

Digital Transformation in the Fashion Industry: A Bibliometric Analysis from a Social Science Perspective

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ABSTRACT

Digital transformation is increasingly reshaping the fashion industry through technology-driven innovation, sustainable practices, digital design, artificial intelligence, e-commerce and new forms of consumer engagement. This study aims to examine the current research trends and intellectual structure of social science research on digital transformation in the fashion industry using a bibliometric analysis approach. Bibliographic data were retrieved from the Scopus database, covering publications from 2005 to 2026, with 2026 records representing publications indexed up to the date of data extraction. A structured search strategy was applied within the title, abstract and keyword fields, followed by a systematic screening process based on the PRISMA 2020 guidelines. After applying subject-area, document-type and eligibility criteria, 410 publications were retained for final analysis. The data were processed using BiblioSpy® to generate bibliometric indicators, descriptive statistics and keyword co-occurrence visualisations. The analysis examined publication output, citation impact, annual publication and citation trends, leading source titles, highly cited publications, productive institutions and countries, and dominant conceptual clusters. The findings reveal substantial growth in publication productivity, particularly from 2020 onwards, with 2025 recording the highest annual output. The field also demonstrates strong citation visibility, international collaboration and interdisciplinary engagement. China, South Korea, the United States, Italy and the United Kingdom emerged as leading contributors, while key journals reflected intersections between fashion education, sustainability, textiles, marketing and human-computer interaction. Keyword co-occurrence analysis identified major themes related to sustainability, Industry 4.0, circular economy, digital fashion, artificial intelligence, consumer behaviour and fashion education. This study provides a systematic overview of the field and offers a foundation for future research on technology-driven transformation in fashion.

Keywords: Digital transformation; Fashion industry; Bibliometric analysis; Social science research; Sustainability; Industry 4.0

INTRODUCTION

The fashion industry has become one of the most dynamic sectors affected by digital transformation. As fashion systems continue to shift across design, production, retail, marketing and consumption, digital technologies increasingly influence how value is created, communicated and delivered. This transformation is not limited to technical innovation alone, but also involves changes in organisational decision-making, consumer interaction, sustainability priorities, workforce capability and educational preparation. Casciani et al. (2022) explain that digital transformation in fashion creates opportunities for supply chains, business models and sustainability-oriented innovation, showing that the field must be understood as both technological and organisational change.

The growing academic interest in this topic reflects the changing nature of the fashion industry itself. Fashion businesses are expected to respond more quickly to market demand, operate with greater transparency, reduce environmental impact and engage consumers through digital channels. Colombi and D'Itria (2023) argue that digitally enabled practices can support circular business models by improving resource efficiency, traceability and sustainability-oriented value creation. At the same time, digital fashion innovation has expanded into areas such as digital design, e-prototyping, digital business, promotion and virtual environments (Sayem, 2022). These

developments indicate that digital transformation in fashion cannot be understood only through a technological lens. It must also be examined from a social science perspective because it involves human behaviour, management practices, education, sustainability decisions and market responses.

Although digital transformation in fashion has received increasing scholarly attention, the literature remains distributed across several related areas. Hasbullah et al. (2024) examined digital transformation in omni-channel retailing and identified fashion as one of the major sectoral themes, while Bermeo-Giraldo et al. (2025) mapped digital transformation in the textile sector in relation to productivity, product quality, sustainability, customer satisfaction and supply-chain performance. Meanwhile, Sholikhah et al. (2026) focused on digital fashion skills in Green TVET, highlighting the importance of vocational education, digital competencies and sustainability-oriented teacher preparation. These studies show that digital transformation in fashion-related fields has been examined through retail, textile, sustainability and educational perspectives. However, their different sectoral boundaries also indicate that the field remains fragmented.

Bibliometric analysis provides a useful approach for addressing this issue. By examining publication output, citation impact, authorship patterns, source productivity, institutional and country contributions, and keyword co-occurrence, bibliometric methods allow researchers to identify the intellectual structure and development of a research field. Donthu et al. (2021) describe bibliometric analysis as a rigorous method for exploring large volumes of scientific data and identifying emerging areas within a field. This approach is particularly relevant for interdisciplinary topics such as digital transformation in the fashion industry, where research expands across different disciplines, publication outlets and conceptual perspectives.

This study therefore aims to map social science research on digital transformation in the fashion industry through a bibliometric analysis of Scopus-indexed publications from 2005 to 2026. A total of 410 publications were analysed using BiblioSpy® to generate bibliometric indicators, descriptive statistics and keyword co-occurrence networks. The analysis focuses on publication and citation trends, active source titles, highly cited documents, leading institutions and countries, and dominant conceptual clusters within the field. By offering a structured bibliometric overview, this study contributes to future research on how digital transformation continues to influence the fashion industry from social, educational, managerial, consumer-oriented and sustainability-related perspectives.

LITERATURE REVIEW

Digital Transformation in the Fashion Industry

Digital transformation in the fashion industry refers to the integration of digital technologies into design, production, distribution, retailing and consumer engagement. It involves more than the adoption of technological tools, as it changes organisational processes, business models and value-creation practices. Casciani et al. (2022) explain that digital transformation creates opportunities for fashion supply chains, business models and sustainability-oriented innovation, showing that digitalisation affects the industry at both operational and strategic levels. Similarly, Conlon and Gallery (2024) highlight that technologies such as artificial intelligence, augmented reality, virtual reality, digital fashion design, NFTs, 3D textiles and blockchain are reshaping product development, production, sales and customer experiences. In design and production, these tools support faster product development, improved visualisation and reduced dependence on physical sampling. In retail and marketing, they enable personalised recommendations, online shopping experiences, social commerce and interactive brand communication. Therefore, digital transformation in fashion can be understood as a socio-technical process that connects technological innovation with organisational change, consumer behaviour and industry competitiveness.

Sustainability and Circular Transformation in Fashion

Sustainability has become a central concern in fashion due to overproduction, textile waste, resource consumption, carbon emissions and limited supply-chain transparency. In response, digital transformation is increasingly discussed as a potential enabler of more sustainable and circular fashion practices. Casciani et al. (2022) show that digital transformation creates opportunities for fashion supply chains, business models and

sustainability-oriented innovation, while Colombi and D'Itria (2023) argue that digitally enabled practices can support circular business models through improved resource efficiency, traceability and value creation. However, the relationship between digitalisation and sustainability should not be treated as automatically positive. Niinimäki et al. (2020) caution that fast fashion is driven by cheap manufacturing, frequent consumption and short garment use, which contribute to major environmental impacts. This means that digital tools may reduce waste and improve transparency, but they may also intensify demand, accelerate trend cycles and strengthen data-driven consumption. Therefore, sustainability-oriented digital transformation requires responsible implementation, where technological innovation is aligned with circular economy principles, ethical production and conscious consumption practices.

Consumer, Market and Educational Dimensions of Digital Fashion

From a social science perspective, digital transformation in fashion also involves changes in consumer behaviour, market interaction and education. The growth of e-commerce, social media marketing, virtual fitting, digital fashion, metaverse environments and NFT-related fashion experiences has changed how consumers discover, evaluate and purchase fashion products. Sayem (2022) explains that digital fashion innovation extends beyond design and e-prototyping to include digital business, promotion, virtual environments and smart fashion technologies. Similarly, Park and Lim (2023) argue that the metaverse is becoming an emerging space for fashion brand strategy, customer experience and consumer engagement. However, these developments also raise questions about trust, privacy, authenticity, digital ownership and the sustainability of virtual consumption. Beyond the market dimension, digital transformation also affects fashion education and workforce preparation. Kohli (2025) highlights the need to align fashion curricula with AI-related skills and future job requirements. Therefore, fashion education plays an important role in preparing professionals who can combine creative, technical, analytical and sustainability-oriented competencies. Without curriculum innovation, educator readiness and digital skills training, technological advancement may not translate into meaningful industry transformation.

