economy. The most central and frequently co-occurring term is "employment", shown in a large red node, indicating its foundational role in the literature. Closely surrounding it are keywords like "labor market", "digital economy", "digital transformation", and "commerce", which represent major thematic foci. These terms reflect a strong research emphasis on how employment is shaped by broader economic shifts

toward digitalization, including transitions in commercial structures, labor demand, and workforce participation.

The green cluster, anchored by terms such as "artificial intelligence", "automation", "technological change", and "industry 4.0", represents a distinct stream of literature that emphasizes the technological drivers of employment transformation. These keywords are closely connected to one another and link back to employment and labor productivity, highlighting ongoing concerns about job displacement, skill obsolescence, and the future of work in the face of rapid automation and intelligent systems. This cluster suggests that researchers are deeply engaged in exploring the implications of emerging technologies on workforce composition and job design. The blue cluster, consisting of terms like "digital skills", "productivity", and "workplace", emphasizes the competency and organizational responses to digital change. This thematic group focuses on how employees and organizations adapt to digital tools, with a particular emphasis on reskilling, workplace restructuring, and the need for agility. The linkages to "digital transformation" and "productivity" imply that this literature also explores how digital capabilities contribute to firm-level and economy-wide productivity gains, often requiring new forms of workplace management and learning systems.

Meanwhile, a smaller purple cluster on the right, containing terms such as "training", "digitalization", and "skilled labor", connects to broader educational and policy-oriented themes. It reflects concerns about human capital development in response to digital shifts, particularly the need for targeted training programs and upskilling initiatives. This cluster links conceptually to the other domains, especially those dealing with automation and labor productivity, indicating an integrated focus on how to prepare the workforce for future technological demands.

