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BIBLIOMETRIC PERSPECTIVES ON INTERACTION DESIGN AND USABILITY: A BLEND OF QUANTITATIVE AND QUALITATIVE INSIGHTS

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Abstract: The rapid growth of computer technology, along with the widespread use of the Internet and mobile devices, has garnered interest in improving the user engagement with the systems. This paper presents a thorough review of the progression of computer user interfaces, covering early developments from command-line systems back then to now interactive and attractive graphical user interfaces, with focus to how interaction design and user experience design had brought changes to the field over the years. To discover the evolution of multimedia interaction design, we conducted a ten-year bibliometric study, analyzing academic output and research impact globally, by accessing to the Springer and SCOPUS Elsevier databases to review its history of development. The study highlights major research interest and publication themes in the field of interaction design, while also identifying the regions and countries that majorly propelled its development. Results showed that since 2013, the research community gained increasing interest in multimedia interaction, along with a shift in focus toward interaction design, user experience, and interface design in publications in the following years. These bibliometric findings provide meaningful guidance for regions and nations engaged in advancing multimedia interaction design research as an archive to past studies in addition with a guideline to develop future studies.
Keywords: bibliometric analysis, multimedia interaction design, usability, user interface (UI), quantitative and qualitative analysis.

INTRODUCTION

The rapid evolution of computer technology, coupled with the widespread adoption of the Internet and mobile devices, has greatly increased interest in improving user interaction with digital systems. Over the past few decades, computer interfaces have advanced from command-line operations to more intuitive graphical user interfaces, reflecting a growing emphasis on interaction design and user experience. These developments have not only transformed how people engage with technology but have also positioned interaction design as a key driver in shaping the field of human–computer interaction.

In parallel, research in multimedia interaction design has expanded considerably, with a noticeable rise in scholarly output during the last decade. To track these developments, bibliometric approaches have become a valuable means of systematically mapping publication patterns and identifying emerging themes. Bibliometric analysis provides quantitative insights into research growth, collaboration networks, and citation impact, while also highlighting the countries, institutions, and authors most actively contributing to the field.

Previous studies have demonstrated that bibliometric methods are widely used for measuring research output across multiple disciplines [1]. These approaches are often complemented by other evaluative tools such as citation analysis and peer review, which can provide a more nuanced picture of research quality. Advances in technology have also made bibliometric analysis more accessible, enabling researchers to generate comprehensive reports with relative ease [2]. Despite this progress, challenges remain. For example, Google Scholar, though widely used and freely available, does not index all types of academic literature, which limits its coverage [3]. As a result, databases such as SCOPUS and Springer are frequently relied upon for their broader and more reliable coverage across scientific fields [4].

Against this background, the present study undertakes a decade-long bibliometric analysis of interaction design and related themes, including usability, user experience, and interface design. By examining literature

published between 2013 and early 2024, the study identifies publication trends, research hotspots, and patterns of international collaboration. This analysis not only highlights how the field has developed but also provides insights into the directions in which interaction design research is heading.

METHODOLOGY

Bibliometric techniques were employed in this study to systematically evaluate research output and trace the development of interaction design as a scholarly field. Bibliometric analysis focuses on quantifiable measures such as publication counts, citation rates, impact factors, and patterns of collaboration, allowing researchers to uncover trends, thematic clusters, and the overall growth of academic interest in specific areas. To identify relevant literature, the keywords *"interaction design"* and *"usability"* were searched in titles, abstracts, and author-provided keywords across two leading academic databases: Springer and SCOPUS. The initial search returned 1,236 documents in SCOPUS and 2,807 in Springer. Although Springer is a well-established publishing platform covering diverse disciplines such as science and technology, medicine, and the social sciences, previous studies suggest that SCOPUS provides broader international coverage and a more systematic indexing of peer-reviewed material [5]. Based on this consideration, SCOPUS was chosen as the primary source of data for this analysis.

As of January 2024, the SCOPUS search yielded 585 publications related to *"interaction design"* and *"usability."* Together, these papers received 3,995 citations since 2013, averaging seven citations per document. The dataset includes journal articles, review papers, and conference proceedings. Specifically, 132 research articles, 9 review papers, and 444 conference papers were retrieved. For advanced analysis, the bibliographic records were processed using BiBliometrix, a software tool designed for scientific mapping and bibliometric evaluation [6]. This allowed for both quantitative assessment of publication trends and qualitative exploration of influential works. To gain further insight into the direction of research within interaction design and user experience, the 20 most frequently cited papers were examined in greater detail.

TABLE 1 Summary of the Key Information of Queried Bibliometric Data

DESCRIPTION	RESULTS
TIMESPAN	2013-2024
SOURCES (JOURNALS, BOOKS, ETC)	271
DOCUMENTS	580
ANNUAL GROWTH RATE %	-29.8
DOCUMENT AVERAGE AGE	5.62
AVERAGE CITATIONS PER DOC	6.636
KEYWORDS PLUS (ID)	3285
AUTHOR'S KEYWORDS (DE)	1754
AUTHORS	1741
AUTHORS OF SINGLE-AUTHORED DOCS	45
SINGLE-AUTHORED DOCS	49
CO-AUTHORS PER DOC	3.44
INTERNATIONAL CO-AUTHORSHIPS %	19.83
ARTICLE	132
CONFERENCE PAPER	435
CONFERENCE PAPER REVIEW	1
REVIEW	8

QUANTITATIVE ANALYSIS

Analysis of Publication Years

Figure 1 illustrates the distribution of studies on interaction design, user experience, usability, and interface design from 2013 through January 2024. A total of 585 publications were identified during this period, consisting of 444 conference proceedings, 132 journal articles, and 9 review papers. Research activity dipped slightly between 2013 and 2015 but peaked in 2017 with 65 publications. The years 2016 to 2017 marked a sharp rise in output, followed by fluctuations from 2017 to 2019. After 2019, publication numbers stabilized, although modest growth was observed again in 2022 and 2023, with 58 and 60 papers published, respectively. By the end of 2023, the data suggested a sustained upward trajectory, reflecting a continuing expansion of scholarly interest in interaction design.

