Article

Exploring Global Trends in Intangible Cultural Heritage Design: A Bibliometric and Content Analysis Towards Sustainable Development

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Abstract: This paper aims to explore the development of the field of Intangible Cultural Heritage Design. It seeks to understand the global trends in this field and provide insights for its growth and development. The objectives are achieved through a mixed-methods approach that combines bibliometric methods and content analysis. This approach allows for a quantitative and qualitative analysis of the scientific literature related to Intangible Cultural Heritage Design. The findings of the work include an analysis of the most productive countries/regions, institutions, journals, and authors in the field of Intangible Cultural Heritage Design. It also includes citation and co-citation analysis, which helps identify influential scholars and popular journals in the field, as well as patterns of col-laboration within the field. The outcomes and implications for practice include a better understanding of the global trends in Intangible Cultural Heritage Design and insights for its growth and development. The research find-ings have important theoretical and practical implications for the field, and future research directions are pro-posed. The value of the paper lies in its contribution to a better understanding of the global trends in Intangible Cultural Heritage Design. It provides insights and assistance for its growth and development, mak-ing it valuable to researchers and practitioners in the field.

Keywords: Intangible Cultural Heritage Design; Bibliometric analysis; Content analysis; Global Trends; Sustainable Development

1. Introduction

Intangible cultural heritage (ICH) is a promising field of research that has gained significant academic interest worldwide [1–3]. Strengthening the protection, inheritance, and utilization of ICH is crucial for preserving historical context, cultivating a sense of national identity, and promoting cultural exchanges and mutual learning [4,5]. Digital technology and high-performance computing methods have been applied to protect and develop ICH, providing accurate identification and protection [6]. The integration of intangible cultural heritage (ICH) and tourism has the potential to drive the growth of the service sector and advance the development of a sustainable green economy [7]. Furthermore, museums have been using interactive storytelling and projection mapping to convey ICH, connecting tangible and intangible cultural heritage through narration and vivid illustrations (Nikolakopoulou et al., 2022).

The study of the relationship between ICH and design is crucial for promoting sustainable development in non-heritage contexts. Integrating ICH with technology, such as augmented reality (AR), can enhance visitors' learning experiences and contribute to the protection, inheritance, and promotion of ICH [8]. Combining ICH protection with tourism can generate new protection forms, maintain cultural vitality, and empower people with knowledge to ensure ICH's sustainability. Furthermore, the Live Transmission approach encourages innovations in traditional handicrafts, aiming to revitalize the economies and cultural identities of traditional craft communities [9].

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There is an apparent gap in the literature on the summarization of the Intangible Cultural Heritage Design field. Although there have been case studies and discussions from narrow perspectives such as tourism, gender, and natural resource management, further research is needed to explore the comprehensive vision of sustainable heritage [10]. Intangible Cultural Heritage refers to the tools, objects, artifacts, and cultural spaces that communities, groups, and individuals consider a part of their cultural heritage [11]. The transmission of Intangible Cultural Heritage is a people-centered cultural dissemination that shapes one's morality, character, sentiment, will, ideals, beliefs, values, humanities, artistic taste, thinking mode, wisdom, and practical ability [12]. Therefore, it is necessary to further study the current status of Intangible Cultural Heritage and its re-creation through the market [12,13]. Additionally, the field of innovation in entrepreneurial education for Intangible Cultural Heritage inheritance is also worth paying attention to [12]. Although there have been studies on Intangible Cultural Heritage Design, there is still a need for a comprehensive summary of the field, taking into account various perspectives and impacts of sustainable development.