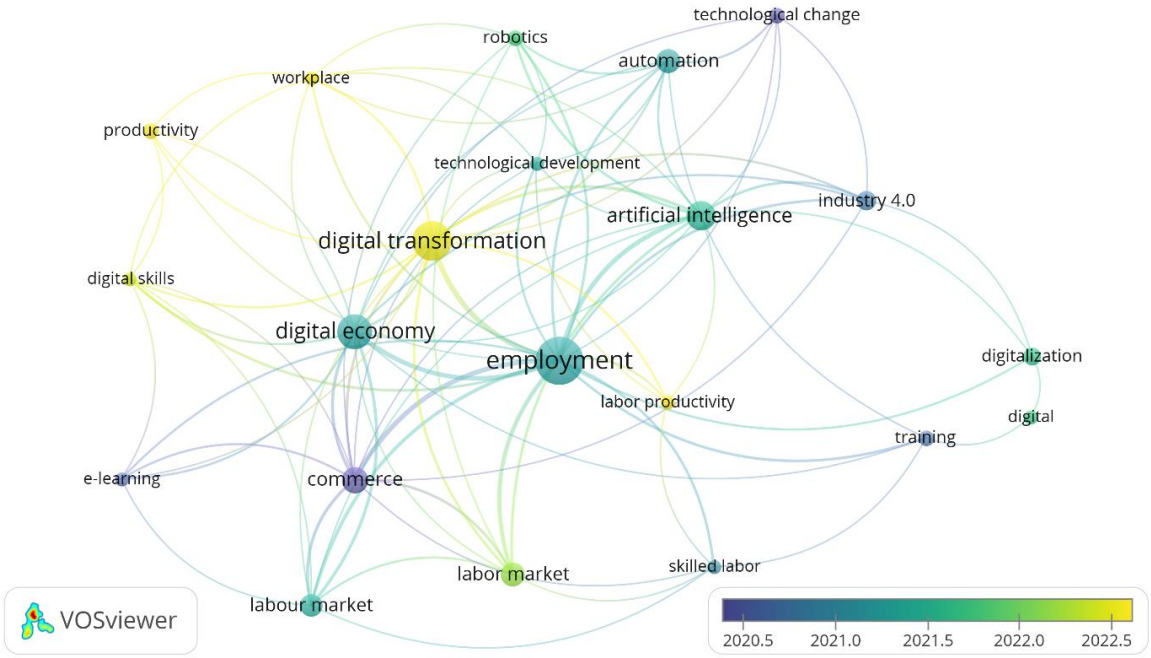

Figure 4. Overlay Visualization
Source: Data Analysis

The overlay visualization map above illustrates the temporal evolution of research themes related to employment transformation in the digital economy. The color gradient, ranging from blue (older average publication year) to yellow (more recent), reflects the recency of interest in each keyword. The central node “employment” appears in greenish-blue, suggesting it has been a consistently explored theme from around 2021 onward. In contrast, more recent interest highlighted in yellow is concentrated around keywords such as “digital transformation”, “digital skills”, and

"workplace", indicating a shift in focus toward adaptation and human capital development in the context of accelerating digital change post-pandemic.

The technological dimension of the literature represented by terms like "artificial intelligence", "automation", "industry 4.0", and "technological development" displays a blend of light blue to green hues, indicating steady scholarly attention from 2020 through 2022. The placement and color of these nodes suggest that while the technological disruptors of work were focal topics during the early COVID-19 period, they continue to maintain relevance in more recent studies. This reflects a stable and ongoing academic concern with how these technologies reshape labor markets, drive productivity, and influence skill requirements.

Notably, older themes such as "e-learning", "commerce", and "digitalization" appear in darker shades (blue to violet), suggesting that research around digital infrastructures and commerce surged earlier in the timeline—possibly in response to the immediate need for digital transition at the beginning of the pandemic. Meanwhile, the emergence of newer keywords related to "digital transformation", "productivity", and "labor market" in yellow-green hues implies a shifting research emphasis toward evaluating the outcomes and structural changes induced by digital adoption, including how organizations and labor systems evolve in a more permanent hybrid or digital-first environment.