Bibliometric Studies on Fashion-Related Digital Transformation

Previous bibliometric and systematic review studies have provided useful insights into digital transformation across fashion-related domains. Hasbullah et al. (2024) examined digital transformation in omni-channel retailing and identified fashion as one of several major sectoral themes alongside grocery, luxury and tourism. Their study is useful for understanding how digital integration reshapes retail environments, particularly in relation to consumer experience and market transformation. Bermeo-Giraldo et al. (2025) offer a more sector-specific contribution by examining digital transformation in the textile sector, showing how digital technologies are associated with productivity, product quality, sustainability, customer satisfaction and supply-chain performance. Meanwhile, Sholikhah et al. (2026) extend the discussion into vocational education by mapping digital fashion skills within Green TVET and emphasising digital competencies, sustainability-oriented curriculum development and teacher preparation. Collectively, these studies show that digital transformation in fashion-related fields has been examined through retail, textile, sustainability and educational perspectives. However, their different sectoral boundaries also indicate that the field remains fragmented. Therefore, further structured bibliometric mapping is needed to clarify how social science research conceptualises digital transformation within the fashion industry.

Research Gaps and Future Directions

Recent bibliometric and systematic review studies have contributed important insights into digital transformation across fashion-related domains (see Table 1). Existing studies have examined omni-channel retailing, digital transformation in the textile sector, sustainability and supply-chain development, and digital fashion skills within Green TVET. However, these studies tend to approach the field from separate perspectives. Retail-oriented studies mainly focus on consumer experience, omni-channel integration and market transformation, while textile-sector studies emphasise productivity, product quality, supply-chain performance, sustainability and technology adoption. In contrast, education-focused reviews concentrate more specifically on digital skills, vocational teacher competencies, curriculum development and sustainability-oriented fashion education.

Therefore, the main research gap does not lie in the complete absence of bibliometric or review studies on digital transformation in fashion-related areas. Rather, limited attention has been given to how digital transformation in the fashion industry has developed within the social science literature as a broader intellectual field. Previous studies also vary in terms of sectoral boundaries, database coverage, time span, thematic focus and bibliometric indicators, making it difficult to understand how technological innovation, sustainability concerns and education-related discussions are connected. Accordingly, this study provides an updated bibliometric and network analysis of social science research on digital transformation in the fashion industry from 2005 to 2026. By examining publication growth, citation impact, authorship patterns, influential sources and documents, leading institutions and countries, and conceptual clusters, this study extends previous research by mapping the intellectual structure and thematic development of the field.

Table 1: Summary of several key past studies that have employed bibliometric methods to map digital transformation in fashion, textiles, retail, and fashion education.

Authors (Year)	Objective (Summary)	Data Source & Year Coverage	TDE	Bibliometric Attributes Examined
Hasbullah et al. (2024)	Map the development of digital transformation in omni-channel retailing by identifying publication trends, prominent journals, prolific authors, leading countries, and major research themes. Although the study was not limited to fashion, fashion was identified as one of four major sectoral themes alongside grocery, luxury, and tourism.	Scopus; 2013 to 23 March 2023	773	Annual publication growth; document type, source type, subject area, and publication language; productive journals and citation performance; prolific authors and h-index; country distribution and collaboration; highly cited publications; keyword co-occurrence involving 2,103 keywords; and thematic clusters covering grocery, fashion, luxury, and tourism.
Bermeo-Giraldo et al. (2025)	Examine the evolution of digital transformation research in the textile sector and formulate a future research agenda, with particular attention to how digital technologies affect productivity, product quality, customer satisfaction, sustainability, and operational performance.	Scopus and Web of Science; 1969–2023	101	Annual publication trends; publication and citation performance of authors, journals, and countries; co-authorship networks; keyword co-occurrence; thematic evolution; keyword frequency and recency; research clusters; emerging themes; and development of a future research agenda involving AI, e-commerce, sustainability, supply chains, digital skills, and ethics.

Sholikhah et al. (2026)	Map global research trends in digital fashion skills within Green TVET, identify sustainability-oriented digital fashion competencies, and develop a competency framework for future vocational fashion teachers.	Scopus; 2021–2025	62	Annual and source-level publication trends; country contributions; keyword co-occurrence and thematic clustering; descriptive analysis of research topics and methods; thematic coding of digital fashion skills; and development of eight competency domains covering design, patternmaking, production, sustainability, ethics and data security, pedagogy, communication and marketing, and entrepreneurship.
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Research Questions

Accordingly, this study addresses the following research questions:

RQ1. What is the current state and bibliometric profile of social science research on digital transformation in the fashion industry based on publication output, citation impact, authorship patterns and bibliometric performance indicators?

RQ2. What publication and citation trends are observable in social science research on digital transformation in the fashion industry from 2005 to 2026?

RQ3. Which journals and publication sources are central to the dissemination of social science research on digital transformation in the fashion industry?

RQ4. Which highly cited publications have significantly shaped the scholarly discourse on digital transformation in the fashion industry within the social science literature?

RQ5. Which institutions and countries are the leading contributors to social science research on digital transformation in the fashion industry?

RQ6. What core research themes and conceptual clusters define the evolution of social science research on digital transformation in the fashion industry?

The comprehensive nature of this study provides an opportunity to understand the development of social science research on digital transformation in the fashion industry. Through bibliometric and network analysis, it offers a systematic overview of publication trends, citation impact, influential publications, active journals, leading countries and institutions, and dominant conceptual themes. The findings highlight how technological innovation, sustainability concerns and education-related discussions have shaped the direction of research in this field. In essence, this study delineates the intellectual structure, historical development, current status and emerging thematic patterns of digital transformation in the fashion industry from a social science perspective. It therefore provides a foundation for future research on how digital technologies, sustainable practices and human capability development can support the continuing transformation of the fashion industry.

METHODS

This study utilised bibliographic data retrieved from the Scopus database for the period from 2005 to 2026, with data extraction conducted in 2026. Scopus was selected as the sole bibliographic database due to its established reputation as one of the largest abstract and citation databases for peer-reviewed scholarly literature (Aghaei Chadegani et al., 2013). Its broad coverage of social sciences, business and management, education, environmental studies, design, communication and technology-related research makes it suitable for examining digital transformation in the fashion industry from a social science perspective. Scopus also provides structured bibliographic metadata, including citation counts, authorship information, institutional affiliations, countries,

source titles, references and author-supplied keywords, which are essential for systematic bibliometric analysis. Although databases such as Web of Science and Dimensions may include additional relevant publications, the use of Scopus enabled the construction of a consistent and reproducible dataset within a clearly defined indexing source. Therefore, the findings of this study should be interpreted as representing Scopus-indexed social science literature rather than the entire global body of research on digital transformation in the fashion industry.

It should be noted that the 2026 data represent publications indexed in Scopus up to the date of data extraction and do not reflect a complete publication year. Therefore, the lower number of publications recorded in 2026 should not be interpreted as a decline in research interest. Instead, the 2026 value is treated as partial-year data and is included to reflect the most recent available publications at the time of analysis.