In recent years, the number of scientific publications on Intangible Cultural Heritage Design has dramatically increased, yet a comprehensive bibliometric and visualization analysis is still lacking to provide insights into the research status. The research topics are scattered, and the research methods and theoretical foundations are not clear enough, which poses challenges to the coherence and systematization of the field. In addition, there is a lack of smooth communication channels among researchers, which leads to limited discussions and exchanges, and hinders the formation of organic connections and collective efforts. This also poses difficulties for decision-makers, such as accurately assessing the research hotspots and trends in the field, developing relevant policies, and constraining the stable development of the field. Moreover, existing research on this topic is dispersed across journals in different disciplines, which poses obstacles to the dissemination and sharing of research findings and hinders the establishment of a consensus in the broader research field.

This article aims to explore the current state of research on Intangible Cultural Heritage Design, further discussing the evolution of research paradigms, tracking research frontiers and hotspots, and providing references and guidance for future practical and theoretical research in this field. In order to bring clarity to the existing research, we developed the following research questions (RQs):

RQ1. How has research in the field of Intangible Cultural Heritage Design evolved over time?

RQ2. What are the primary themes and current issues in Intangible Cultural Heritage Design research?

RQ3. What are the theoretical and practical implications of our research, and what are the future research directions for this field?

In order to accomplish the aforementioned objectives, this article is organized as follows. Section 2 outlines the research methodology, data sources, and software employed in this study. Section 3 presents the results of the bibliometric and content analysis. Section 4 discusses the theoretical and practical implications of our findings and suggests potential avenues for future research. Section 5 highlights the limitations of this study and concludes with final remarks.

2. Data and Methodology

2.1. Software and data

To examine the knowledge structure and trends in the research field, we employed VOSviewer software (version 1.6.18, Centre for Science and Technology Studies, Leiden University, Netherlands) for quantitative analysis of the relevant literature [14,15]. VOSviewer is a practical research tool used for building and visualizing bibliometric networks based on citation, co-citation, co-authorship, or bibliographic coupling relationships. It can identify research hotspots and emerging research directions, establish knowledge maps of research fields, and reveal the development and evolution of research themes on the basis of large-scale academic literature data [16].

All articles were searched using the Web of Science (WoS) on April 20, 2023. The search was conducted in a public database, therefore, no ethical approval was required. WoS is the first database to track journal quality and collect important scientific literature since 1900, with over 159 million

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publications [17,18]. It indexes over 9,000 academic journals across a wide range of scientific fields, making it a comprehensive academic information platform [19]. Boolean formulas were used in the WoS database to conduct an advanced search of articles related to Intangible Cultural Heritage Design. The downloaded publication information includes the title, publication year, authors, country/region, institution, journal, keywords, and abstract, which were downloaded in TXT format.

((((TS = (Intangible Cultural Heritage) AND TS = (Design))) AND LA = (English)) AND DT = (Article))

Indexes: SCI-EXPANDED, SSCI,ESCI, A&HCI.

2.2. Methodology

This article uses a mixed methods field that combines bibliometric methods and content analysis to conduct a quantitative and qualitative analysis of the scientific literature related to Intangible Cultural Heritage Design [20]. Bibliographic databases and bibliometric features can be used in combination with bibliometric analysis and content analysis methods to study various research fields, identify trends, and analyze the evolution of topics over time. These methods have been applied in various domains, such as virtual reality in computer science education [21], EEG in neurorehabilitation [22], and policy instruments in prefabricated construction in China [23].

Bibliometric analysis involves the quantitative assessment of scientific publications, including citation analysis, co-citation analysis, and co-word analysis. This method helps identify influential studies, research hotspots, and collaboration networks among authors, institutions, and countries [24]. Content analysis, on the other hand, is a qualitative research method that involves the systematic examination of textual data to identify patterns, themes, and trends. This method can be applied to analyze the content of articles, abstracts, and titles to understand the focus of research in a particular field [25].

As an interdisciplinary field related to multiple research areas [26,27], Intangible Cultural Heritage Design holds great research prospects [28]. The rapid growth of scientific publications in the field of Intangible Cultural Heritage Design has made it challenging to conduct a comprehensive literature review using traditional methods. To address this issue, this study employs a mixed-methods approach that combines bibliometric and content analyses to provide an overview of the field's key themes and research directions. By integrating quantitative and qualitative methods, the authors aim to offer a more comprehensive understanding of Intangible Cultural Heritage Design in the existing literature [29].