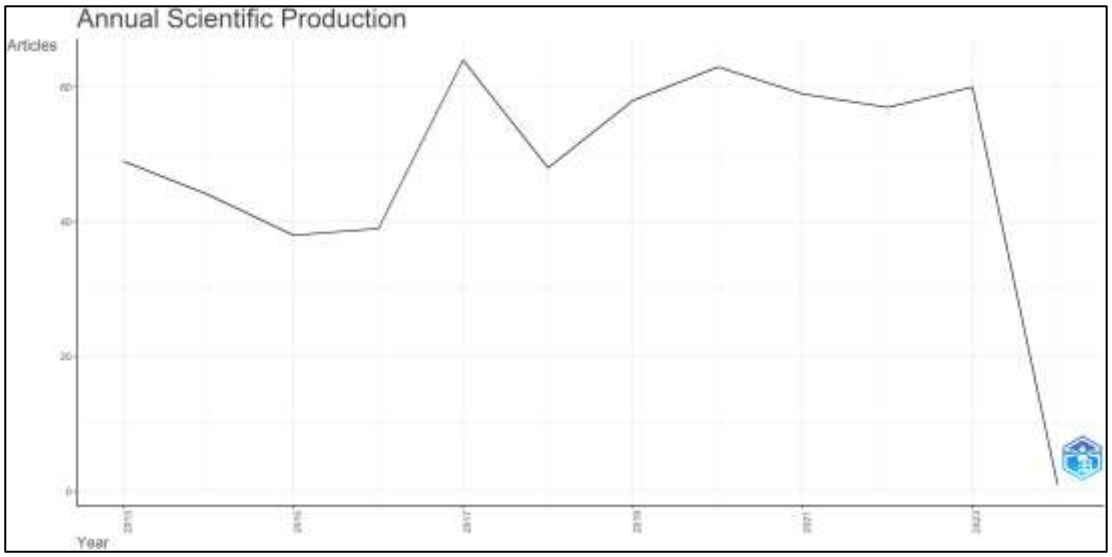

FIGURE 1 Scientific output for interaction design research in 2013 - 2024

Figure 2 presents the trend in average annual citation counts for publications within the same period. Articles published in 2015 achieved the highest citation rate on average, while those from 2013 also demonstrated consistently strong impact. In contrast, works appearing after 2021 showed a noticeable decline in citation frequency, largely reflecting the smaller number of publications and the limited time for citations to accumulate. In total, the dataset comprises 585 cited documents, spanning journal articles, conference papers, and review studies.

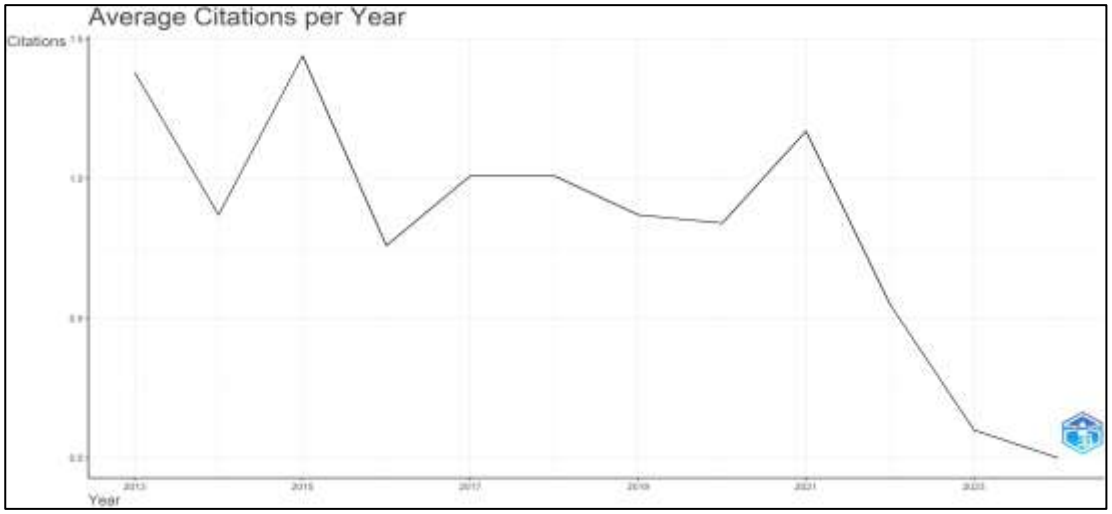

TABLE 1

FIGURE 2 Averaged yearly citations of articles used in interaction design research in 2013 - 2024

Analysis of Authors

Figure 3 presents the most frequently cited works published between 2013 and 2024. The analysis shows that the two leading papers, both released in 2015, received the highest local citation counts, marking that year as particularly influential in this field. Author productivity analysis reveals that Lee H emerged as the most prolific contributor, with nine publications during the study period. Close behind were Lee J and Zhao, each producing more than eight papers. The visualization also highlights that several of the most influential articles appeared in the early years of the dataset, particularly between 2013 and 2014. Taken together, these findings suggest a steady rise in scholarly engagement with interaction design research, with both early foundational works and recent contributions shaping the field's trajectory.