After applying the predetermined search string, subject-area restriction, document-type criteria and data-cleaning procedures, 410 publications were retained for the final bibliometric analysis. The dataset enabled the examination of publication output, citation impact, authorship patterns, source-title productivity, highly cited documents, institutional and country contributions, and author-keyword co-occurrence. The keyword co-occurrence analysis was used to identify dominant conceptual clusters related to digital transformation, sustainability, digital fashion, fashion education, artificial intelligence, circular economy, consumer behaviour, e-commerce, virtual reality and Industry 4.0.

The Scopus records were exported in CSV format and processed using BiblioSpy® (Ahmi, 2026). The software was employed to clean and harmonise bibliographic metadata, calculate performance indicators, generate descriptive statistics and produce keyword co-occurrence visualisations. The indicators included Total Publications (TP), Number of Contributing Authors (NCA), Number of Cited Publications (NCP), Total Citations (TC), Citations per Publication (C/P), Citations per Cited Publication (C/CP), Citations per Author (C/A), Authors per Publication (A/P), Citations per Year (C/Y), h-index, g-index, m-index and citation sum within the h-core.

The bibliometric procedures, indicators and technical terminology employed in this study followed established practices commonly adopted in bibliometric research, particularly in performance analysis and science-mapping studies (Donthu et al., 2021). These procedures were applied within a distinct research context, dataset, temporal scope and analytical focus.

Search Strategy

The review adopted the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines to ensure a systematic and transparent process for identifying, screening, and selecting relevant publications (Page et al., 2021). The search query **TITLE-ABS-KEY ("digital transformation" OR digitalization OR digitisation OR "digital technology" OR "digital innovation" OR "industry 4.0" OR "fashion technology") AND (fashion OR apparel OR textile OR clothing OR garment) AND (sustainability OR education OR "3D design" OR "virtual prototyping" OR "digital skills")** was executed in the Scopus database. The search was conducted within the title, abstract, and keyword fields to retrieve publications related to digital transformation in the fashion industry. The initial search identified 2,857 records, as presented in Figure 1.

Based on the PRISMA flow diagram in Figure 1, the retrieved records were screened through multiple stages to ensure the inclusion of relevant studies. Before screening, 2,313 records were removed because they were outside the Social Sciences subject area, reducing the dataset to 544 records. Subsequently, 123 records were excluded because they were not classified as journal articles or conference papers. As a result, 421 reports were sought for retrieval, and all were successfully retrieved. During the eligibility assessment, 11 reports were excluded due to incomplete or corrupted metadata records. Consequently, 410 studies were retained in the final dataset for bibliometric and network analyses.

To ensure dataset quality and relevance, explicit inclusion and exclusion criteria were applied throughout the screening process. The inclusion criteria comprised Scopus-indexed publications classified under the Social Sciences subject area, published between 2005 and 2026, and categorised as journal articles or conference

papers. The exclusion criteria eliminated records outside the selected subject area, non-article and non-conference paper document types, and records with incomplete bibliographic metadata. This structured procedure produced a transparent and reproducible dataset suitable for examining publication trends, citation performance, leading contributors and conceptual development in digital transformation research within the fashion industry.

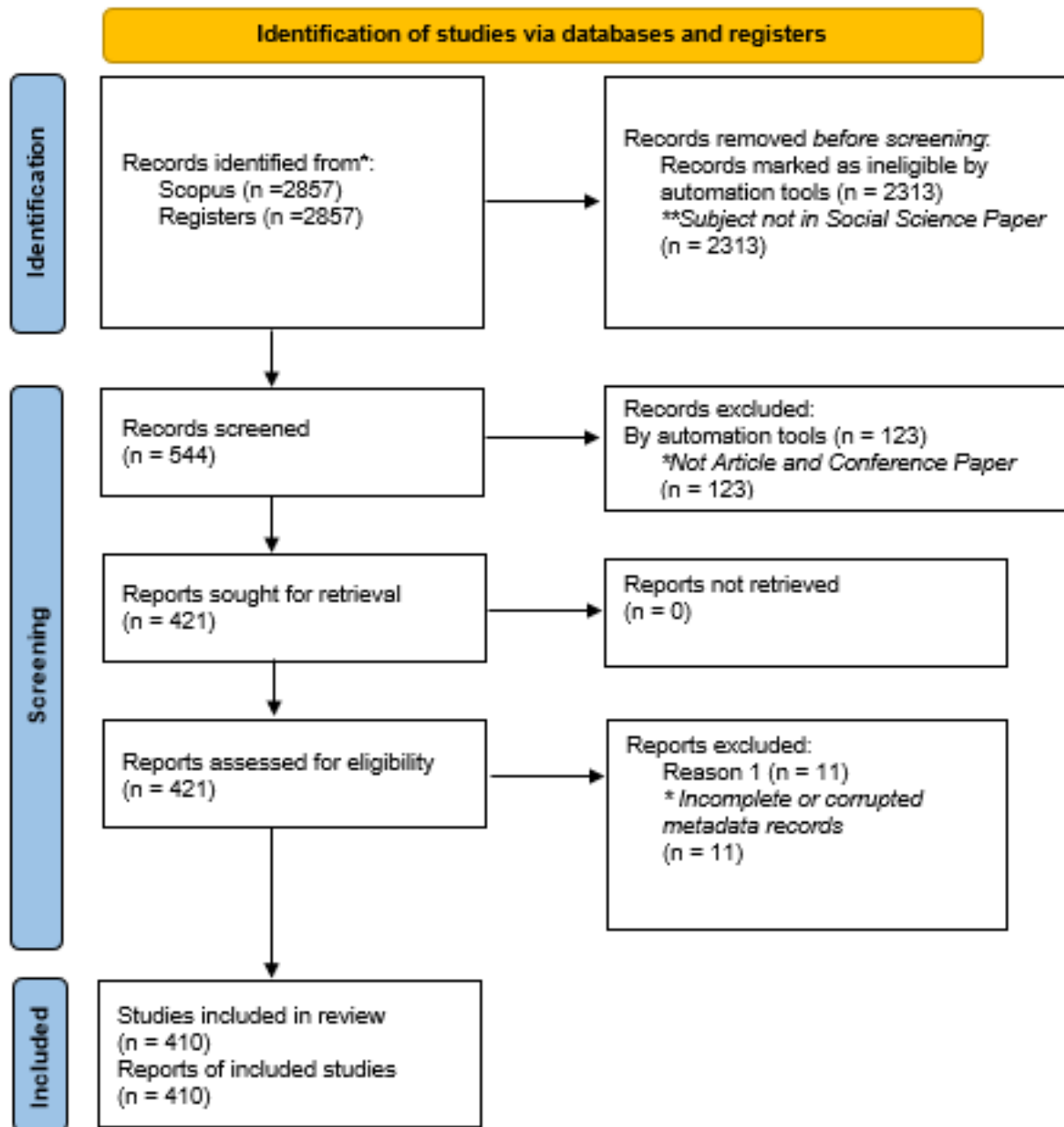


Figure 1. Flow diagram of the search strategy (Page et al., 2021).

Data Cleaning and Harmonisation

Data cleaning and harmonisation were undertaken to ensure the accuracy, consistency, and reliability of the bibliometric dataset. Following the screening process described in the PRISMA flow diagram, 410 publications were retained for the final analysis. The bibliographic records were exported from the Scopus database in CSV format and imported into BiblioSpy® (Ahmi, 2026) for further processing.