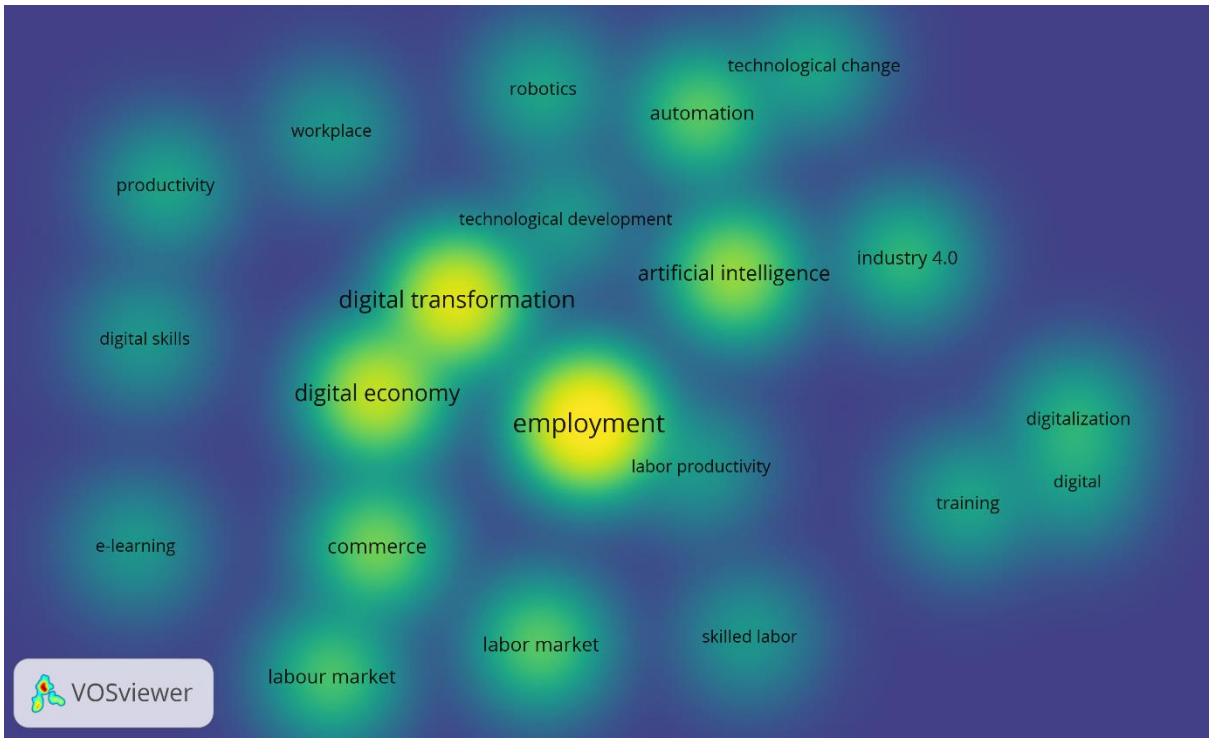

Figure 5. Density Visualization
Source: Data Analysis

The density visualization highlights the most intensively researched themes in the literature on job and employment transformation in the digital economy. The bright yellow nodes, such as "employment", "digital transformation", and "digital economy", indicate areas with the highest frequency of keyword occurrences and co-occurrences, suggesting that these are central, well-established topics in the field. These dense regions represent the scholarly core where digital innovations intersect directly with labor market changes, including structural shifts, technological integration, and evolving employment models. Surrounding these core concepts are moderately dense nodes like "artificial intelligence", "automation", "labor market", and "commerce", which show considerable scholarly attention but slightly less than the core keywords. On the periphery, with lower density and less frequent occurrence, are topics such as "skilled labor", "e-learning", "training",

and "productivity". These areas may represent emerging or specialized sub-themes that, while relevant, are not yet as dominant in the overall research landscape.

DISCUSSION

The results of the bibliometric analysis provide comprehensive insights into the evolving academic discourse surrounding job and employment transformation in the digital economy. Through co-authorship networks, country collaborations, and keyword co-occurrence and density maps, several important patterns and themes emerge that reflect both the maturity of certain research areas and the emergence of new scholarly concerns. This discussion integrates these findings with theoretical interpretations and policy relevance, emphasizing the implications for workforce dynamics, research directions, and interdisciplinary collaboration.

One of the most prominent findings is the centrality of employment as the dominant keyword across all visualizations, affirming that job transformation remains the core concern within the digital economy discourse. Closely linked terms such as digital transformation, digital economy, and labor market suggest that scholars conceptualize employment change not as an isolated phenomenon, but as one intricately linked to macroeconomic shifts and technological modernization. These findings resonate with theories of structural economic transformation, where technological paradigms like Industry 4.0 and AI fundamentally alter the allocation and nature of labor [11], [12], [13].

Furthermore, the keyword co-occurrence map highlights two major thematic streams. The first is technology-driven disruption, with keywords such as automation, artificial intelligence, technological development, and robotics forming a coherent cluster. This stream reflects growing academic concern regarding job displacement, de-skilling, and technological unemployment. Scholars such as Acemoglu and Autor have extensively addressed the dual effect of automation: while it can boost productivity and create new job categories, it also risks eliminating routine jobs, particularly those involving middle skills [14]. The co-occurrence of these terms with “employment” suggests that the literature often addresses both sides of the automation debate.

The second thematic stream concerns skills and human capital adaptation. Keywords such as digital skills, training, e-learning, skilled labor, and workplace suggest a significant body of research focused on workforce readiness in the digital era. This aligns with human capital theory, which posits that the employability of workers depends increasingly on their capacity to learn, adapt, and upskill in response to changing labor demands [15]. In particular, post-pandemic developments have amplified the relevance of digital skills as both a survival mechanism and a long-term strategic necessity for employment security. Studies in this domain often examine the effectiveness of training programs, digital literacy initiatives, and policies to close the skills gap in both developed and developing economies.

The country co-authorship map reflects the geopolitical diversity and fragmentation of the field. The United States emerges as a central node, suggesting its leading role in shaping global research on the digital economy and labor. Countries such as China, Spain, France, and India also show substantial involvement, with varying degrees of connectivity. Notably, regional clusters suggest that collaboration is still somewhat regionally siloed, with strong intra-European and intra-Asian ties but relatively limited intercontinental co-authorship. This pattern suggests the potential for more global comparative research to emerge in the future, especially on topics like platform work regulation, labor informality, and cross-cultural responses to automation.