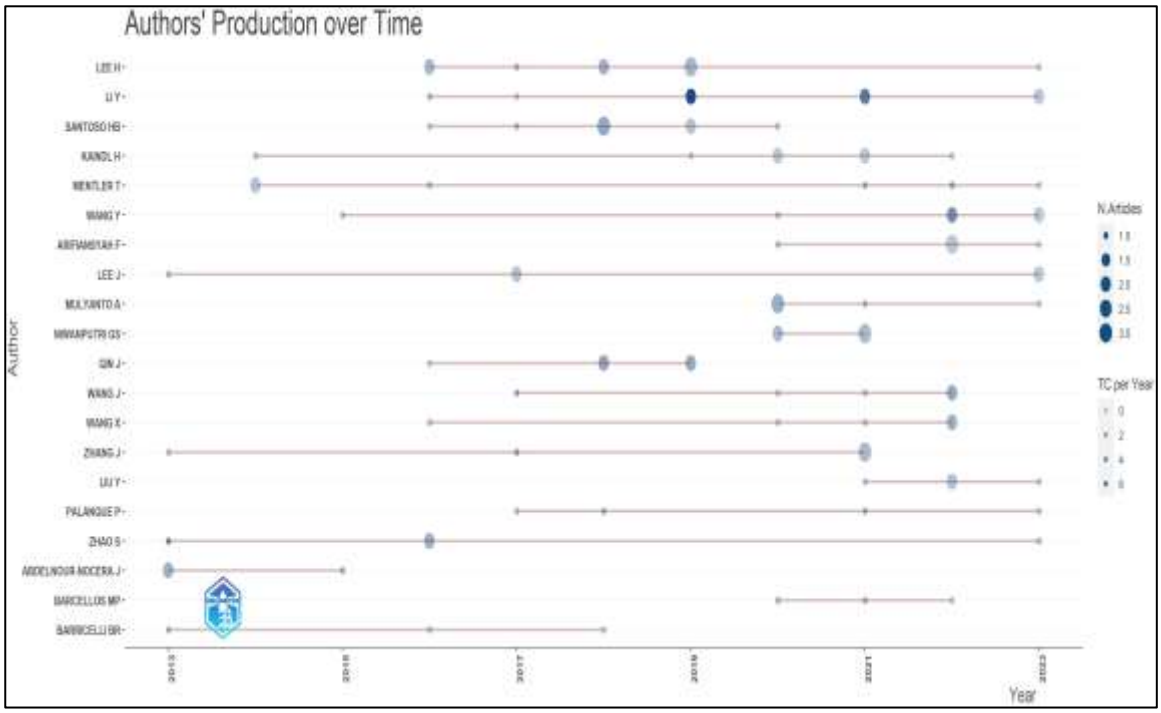

FIGURE 3
Top 20 locally cited publications on the interaction design research field

Analysis of Sources

The dataset contained 585 publications spanning journals, conference proceedings, and related sources. Figure 5 highlights the outlets that have played the most significant role in disseminating research on interaction design and usability. Among them, the *Lecture Notes in Computer Science* series—together with its subseries *Lecture Notes in Artificial Intelligence* and *Lecture Notes in Bioinformatics*—stood out as the dominant venue, contributing 98 papers. The second most frequent source was the *Communications in Computer and Information Science* series, with 15 publications, followed closely by *Advances in Intelligent Systems and Computing* with 14. In comparison, most other journals published fewer than five papers on the topic. This distribution suggests that a small cluster of well-established outlets has served as the primary platform for scholarship in this field.

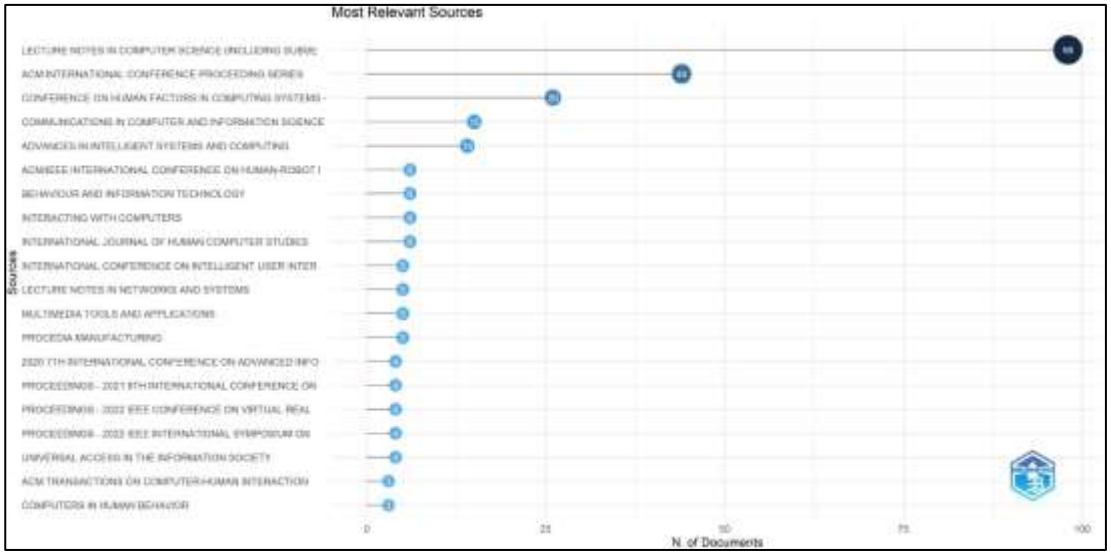

FIGURE 4
The top 20 publisher that provided the greatest number of publications in interaction design research in 2013 – 2024

Analysis of Countries

Within the field of multimedia interaction design, 585 publications were sourced across 64 countries. Figure 6 illustrates the research output of the top 20 nations, distinguishing between internationally co-authored works (Multi-Country Publications, MPC, shown in red) and those produced within a single country (Single-

Country Publications, SCP, shown in green). China emerged as the major contributor with 63 publications, followed by the United States (29) and Germany (27). While China demonstrated the strongest level of international collaboration, the United States accounted for the highest proportion of single-author publications.