The integrated data-cleaning functions in BiblioSpy® were used to identify duplicate records, missing information, and inconsistencies within the bibliographic metadata. Particular attention was given to variations

in author names, institutional affiliations, country names, source titles, and author-supplied keywords. Differences in spelling, abbreviations, punctuation, singular and plural forms, and alternative terms referring to the same concept were reviewed and harmonised where appropriate. This process was necessary to prevent the same author, institution, country, or keyword from being represented as separate entities in the analysis.

Keyword harmonisation was particularly important for the co-occurrence analysis. Keywords with similar meanings or minor linguistic variations were consolidated to improve the clarity and accuracy of the resulting conceptual clusters. Incomplete bibliographic information was also reviewed and corrected where sufficient information was available in the Scopus records. These procedures produced a consistent and structured dataset suitable for descriptive bibliometric and network analyses. Consequently, the cleaning and harmonisation process strengthened the validity of the findings concerning publication performance, citation impact, institutional and national contributions, and the conceptual development of digital transformation research in the fashion industry.

Data Analysis

The data analysis was structured according to the six research questions. Descriptive bibliometric analysis was first conducted to establish the current state and bibliometric profile of digital transformation research in the fashion industry. This analysis examined publication output, citation impact, authorship patterns, references, author keywords, and bibliometric performance indicators.

Annual publication and citation data were analysed to determine the historical development and growth of the research field from 2005 to 2026. Source-level analysis was then performed to identify the journals and publication sources that played central roles in disseminating research. Highly cited document analysis was also conducted to identify landmark publications that had significantly shaped scholarly discourse on digital transformation, technology, sustainability, and education within the fashion industry.

Institutional and country-level analyses were used to identify the leading knowledge-producing institutions and geographical contributors. These analyses considered both publication productivity and citation performance, as institutions or countries with high publication output did not necessarily demonstrate equally strong scholarly influence.

The bibliometric indicators included Total Publications (TP), Number of Contributing Authors (NCA), Number of Cited Publications (NCP), Total Citations (TC), Citations per Publication (C/P), Citations per Cited Publication (C/CP), Citations per Author (C/A), Authors per Publication (A/P), Citations per Year (C/Y), citable years, h-index, g-index, m-index, and citation sum within the h-core. These indicators were calculated across several analytical dimensions, including publication year, source title, document, institution, and country.

Finally, author-keyword co-occurrence analysis was conducted to identify the principal research themes and conceptual clusters within the field. Keywords meeting the specified minimum occurrence threshold were mapped according to their frequency and relationships with other terms. The resulting network revealed connections among major themes such as digital transformation, sustainability, circular economy, fashion design, artificial intelligence, virtual reality, education, supply chains, and Industry 4.0.

Tools

BiblioSpy® (Ahmi, 2026) was employed as the primary software for data cleaning, bibliometric computation, performance analysis and network visualisation. Its integrated functions enabled the importation and harmonisation of Scopus metadata, the calculation of bibliometric indicators, the generation of descriptive tables and figures, and the construction of the author-keyword co-occurrence network. The software was also used to analyse publication trends, citation performance, productive source titles, highly cited documents, leading institutions and contributing countries.

BiblioSpy® was selected because it provides an integrated workflow for cleaning bibliographic records, harmonising author keywords, calculating performance indicators and producing network visualisations within a single platform. This was suitable for the present study because the analysis required both performance analysis

and keyword co-occurrence mapping using one consistent dataset. Compared with VOSviewer, which is widely used for bibliometric network visualisation (van Eck & Waltman, 2010), and bibliometrix, which offers comprehensive science-mapping analysis through the R environment (Aria & Cuccurullo, 2017), BiblioSpy® was considered appropriate because it allowed data cleaning, indicator calculation and visualisation to be conducted within the same analytical workflow. This helped reduce inconsistencies between cleaned records, bibliometric tables and network outputs. Therefore, additional software such as OpenRefine or VOSviewer was not used in the present analysis.

Nevertheless, the use of BiblioSpy® also represents a methodological limitation. Different bibliometric software packages may apply different algorithms, threshold settings and visualisation procedures, which could influence the structure and interpretation of bibliometric networks. Future studies may compare outputs from BiblioSpy®, VOSviewer and bibliometrix to strengthen methodological triangulation.

RESULTS AND FINDINGS

Current State of Research

To address RQ1, bibliometric indicators generated using BiblioSpy® were examined to determine the current state of social science research on digital transformation in the fashion industry from 2005 to 2026. As shown in Table 2, these indicators provide an overview of research productivity, citation performance, authorship patterns and scholarly visibility.

Across 22 citable years, 410 publications were identified, involving 1,179 contributing authors and 1,032 unique authors. Of these publications, 303 received citations, indicating that a substantial proportion of the literature has gained academic recognition. The dataset accumulated 6,664 citations, with an average of 16.25 citations per document and 21.99 citations per cited paper.

The field also demonstrates a collaborative research profile, with an average of 2.88 authors per paper and an international co-authorship rate of 55.37%. In terms of citation performance, the h-index of 44, g-index of 71 and m-index of 2.0 indicate strong scholarly impact. Overall, these indicators suggest that social science research on digital transformation in the fashion industry has developed into a visible, collaborative and academically influential research domain.

Table 2. Bibliometric Summary

Indicator	Value
Timespan	2005:2026
Total Publications (TP)	410
Citable Year Span	22 years
Annual Growth Rate	31.45%
Document Average Age	3.12 years
Total Citations (TC)	6664
Average Citations per Document	16.25
Number of Cited Papers (NCP)	303
Average Citations per Cited Paper	21.99

Average Citations per Year	302.91
Total Contributing Authors	1179
Total Unique Authors	1032
Total Institutions	526
Total Countries	60
Single-Authored Documents	76
Average Authors per Paper	2.88
International Co-authorship Rate	55.37%
Unique Author Keywords	1492
Total References	51197
h-index	44
g-index	71
m-index	2.0
Citation Sum within h-Core	4187

Source: Generated by the author(s) using BiblioSpy® (Ahmi, 2026).

Publication Trends

To address RQ2, which examines publication and citation trends in social science research on digital transformation in the fashion industry, yearly bibliometric indicators from 2005 to 2026 were analysed, as presented in Figure 2 and Table 3. The analysis provides insights into research productivity, citation performance and the changing visibility of this emerging field.

The total number of publications recorded across the period is 410. Early publication activity was relatively limited, with only one to five publications recorded in selected years between 2005 and 2017. A clearer increase began in 2018, followed by stronger growth from 2020 onwards. Publication output rose from 23 papers in 2020 to 100 papers in 2025, representing the highest annual output in the dataset. Although 2026 recorded 43 publications, this figure should be interpreted cautiously because the data represent only publications indexed up to the date of extraction and not a complete publication year. Therefore, the 2026 output should not be interpreted as evidence of declining research productivity.

In terms of citation impact, the publications collectively received 6,664 citations. The highest annual citation count was recorded in 2022, with 1,104 citations, followed by 2020, 2023 and 2018. Overall, the yearly bibliometric indicators reveal that this research area has experienced substantial growth in both productivity and influence. The data illustrate an emerging and increasingly mature research domain, characterised by accelerating publication output and meaningful citation impact, signalling its growing relevance in understanding technology-driven transformation within the fashion industry.