Author co-citation analysis reveals a core group of influential scholars, including Brynjolfsson, McAfee, Frey, and Autor, who are frequently cited together and occupy the intellectual center of the field. These authors have been instrumental in framing foundational debates—such as whether AI leads to net job loss, how tasks are restructured rather than jobs entirely replaced, and what policy responses are most effective. The bridging role played by scholars like Acemoglu, who

connects multiple thematic clusters, demonstrates the interdisciplinary nature of the field—bringing together labor economics, technological innovation studies, and policy analysis. Meanwhile, more peripheral but rising authors may represent emerging voices, offering novel perspectives or regional insights, especially from the Global South.

Temporal analysis using the overlay map offers valuable insights into the evolution of research priorities over time. Terms like digitalization, commerce, and e-learning appeared earlier in the dataset (2020–2021), likely reflecting immediate pandemic-driven shifts. More recent attention has shifted toward digital transformation, workplace, and productivity (2022–2023), indicating a growing interest in long-term organizational adaptation rather than crisis response. This trend suggests a shift in scholarly focus from "reacting to disruption" toward "strategizing for the future." Moreover, the emerging prominence of terms like digital skills and training in recent literature signals the field's increasing concern with human-centered approaches rather than purely technical or economic perspectives.

The density visualization reinforces this interpretation by identifying the most heavily researched and saturated themes. The most intense areas—employment, digital economy, digital transformation, and artificial intelligence—represent the conceptual core of the field, where most of the literature is concentrated. Peripheral but increasingly important themes such as training, skilled labor, and workplace suggest directions where more granular and applied research could contribute. For example, sectoral studies on healthcare, manufacturing, or education may enrich the field with context-specific insights into how digital transformation manifests differently across industries.

From a policy standpoint, these findings carry several implications. First, there is a strong evidence base to support investments in digital infrastructure and workforce reskilling, especially in vulnerable labor segments. Governments and international agencies must adopt proactive strategies to ensure inclusive digital transitions. Second, the literature points to a need for labor market regulations that protect workers in non-standard or platform-based employment arrangements, which are increasingly prevalent in the gig economy. Third, there is an academic consensus on the necessity of multistakeholder collaboration, involving government, academia, industry, and civil society—mirroring the Penta-Helix framework—as a means to address complex labor market challenges in the digital age.

Despite the strengths of the current research landscape, the bibliometric evidence also reveals gaps. For instance, there is limited integration of ethical, psychological, and well-being aspects of employment transformation, such as algorithmic bias, mental health in remote work, and digital fatigue. Additionally, cross-country empirical studies, especially from developing and underrepresented regions, remain scarce. The bibliometric clustering reveals thematic silos that could benefit from more interdisciplinary dialogue—for example, linking AI ethics with labor law, or combining digital infrastructure studies with gendered labor market outcomes.

CONCLUSION

This study provides a comprehensive bibliometric overview of the academic literature on job and employment transformation in the digital economy. Through co-authorship analysis, keyword mapping, and temporal visualization, we identified key contributors, collaboration patterns, dominant themes, and research trends. The results highlight that employment remains at the center of scholarly discourse, surrounded by interlinked concerns such as digital transformation, automation, artificial intelligence, labor market restructuring, and skills development. The findings point to two dominant research clusters: one focusing on technological disruption and the other on human capital adaptation. While established scholars like Brynjolfsson, Frey, and Autor continue to anchor the intellectual development of the field, new areas—particularly concerning training, workplace design, and digital upskilling are gaining traction. The temporal shift toward themes such as digital productivity and transformation post-2021 suggests a transition from reactive to strategic

research orientations. Furthermore, although research collaboration is growing, it remains concentrated in specific regions, with limited representation from the Global South. Addressing these gaps and integrating underexplored themes such as worker well-being, digital inequality, and cross-sectoral policy innovation will be crucial for a more holistic understanding of the evolving labor landscape.

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