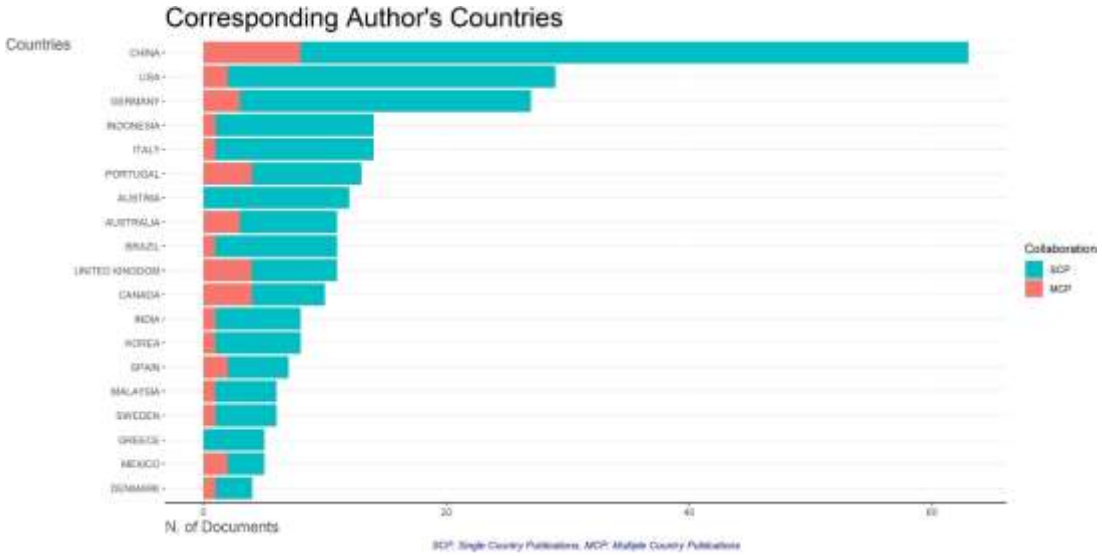

FIGURE 5 Corresponding author's origin country, ranked from 1 - 20 (red stroke: Multiple Countries Publication (MCP), Single Country Publication (SCP)

Figure 6 outlines the distribution of authors by country, while Figure 7 maps the number of collaborative publications in the areas of interaction design and usability. Darker shades of blue represent larger author groups, with China contributing the most substantial cluster of researchers. In contrast, lighter shades correspond to smaller communities, such as those in Moscow, Greece, and Denmark. Overall, China and the United States stand out as the primary centres of research activity, followed by the United Kingdom and Germany as secondary but still notable contributors.

Collaboration trends become more apparent in Figure 9, where the thickness of red lines reflects the intensity of international co-authorship. The strongest partnership is seen between China and the United States, highlighting their joint influence in shaping the global knowledge base of interaction design. The broader network of connections further emphasizes China's pivotal role, as it engages in frequent collaborations with a wide range of countries, consolidating its central position within this research domain.

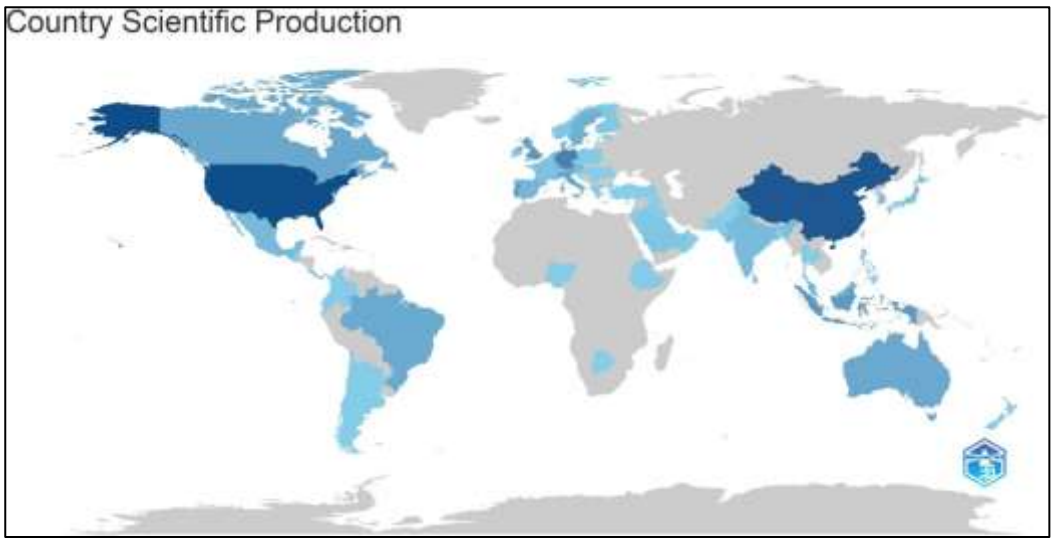

FIGURE 6 The production of scientific papers on interaction design across the world (Blue color intensity: the number of contributing authors related to respective countries; grey color: non-affiliated countries)

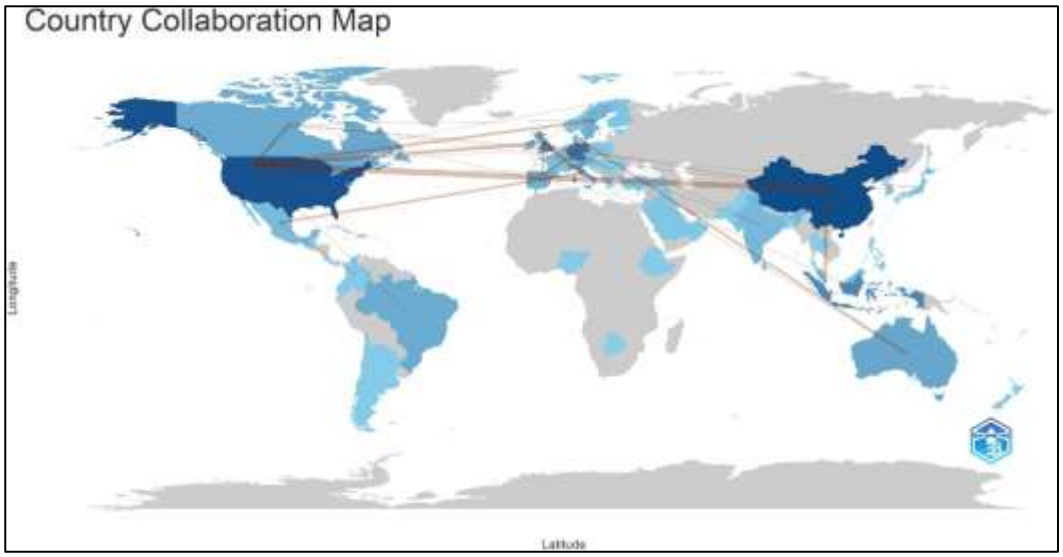

FIGURE 7 The collaboration of scientific papers on interaction design across the world (Blue color intensity: the number of contributing authors related in respective countries; grey color: non-affiliated country; red lines: number of shared publications, thickness intensifies with publication number)