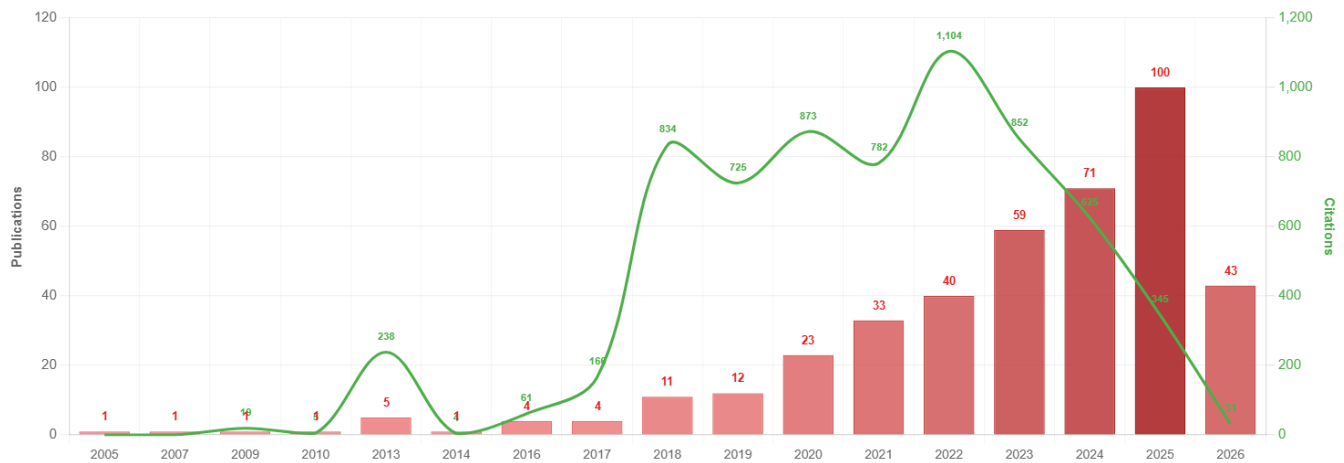


Figure 2. Annual Publications & Citations

Source: Generated by the author(s) using BiblioSpy® (Ahmi, 2026).

Table 3. Yearly Bibliometric Statistics

Year	TP	NCA	NCP	TC	C/P	C/CP	h	g	m	e
2026	43	140	11	31	0.72	2.82	2	4	0.091	3.61
2025	100	272	62	345	3.45	5.56	11	15	0.524	9
2024	71	216	61	625	8.8	10.25	16	22	0.8	12.21
2023	59	150	46	852	14.44	18.52	14	28	0.737	21.73
2022	40	119	35	1104	27.6	31.54	17	33	0.944	26.83
2021	33	87	26	782	23.7	30.08	15	27	0.882	21.93
2020	23	62	23	873	37.96	37.96	12	23	0.75	26.42
2019	12	32	12	725	60.42	60.42	8	12	0.533	25.42
2018	11	28	11	834	75.82	75.82	11	11	0.786	26.7
2017	4	9	4	166	41.5	41.5	3	4	0.231	12.49
2016	4	7	4	61	15.25	15.25	3	4	0.25	7.14
2014	1	2	1	4	4	4	1	1	0.1	1.73
2013	5	7	5	238	47.6	47.6	5	5	0.556	14.59
2010	1	3	1	5	5	5	1	1	0.167	2
2009	1	3	1	19	19	19	1	1	0.2	4.24
2007	1	2	0	0	0	0	0	0	0	0
2005	1	3	0	0	0	0	0	0	0	0

Note: TP = Total Publications; NCA = Number of Contributing Authors; NCP = Number of Cited Publications; TC = Total Citations; C/P = Citations per Publication; C/CP = Citations per Cited Publication; h = h-index; g = g-index; m = m-Quotient; e = e-index

Source: Generated by the author(s) using BiblioSpy® (Ahmi, 2026).

Publications by Source Titles

To address RQ3, Figure 3 and Table 4 present the top 10 most productive source titles in the dataset. The findings show that publication output is concentrated in a small group of journals related to fashion education, sustainability, textiles, marketing and human-computer interaction.

The *International Journal of Fashion Design, Technology and Education* emerged as the most productive source, with 38 publications and 815 citations, indicating its central role in disseminating research on fashion education, design practice and technological innovation. *Sustainability (Switzerland)* ranked second with 35 publications and recorded the highest citation impact among the top sources, with 1,252 citations. This reflects its strong influence in research linking digital transformation with sustainability and circular economy issues.

Other notable sources include the *Journal of Silk, Fashion and Textiles*, the *Journal of Global Fashion Marketing* and the *International Journal of Human-Computer Interaction*. Overall, the source-title distribution indicates that digital transformation in fashion is a multidisciplinary research area spanning education, sustainability, textiles, marketing and technology-related studies.

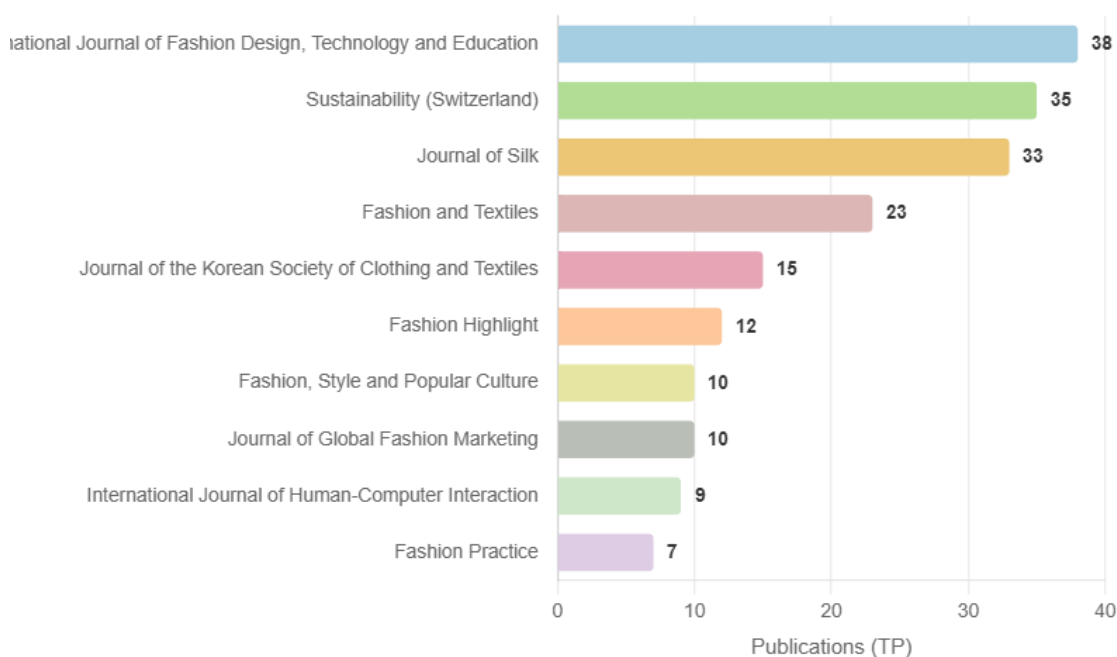


Figure 3. Top 10 Most Productive Source Titles

Source: Generated by the author(s) using BiblioSpy® (Ahmi, 2026).