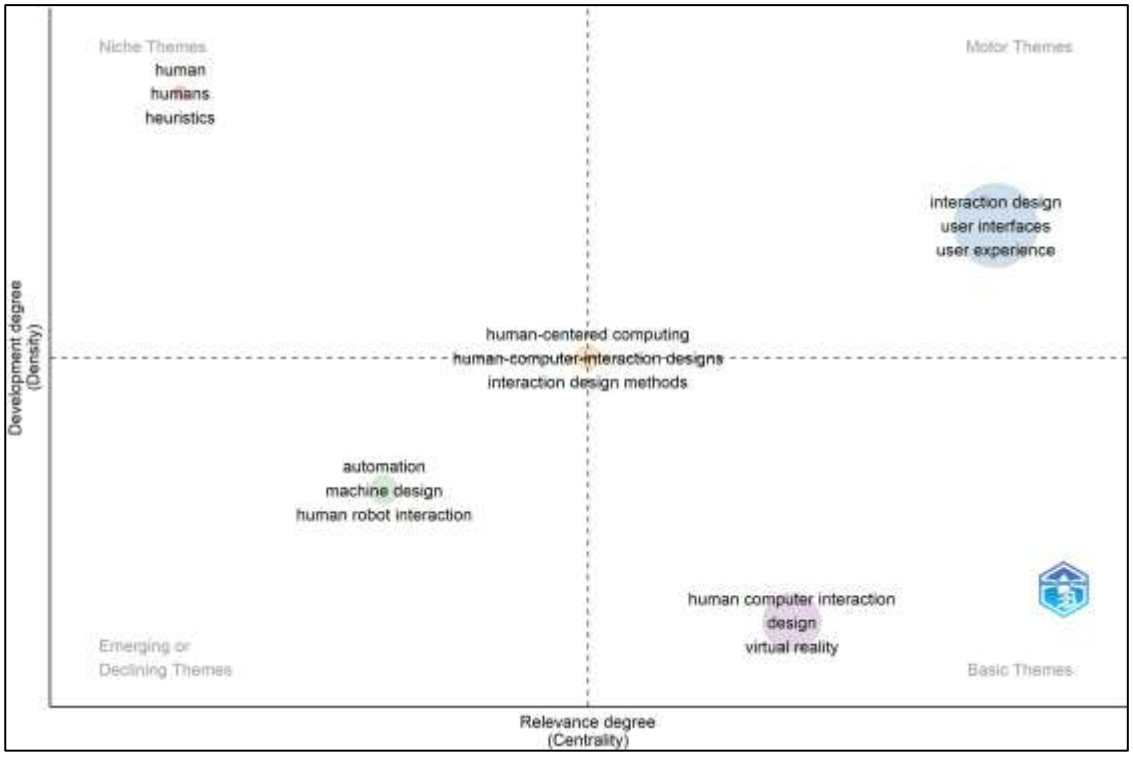

FIGURE 8 Keywords network clusters in interaction design, presented in thematic map (Bubble magnitude: frequency of the keyword)

Analysis of Keywords

Figures 9 and 10 illustrate how keywords in interaction design and usability research intersect with the institutional affiliations of contributing authors. To visualize these connections, three domain graphs were generated. In Figure 9, countries are positioned at the center, journals on the left, and keywords on the right. This mapping shows how frequently used terms link to publication venues and national research activity. Core keywords include *interaction design*, *usability*, *user centered design*, *human computer interaction*, and *computer interaction*, alongside related terms such as *user experience*, *interface design*, and *production design*.

Figure 10 presents the analysis from another perspective, placing institutional affiliations at the center, with journals on the left and keywords on the right. Compared with Figure 9, this visualization reveals denser connections between journals and keywords, offering a clearer view of how research themes align with institutional contributions. The keywords in this analysis were extracted automatically from titles and citations, ensuring comprehensive coverage of recurring concepts.

The mapping highlights not only established themes but also emerging areas of focus. As shown in Figure 10, a substantial portion of the literature appears in the *Lecture Notes in Computer Science* series and its

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subseries *Lecture Notes in Artificial Intelligence* and *Lecture Notes in Bioinformatics*. These venues publish a large body of work on interaction design, usability testing, user experience, and interface design. The *ACM International Conference Proceeding Series* also plays a significant role, contributing 44 articles to the dataset and serving as a key platform for advancing scholarship in this field.

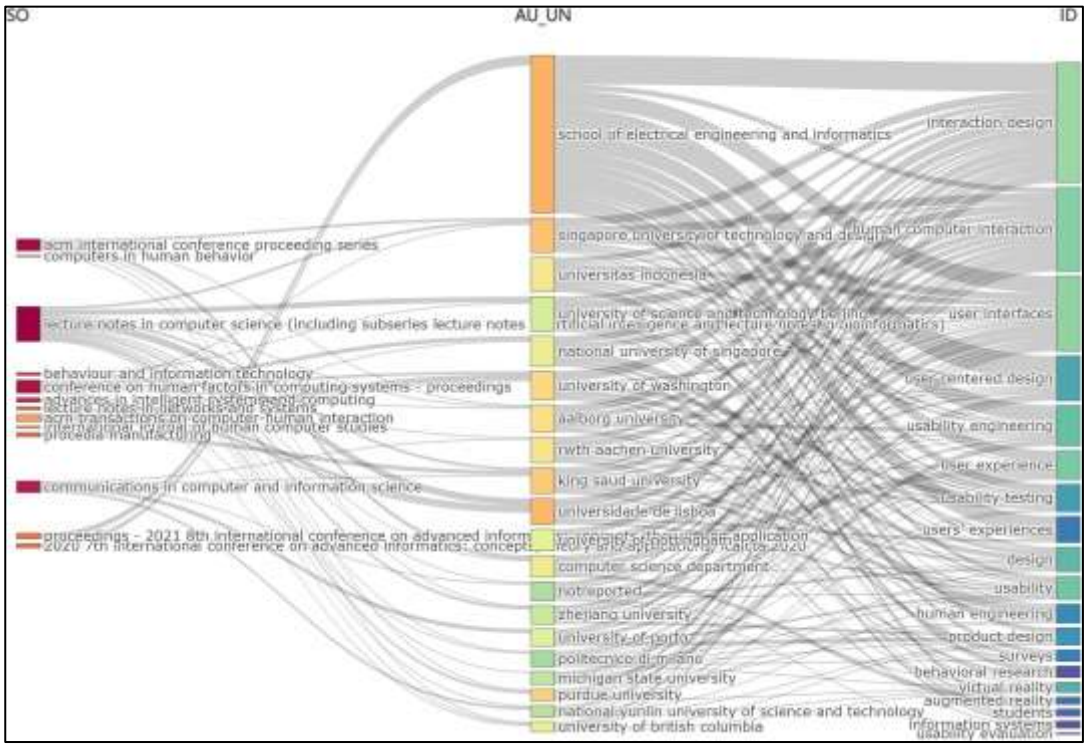

FIGURE 9Affiliation among topmost publications (left), top contributing institute (middle), and top keywords (right) in interaction design, in a three-area plot

An additional 27 articles appeared in the *Conference on Human Factors in Computing Systems Proceedings*, a leading venue for research on user centered design, user experience, usability evaluation, interaction design, human computer interaction, and human factors. *Advances in Intelligent Systems and Computing* and *Communications in Computer and Information Science* each contributed 15 publications. The dispersion of research across these and other outlets underscores the diversity of publication platforms in the field. In this context, Figure 9 offers a useful point of reference by highlighting the dominant themes within top tier journals. Such mapping not only guides scholars in identifying the most influential venues for dissemination but also clarifies where research achieves the greatest visibility and impact.

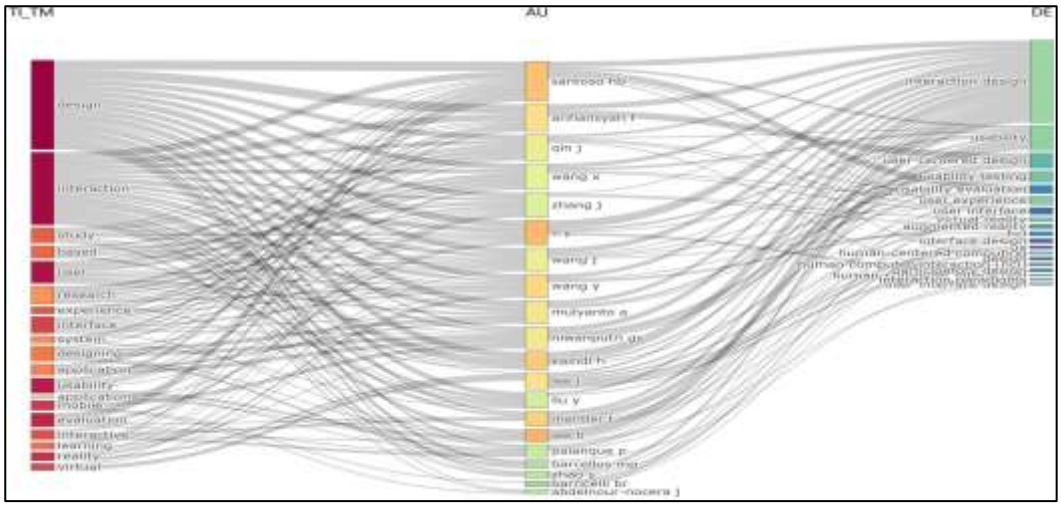

FIGURE 10 The affiliation among topmost keywords (left), top authors (middle), and top research topics (right) in modularity for sustainability publications, in a three-area plot

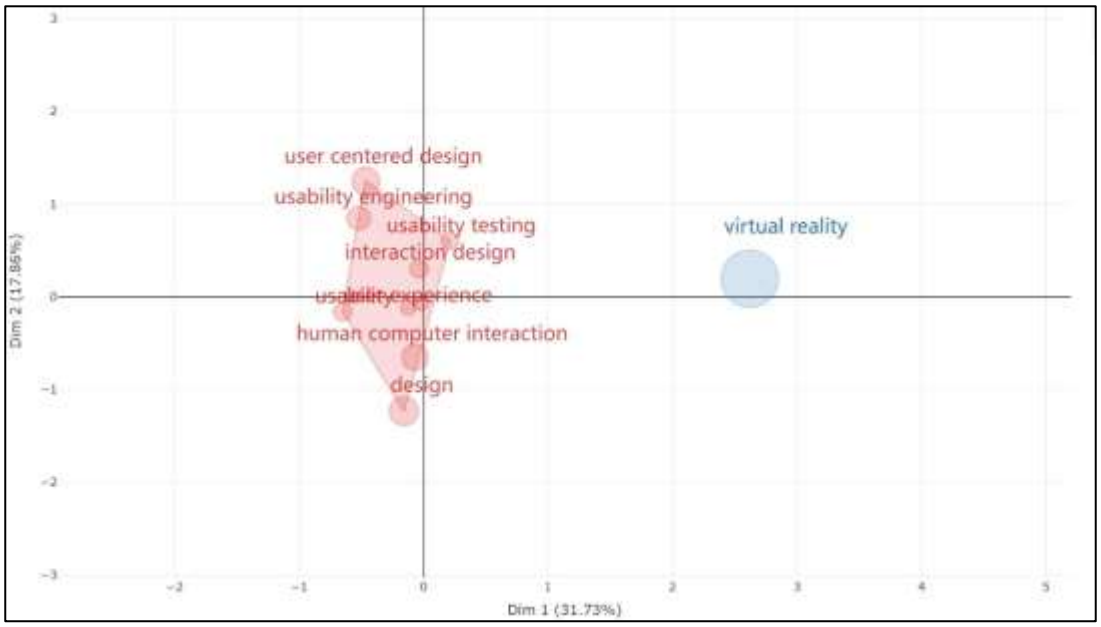

FIGURE 11Keywords in interaction design (Dim.1 and Dim.2: the typical situation of the articles involved in each keyword), in a conceptual structure map