Table 4. Top 10 Most active source titles

Source Title	Publisher	TP	TC	NCA	NCP	C/P	C/CP	h	g	m	e	CiteScore	SJR	SNIP	Q (Scopus)	JIF	Q (WoS)	ABDC	AJG
International Journal	Taylor and	38	815	101	34	21.47	23.971	15	28	1.364	22.27	4.1	0.542	1.109	Q1	2.2	Q2	nan	nan

of Fashion Design, Technology and Education	Francis Ltd.																		
Sustainability (Switzerland)	MDPI	35	1252	111	33	35.771	37.939	20	35	2.5	26.65	7.7	0.688	1.113	Q1	3.3	Q2	nan	nan
Journal of Silk	China Silk Association	33	106	86	24	3.212	4.417	68	85	0.75	4.47	0.7	0.168	0.475	Q2	nan	nan	nan	nan
Fashion and Textiles	Springer	23	574	58	18	24.957	31.889	11	23	1	20.69	6.1	0.75	1.49	Q1	3.5	Q1	nan	nan
Journal of the Korean Society of Clothing and Textiles	Korean Society of Clothing and Textiles	15	29	37	9	1.933	3.222	35	5	0.3	3.46	0.6	0.172	0.324	Q2	nan	nan	nan	nan
Fashion Highlight	Firenze University Press	12	19	18	8	1.583	2.375	23	3	0.667	2.65					nan	nan	nan	nan
Fashion, Style and Popular Culture	Intellect Ltd.	10	44	17	4	4.4	11	36	6	0.6	5.83	0.8	0.27	0.277	Q2	nan	nan	nan	nan
Journal of Global Fashion Marketing	Routledge	10	195	30	8	19.5	24.375	60	10	0.462	12.37	9	1.171	1.263	Q1	5.5	Q1	B	1
International Journal of Human-Computer	Taylor and Francis Ltd.	9	255	32	9	28.333	28.333	69	9	1.5	14.63	8.7	1.175	2.248	Q1	4.9	Q1	B	nan

r Interacti on																			
Fashion Practice	Routled ge	7	52	14	5	7.42 9	10.4	4	7	0.4	5.8 3	2.7	0.4 91	0.8 39	Q1	2. 2	nan	nan	na n

Note: TP = Total Publications; TC = Total Citations; NCA = Number of Contributing Authors; NCP = Number of Cited Publications; C/P = Citations per Publication; C/CP = Citations per Cited Publication; h = h-index; g = g-index; m = m-Quotient;

Source: Generated by the author(s) using BiblioSpy® (Ahmi, 2026).

Highly Cited Documents

To address RQ4, Table 5 presents the top 10 highly cited publications in the dataset. These papers represent influential contributions that have shaped scholarly discussion on digital transformation, sustainability, artificial intelligence, supply chains and consumer engagement in fashion-related social science research.

Choi and Luo (2019) recorded the highest citation count, with 388 citations, highlighting the importance of blockchain, data quality and sustainability in fashion supply-chain operations. This was followed by Sharma et al. (2020), which contributed to broader debates on artificial intelligence governance, and Acharya et al. (2018), which examined big data, knowledge co-creation and decision-making in the fashion industry.

Other highly cited works, including Fu et al. (2018), Casciani et al. (2022) and Ahmad et al. (2020), further emphasise the role of blockchain, business intelligence, Industry 4.0 and sustainability-oriented innovation in fashion, textile and apparel contexts. Meanwhile, studies by Kim et al. (2017), Jin and Youn (2023), Gkikas et al. (2022), and Kautish and Khare (2022) highlight the growing relevance of consumer adoption, human-AI interaction, social media analytics and AI-enabled service experiences. Overall, the highly cited literature indicates that the intellectual foundation of the field is shaped by supply-chain transformation, sustainability, artificial intelligence, big data and digitally mediated consumer engagement.

Table 5. Highly-Cited Papers

No.	Authors	Title	Source	TC	C/Y	NTC
1	Choi & Luo (2019)	Data quality challenges for sustainable fashion supply chain operations in emerging markets: Roles of blockchain, government sponsors and environment taxes	Transportation Research Part E: Logistics and Transportation Review	388	48.5	6.42
2	Sharma et al. (2020)	Artificial intelligence and effective governance: A review, critique and research agenda	Sustainable Futures	211	30.14	5.56
3	Acharya et al. (2018)	Big data, knowledge co-creation and decision making in fashion industry	International Journal of Information Management	207	23	2.73
4	Fu et al. (2018)	Blockchain enhanced emission trading framework in fashion apparel manufacturing industry	Sustainability (Switzerland)	184	20.44	2.43
5	Casciani et al. (2022)	Exploring the nature of digital transformation in the fashion industry: opportunities for supply chains,	Sustainability: Science, Practice, and Policy	177	35.4	6.41

		business models, and sustainability-oriented innovations				
6	Ahmad et al. (2020)	Towards sustainable textile and apparel industry: Exploring the role of business intelligence systems in the era of industry 4.0	Sustainability (Switzerland)	159	22.71	4.19
7	Kim et al. (2017)	Consumer adoption of smart in-store technology: assessing the predictive value of attitude versus beliefs in the technology acceptance model	International Journal of Fashion Design, Technology and Education	153	15.3	3.69
8	Jin & Yoon (2023)	Social Presence and Imagery Processing as Predictors of Chatbot Continuance Intention in Human-AI-Interaction	International Journal of Human-Computer Interaction	148	37	10.25
9	Gkikas et al. (2022)	How do text characteristics impact user engagement in social media posts: Modeling content readability, length, and hashtags number in Facebook	International Journal of Information Management Data Insights	117	23.4	4.24
10	Kautish & Khare (2022)	Investigating the moderating role of AI-enabled services on flow and awe experience	International Journal of Information Management	115	23	4.17

Note: TC = Total Citations; C/Y = Citations per Year; NTC = Normalised Total Citations

Source: Generated by the author(s) using BiblioSpy® (Ahmi, 2026).

Publications by Institutions

Table 6 presents the top 10 most productive institutions contributing to social science research on digital transformation in the fashion industry. The table highlights institutional productivity, citation performance and bibliometric impact, offering insights into the leading academic contributors across different countries.

Donghua University in China emerges as the most productive institution, with 14 publications supported by 37 contributing authors. These publications accumulated 222 citations, producing a C/P of 15.86 and C/CP of 20.18. This indicates that Donghua University has played a substantial role in advancing research output in this field. Politecnico di Milano in Italy follows closely with 13 publications and records a slightly higher citation performance, with 251 total citations, a C/P of 19.31 and a C/CP of 27.89, reflecting strong scholarly influence alongside high productivity.

Yonsei University in South Korea ranks third with 11 publications, while Hong Kong Polytechnic University and Zhejiang Sci-Tech University each contributed 10 publications. Notably, Hong Kong Polytechnic University demonstrates the strongest citation impact among the listed institutions, with 679 citations and a high C/P of 67.90. This suggests that although its publication volume is comparable to Zhejiang Sci-Tech University, its publications have achieved greater academic visibility.

Other productive institutions include Beijing Institute of Fashion Technology, Seoul National University, Ewha Womans University, Jiangnan University and Cornell University. Overall, Table 6 indicates that institutional contributions are strongly concentrated in China, South Korea, Italy and the United States, with some institutions leading through publication volume and others through high-impact citation performance.

Table 6. Top 10 Most productive institutions.