Figure 11 presents the keyword clusters generated through categorized clustering, where each color corresponds to a distinct group of terms. Two clusters were identified in total. The blue cluster contains only a single keyword, whereas the red cluster is considerably larger and includes nine related terms. These keywords encompass interaction design, user interfaces, human–computer interaction, user experience, usability, usability engineering, design, virtual reality, user-centered design, and usability testing.
Figure 12 provides an alternative visualization of these relationships using a tree map, a method commonly applied to display hierarchical data. In a tree map, rectangular areas represent clusters, with their size reflecting the relative weight or significance of the associated terms. Although this graph conveys the same information as Figure 11, it presents the keyword groupings from a different perspective. Like the earlier figure, the tree map divides the terms into two main clusters while also illustrating the conceptual proximity among related words.

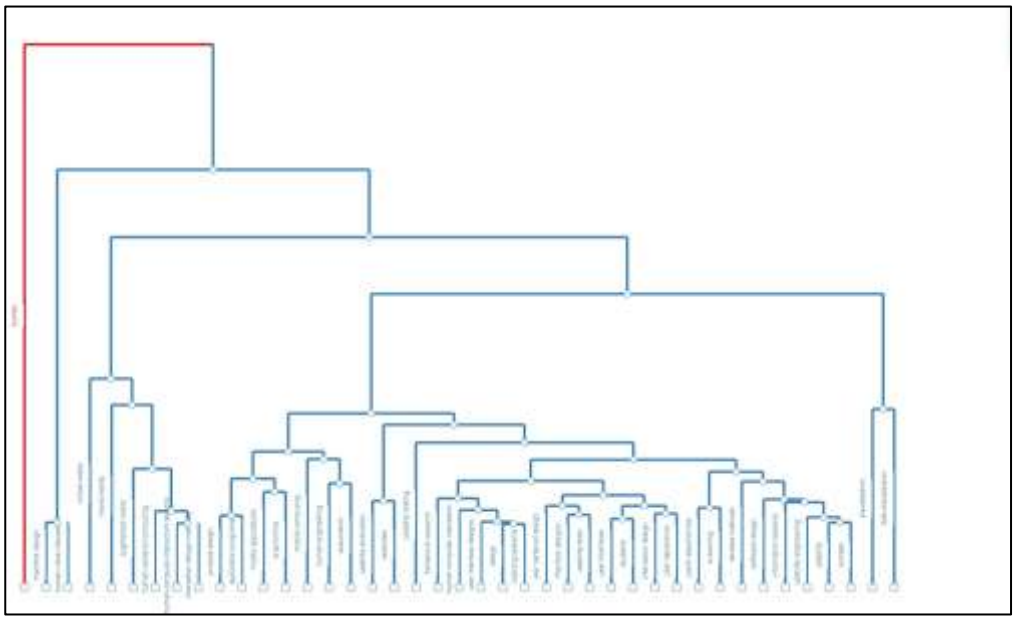

FIGURE 12 Keywords in interaction design (height: the distance among clusters of words) in form of conceptual structure dendrogram

Researchers often need a quick way to recognize the most frequently used terms in their field. One effective approach is the use of a word cloud, a visual technique that arranges words according to their frequency and importance, making patterns in textual data easier to grasp. Figures 13–16 illustrate this by displaying the most common keywords, author-supplied keywords, title words, and abstract words. Keywords extracted directly from article titles provide an overview of the focus and depth of the publications, while author keywords reflect the topics that researchers themselves consider most central. Although both types serve

similar purposes in bibliometric analysis, author keywords tend to capture a broader range of themes. In addition, the most frequent title and abstract words are shown after filtering out punctuation and trivial terms such as “paper,” “study,” “work,” and “data,” ensuring that the results emphasize meaningful content.

FIGURE 13
Keywords in interaction design publications (Font size: frequency of keyword appearances)

Figure 14 presents the distribution of author keywords, which range from 340 occurrences to as few as two. Frequently used terms include interaction design, user interfaces, usability, user experience and human–computer interaction. Figure 15 highlights the most common words appearing in article titles, such as design, user, usability, evaluation, reality, interaction, interface, virtual, moble and interactive—terms that closely reflect the focus of this research area. Similarly, Figure 16 shows that abstracts most often feature words like design, interaction, user, usability, study, system and experience. Together, these findings suggest a consistent pattern across author keywords, title words, and abstract terms, all converging around core themes of interaction design. This consistency indicates that researchers should carefully select precise and relevant vocabulary when crafting titles, abstracts, and keywords, as these elements play a critical role in ensuring visibility and alignment within the field.

FIGURE 14Top authors’ keywords in interaction design publications (Font size: frequency of keyword appearances)

FIGURE 15
Top title words in interaction design publications (Font size: frequency of keyword appearances)

FIGURE 16 Topmost abstract words in interaction design publications (Font size: frequency of keyword appearances)

Figure 16 illustrates the keywords most frequently found in abstracts, design, usability, users, interaction, study, experience and system emerging as the most common. These terms appear consistently across publications on interaction design, yet what stands out is that several of the leading words are drawn from general data collection language rather than domain-specific concepts. Interestingly, the distribution of abstract, title, and author keywords does not fully align with the trends seen in the keyword cloud. This discrepancy suggests that researchers should consider adopting more thematically precise terms to better capture the focus of their studies and enhance the visibility of their work.