Institution	Country	TP	NCA	NCP	TC	C/P	C/CP	h	g	m	e
Donghua University	China	14	37	11	222	15.86	20.18	5	14	0.31	13.75
Politecnico di Milano	Italy	13	21	9	251	19.31	27.89	4	13	0.40	15.03
Yonsei University	South Korea	11	31	8	84	7.64	10.50	4	9	0.67	7.68
Hong Kong Polytechnic University	China	10	29	10	679	67.90	67.90	4	10	0.44	25.48
Zhejiang Sci-Tech University	China	10	32	10	76	7.60	7.60	5	8	0.56	6.48
Beijing Institute of Fashion Technology	China	9	29	6	54	6.00	9.00	4	7	0.50	5.74
Seoul National University	South Korea	8	20	6	205	25.62	34.17	4	8	0.67	13.64
Ewha Womans University	South Korea	6	10	4	50	8.33	12.50	2	6	0.50	6.56
Jiangnan University	China	6	16	4	50	8.33	12.50	3	6	0.75	6.24
Cornell University	United States	5	10	3	9	1.80	3.00	2	3	0.25	2.00

Note: TP = Total Publications; NCA = Number of Contributing Authors; NCP = Number of Cited Publications; TC = Total Citations; C/P = Citations per Publication; C/CP = Citations per Cited Publication; h = h-index; g = g-index; m = m-Quotient; e = e-index

Source: Generated by the author(s) using BiblioSpy® (Ahmi, 2026).

Publications by Countries

To further address RQ5, which examines the leading country contributors to social science research on digital transformation in the fashion industry, Figure 4 visualises the global distribution of publications, while Table 7 presents the top 10 most productive country statistics. The findings show that contributions are geographically diverse, with representation from Asia, Europe, North America and Australia. However, scholarly leadership is concentrated within a small group of countries.

China emerged as the leading contributor in both publication output and total citations, indicating its dominant role in this research area. South Korea and the United States also demonstrated strong research activity, although

the United States recorded higher citation visibility despite slightly lower publication output than South Korea. Italy and the United Kingdom were the main European contributors, with the United Kingdom showing particularly strong citation impact relative to its output. Other countries, including India, Germany, Portugal, Indonesia and Australia, further reflect the international spread of the field. Overall, the results suggest a globally distributed but uneven research landscape.

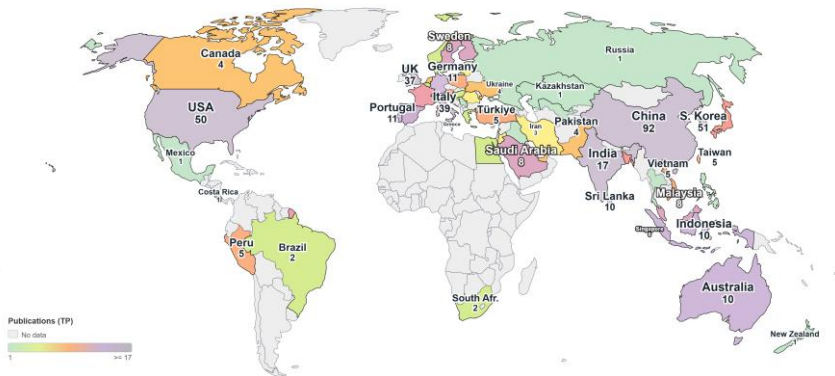


Figure 4. World Map

Source: Generated by the author(s) using BiblioSpy® (Ahmi, 2026).

Table 7. Top 10 Most Productive Country Statistics

Country	TP	NCA	NCP	TC	C/P	C/CP	h	g	m	e
China	92	286	69	1425	15.49	20.65	15	36	0.682	30.46
South Korea	51	109	39	695	13.63	17.82	15	26	1.154	19.29
United States	50	145	39	973	19.46	24.95	17	31	1.214	23.73
Italy	39	89	28	437	11.21	15.61	9	20	0.818	17.46
United Kingdom	37	95	31	940	25.41	30.32	16	30	0.889	24.19
India	17	56	14	469	27.59	33.5	7	17	0.778	19.87
Portugal	11	41	4	36	3.27	9	2	6	0.4	5.48
Germany	11	32	10	278	25.27	27.8	8	11	1.333	14.53
Indonesia	10	39	5	57	5.7	11.4	2	7	0.222	7
Australia	10	28	6	261	26.1	43.5	4	10	0.444	15.43

Note: TP = Total Publications; NCA = Number of Contributing Authors; NCP = Number of Cited Publications; TC = Total Citations; C/P = Citations per Publication; C/CP = Citations per Cited Publication; h = h-index; g = g-index; m = m-Quotient; e = e-index

Source: Generated by the author(s) using BiblioSpy® (Ahmi, 2026).

Co-occurrence Analysis

To address RQ6, which examines the pivotal research themes underpinning social science research on digital transformation in the fashion industry, a keyword co-occurrence analysis was conducted using author keywords with at least five occurrences. Figure 5 presents the network visualisation, revealing six colour-coded clusters that represent the conceptual structure and thematic relationships within the dataset.

At the centre of the network, keywords such as “fashion”, “fashion industries”, “digital transformation”, “sustainability”, “industry 4.0” and “circular economy” appear as highly connected nodes. Their central position indicates that the field is strongly shaped by the interaction between technological change and sustainability-oriented transformation. In particular, the dark red cluster highlights themes related to industrial transformation, including “industry 4.0”, “sustainability”, “digital transformation”, “AI”, “apparel industry” and “circular economy”. This suggests that research in this area frequently examines how digital technologies support more sustainable and efficient fashion systems.

The red cluster extends this discussion through keywords such as “digital technologies”, “fashion education” and “CSR”, indicating the growing relevance of education, responsibility and capability development in digital fashion transformation. Meanwhile, the orange cluster is more consumer- and market-oriented, linking “metaverse”, “NFT”, “consumer behaviour”, “purchase intention”, “e-commerce”, “fast fashion” and “digital fashion”. This cluster reflects the increasing attention given to digitally mediated consumption and emerging virtual fashion experiences.

The yellow and light orange clusters further emphasise enabling technologies and design-related applications. Keywords such as “blockchain”, “machine learning”, “deep learning”, “big data”, “generative AI”, “AR”, “virtual reality”, “virtual fitting”, “fashion design” and “digitisation” demonstrate the technological diversity of the field. Collectively, Figure 5 indicates that digital transformation in the fashion industry is not confined to a single theme, but is shaped by interconnected discussions on sustainability, advanced technologies, education, consumer behaviour and digital design practices.

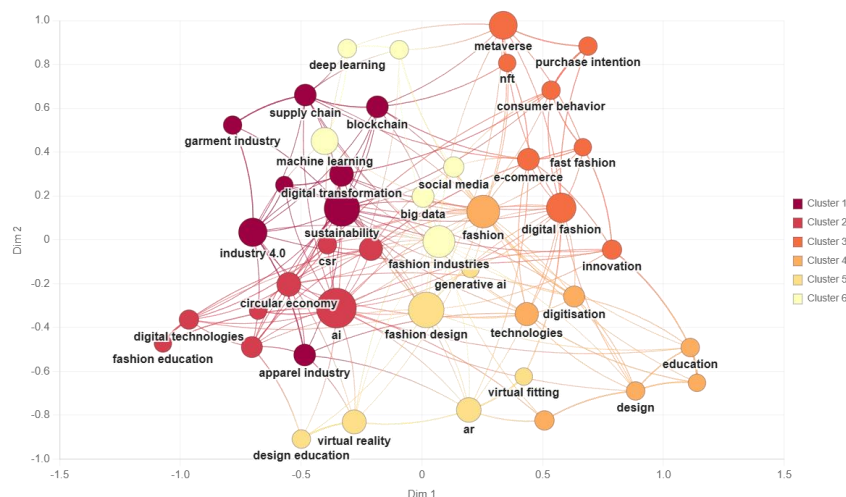


Figure 5. Network visualisation of author keywords with at least 5 min. occurrences

Source: Generated by the author(s) using BiblioSpy® (Ahmi, 2026).

DISCUSSION

The findings of this bibliometric analysis indicate that social science research on digital transformation in the fashion industry has developed into a more visible and conceptually diverse research domain. The growth of publication output, citation performance and international collaboration suggests that this field is no longer limited to early discussions of technology adoption, but has expanded into wider debates concerning sustainability, consumer behaviour, digital design, education and industrial transformation. The keyword co-

occurrence analysis further demonstrates that the field is structured around several interconnected themes rather than a single dominant research direction.

Digital Transformation, Sustainability and Industry 4.0

The first major theme reflects the close relationship between digital transformation, sustainability, Industry 4.0, artificial intelligence, circular economy and the apparel industry. This pattern suggests that social science research increasingly positions digital transformation as a strategic response to sustainability challenges in fashion, rather than merely as a tool for operational improvement. This interpretation aligns with studies showing that digital technologies can support circular business models through material efficiency, waste reduction, traceability and digitally enabled business model innovation (Colombi & D'Itria, 2023; Happonen & Ghoreishi, 2022). However, Roh (2026) cautions that technological innovation alone cannot generate meaningful sustainability impact unless it is aligned with environmental assessment, ethical and institutional mechanisms, and circular strategies. Therefore, future studies should move beyond discussing technology adoption and examine how digital transformation produces measurable sustainability outcomes, particularly in reducing waste, improving supply-chain transparency and supporting scalable circular business models in the fashion industry.

Fashion Education, Digital Capability and Social Responsibility

The second theme highlights the connection between digital technologies, fashion education and corporate social responsibility. This cluster indicates that the transformation of the fashion industry is not only a technological issue, but also a human-capability issue. Digital transformation requires educators, students, workers and organisations that are prepared to use digital tools effectively, creatively and responsibly. This interpretation aligns with Sayem's (2022) discussion of digital fashion innovation, which shows how digitalisation is reshaping fashion design, simulation and industry practices. More specifically, Kohli (2025) argues that fashion curricula need to be revised to address emerging AI-related skills and future job requirements, suggesting that current education may not fully prepare students for digitally transformed work environments. Similarly, Zakaria, Zainuddin and Aris (2025) highlight the value of project-based learning in strengthening technical proficiency, problem-solving, sustainability awareness and industry engagement in fashion education. However, compared with sustainability and technology adoption, this theme remains less developed. Future research should therefore examine educator readiness, curriculum innovation, digital competence and workforce preparation, particularly in vocational and higher education contexts.

Digital Consumer Behaviour and Virtual Fashion Markets

The third theme is centred on consumer behaviour, purchase intention, e-commerce, fast fashion, digital fashion, the metaverse and NFT. This cluster shows that digital transformation is reshaping how fashion products are marketed, experienced and consumed. The emergence of metaverse and NFT-related keywords reflects growing interest in virtual fashion experiences, digital ownership and new consumer engagement models. This interpretation aligns with Park and Lim (2023), who argue that the metaverse is becoming an emerging space for fashion brand strategies, customer experience and brand engagement. Similarly, Profumo et al. (2024) highlight that research on the metaverse in fashion is expanding, although its scope and long-term implications remain underdeveloped. However, Donvito et al. (2024) caution that metaverse adoption also raises consumer-related concerns, including privacy, psychological well-being, legal issues and technology dependence. More critically, Xin (2025) argues that digital fashion and NFTs may support sustainability, but may also worsen environmental concerns if they encourage additional digital consumption. Future studies should therefore examine whether virtual fashion, social commerce and digital marketing promote sustainable consumer behaviour or simply create new forms of consumption.

Enabling Technologies and Digital Design Practices

The fourth theme concerns enabling technologies such as blockchain, machine learning, deep learning, big data, generative AI, augmented reality, virtual reality, virtual fitting, fashion design and digitisation. These keywords indicate that digital transformation in fashion is becoming technologically diverse, with growing attention to

how advanced tools influence design, production, decision-making and consumer interaction. Bieńkowska (2025) supports this interpretation by showing that artificial intelligence is increasingly applied in fashion design, production, e-commerce, personalisation, supply-chain management and big-data-based forecasting. Similarly, Badhwar, Islam and Tan (2023) show that blockchain has been examined as a mechanism for improving traceability, transparency and authenticity in fashion and textile supply chains. However, technological expansion also introduces unresolved ethical and organisational concerns. Niyompatama and Lapatoura (2025), for example, highlight copyright issues arising from generative AI-assisted fashion design. Therefore, future social science research should move beyond describing technological applications and critically examine issues such as data privacy, algorithmic bias, intellectual property, accessibility, user trust, digital skills and long-term sustainability impact.

Limitation

Several limitations should be acknowledged. First, this study relied exclusively on Scopus-indexed publications. Although Scopus provides broad multidisciplinary coverage and structured bibliographic metadata, relevant studies indexed only in Web of Science, Dimensions, Google Scholar or other databases may not have been captured. Therefore, the findings should be interpreted within the scope of Scopus-indexed social science literature. Second, the 2026 records represent partial-year data based on the date of extraction and should not be interpreted as a complete annual publication trend. Third, the analysis was conducted using BiblioSpy®, which was selected for its integrated data-cleaning, bibliometric and visualisation functions. Nevertheless, bibliometric results may vary across software tools due to differences in algorithms, data processing and network visualisation settings. Future studies could expand database coverage and compare multiple bibliometric tools to enhance robustness.

CONCLUSION

This study mapped the intellectual structure and development of social science research on digital transformation in the fashion industry through a bibliometric analysis of 410 Scopus-indexed publications from 2005 to 2026. The findings show that the field has grown substantially, particularly from 2020 onwards, reflecting increasing scholarly interest in how digital technologies are reshaping fashion-related systems, practices and research agendas. The results demonstrate that this research area has achieved considerable academic visibility, supported by strong citation performance, international collaboration and multidisciplinary publication outlets. The most active journals indicate that the field is positioned across fashion education, sustainability, textiles, marketing and human-computer interaction. At the geographical level, China, South Korea, the United States, Italy and the United Kingdom emerged as leading contributors, suggesting that knowledge production is internationally distributed but still concentrated in selected countries and institutions.

The keyword co-occurrence analysis further reveals that digital transformation in the fashion industry is shaped by several interconnected themes. These include sustainability, circular economy, Industry 4.0, artificial intelligence, digital design, consumer behaviors, e-commerce, metaverse, virtual fashion and fashion education. These themes indicate that digital transformation in fashion is not merely a technological issue, but also involves environmental responsibility, market behaviors, educational readiness and organizational change.

Overall, this study contributes by providing a structured overview of the field from a social science perspective. It clarifies the major contributors, influential sources, citation patterns and conceptual clusters that define current research. Future studies should move towards more theory-informed and empirical investigations, particularly on digital skills, ethical governance, inclusive access, sustainable consumer behaviour and the measurable impact of digital technologies on fashion-industry transformation.

Competing Interests

No potential conflict of interest was reported by the authors.

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