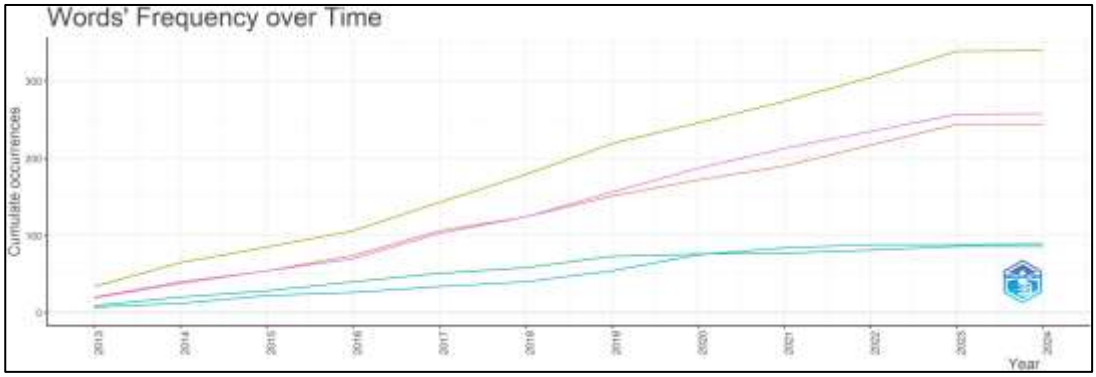

FIGURE 17 Frequency of top keywords in interaction design in the 2013 - 2024 (method: Loess smoothing)

Figure 17 shows a clear upward trajectory in the visibility of interaction design as a research focus between 2013 and January 2024, with occurrences rising steadily and reaching 280 by 2023. Over time, keywords such as Human-Computer Interaction, user interfaces, usability, and user experience have appeared more frequently, reflecting their centrality in the field. Notably, the term "user experience" has attracted comparatively less attention since 2019, despite its earlier prominence. Overall, the increasing use of these core keywords each year highlights the sustained and expanding scholarly interest in interaction design. Given the strong growth trend observed over the past decade, it is reasonable to expect that this area will continue to attract substantial research attention in the coming years.

Qualitative Analysis

Between 2013 and January 2024, 585 papers on interactive design were published in the multimedia field. Of these, about 2 percent have been cited more than 50 times, indicating a subset of highly influential contributions within the dataset. This translates to at least 12 papers reaching the 50-citation threshold. The following section provides a qualitative analysis of these works, with attention to their thematic focus and impact on the field.

Subjects

The most frequently cited papers converge around recurring themes such as user experience, interaction design, usability, and interface design. A supplementary table summarizes the primary article themes and sub-themes, showing that nearly all of the top-cited works place usability at the core of their analyses or case studies.

Methodologically, most of these studies employed statistical techniques such as variance analysis and t-tests, often supported by SPSS for quantitative document analysis. For this paper, a closer review was conducted of ten highly cited articles. Collectively, these works emphasize the integration of technology, user experience, and practical considerations in design. Topics such as user satisfaction, usability testing, and biofeedback illustrate both the breadth of approaches and the challenges that remain unresolved across domains.

For example, Zhao et al. examined technology's role in social media interaction design, emphasizing how real-time feedback and passive monitoring can enhance usability and sociability [7]. Roman et al. highlighted navigation in electronic health records as a critical factor shaping usability and user experience [8]. Ren and O'Neill compared tangible and graphical interfaces, finding similar performance outcomes but a strong user preference for tangible interfaces—underscoring the significance of subjective experience in design evaluation [9].

Cognitive and affective dimensions of user satisfaction were central to Coursaris and Osch, who argued that effective web design must balance visual aesthetics with cognitive factors to optimize engagement [10]. In mobile augmented reality (MAR), Kourouthanassis et al. proposed interaction design principles that improve usability and performance, thereby enhancing satisfaction [11]. Similarly, Ren and O'Neill explored low-cost, camera-based free gestures in 3D user interfaces, which enabled immersive interaction but introduced distinct challenges compared to 2D or device-dependent alternatives [9].

Mobile UI design patterns have also emerged as a notable focus. Punchoojit and Hongwarittorrn identified gaps in scholarship and called for more systematic research to establish robust design guidelines [12]. In the educational domain, Lin et al. investigated the use of augmented reality in geometry learning, reporting benefits such as improved spatial perception and academic performance. However, their findings also underscored methodological limitations, particularly in sample size and study design, pointing to important avenues for future inquiry [13].

Taken together, these studies highlight the diversity of design and evaluation practices across multiple domains. They emphasize the importance of integrated approaches that combine technological innovation, usability testing, and user-centered perspectives. By advancing understanding of user needs and refining design methods, future research can foster both practical improvements and conceptual innovation in interaction design. In particular, the development of augmented reality-based mobile UI design not only enhances educational outcomes but also contributes to broader advances in interactive learning technologies.

CONCLUSION

Bibliometric analysis employs mathematical and statistical techniques to evaluate patterns in scholarly output. Although prior research has addressed themes such as interaction design and usability, no comprehensive bibliometric review of interaction design literature has been undertaken. To fill this gap, the present study examined SCOPUS-indexed publications on interaction design from 2013 to January 2024.

The results reveal steady growth in research output over the past decade, with a notable peak in 2015. China, the United States, Germany, and Japan emerged as the most prolific contributors, with China and the United States leading in publication volume. Among publication venues, the *Lecture Notes in Computer Science* series (including its subseries) was identified as the most prominent outlet for interface and interaction design scholarship.

Keyword analysis further highlighted interaction design, usability, and user experience as the most frequent and strongly co-occurring terms, underscoring their central role in the field. The years 2015 and 2017 stand out as pivotal moments, marking shifts in research emphasis and scholarly momentum.

Taken together, these findings trace the intellectual evolution of interaction design research while identifying its current trends and future directions. They provide valuable guidance for scholars and practitioners by clarifying key themes, spotlighting influential contributors, and pointing to promising opportunities for advancing knowledge and practice in interaction design.

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