3. Results

3.1. Bibliometric analysis

In this section, we present an analysis of the most productive countries/regions, institutions, journals, and authors in the field of Intangible Cultural Heritage Design. We also perform citation and co-citation analysis, which can help researchers identify influential scholars and popular journals in the field, as well as patterns of collaboration within the field. Therefore, we pose the first research question: RQ1. How has research in the field of Intangible Cultural Heritage Design evolved over time?

3.1.1. Subsubsection

The sample files collected from 2007 to 2023 offer a wealth of information on the topic of Intangible Cultural Heritage Design. They include essential details such as article titles, publication dates, author names and affiliations, journal titles, abstracts, keywords, references, and citations, among other relevant information. In the earliest published paper, Adalberto [30] proposed a viewpoint, starting from a three-step pathway (General trend, Specific operational platforms, and The role of science), to infer how to use design as the basic foundation of spatial practice to transform the cultural identity of islands and incorporate ecological identity.

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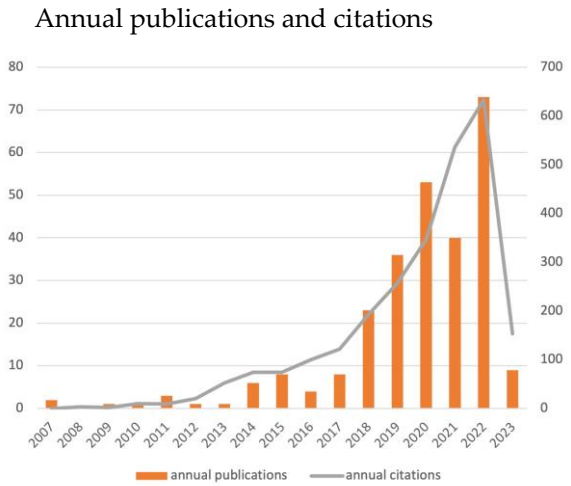

Figure 1. Annual number of publications and citations.

Figure 1 illustrates the annual publication and citation counts. Based on the number of articles published each year, the period between 2007 and 2013 can be considered the starting stage of the research field, during which the field was not very active and only a few researchers were interested in it. The period from 2014 to 2017 can be seen as the initial stage of the research field, during which it received increasing attention. The period from 2018 to 2022 can be seen as the developmental stage of the research field, during which it received more and more attention, resulting in a significant increase in the number of research outputs. Publications during this stage accounted for 83.96% of the total publications. This may also indicate that the importance and influence of the field are continuously increasing, attracting more researchers and funding.

In terms of the number of citations per year, a total of 269 articles were published in this field from 2008 to 2023, with a total citation count of 2,585 and an average of 9.61 citations per article. The citation percentage sharply increased from 2020 to 2022, reaching 58.64% of the total citation count. This suggests that the research topic has shown a rapid growth trend in recent years, receiving more attention and citations from scholars.

- Subject areas

Figure 2. The literature is distributed in various subject areas.

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Figure 2 shows the top 20 relevant subject areas identified from the publications, with Science Technology Other Topics, Arts Humanities Other Topics, and Computer Science being the top three most frequent research areas. Science Technology Other Topics had 73 publications, covering 27.14% of the total, while Arts Humanities Other Topics and Computer Science had 43 and 39 publications, respectively, accounting for 15.99% and 14.50%. Additionally, the Web of Science Categories were distributed among Green Sustainable Science Technology (59), Humanities Multidisciplinary (42), Environmental Studies (33), Environmental Sciences (27), Computer Science Information Systems (20), Hospitality Leisure Sport Tourism (15), and Multidisciplinary Sciences (14).

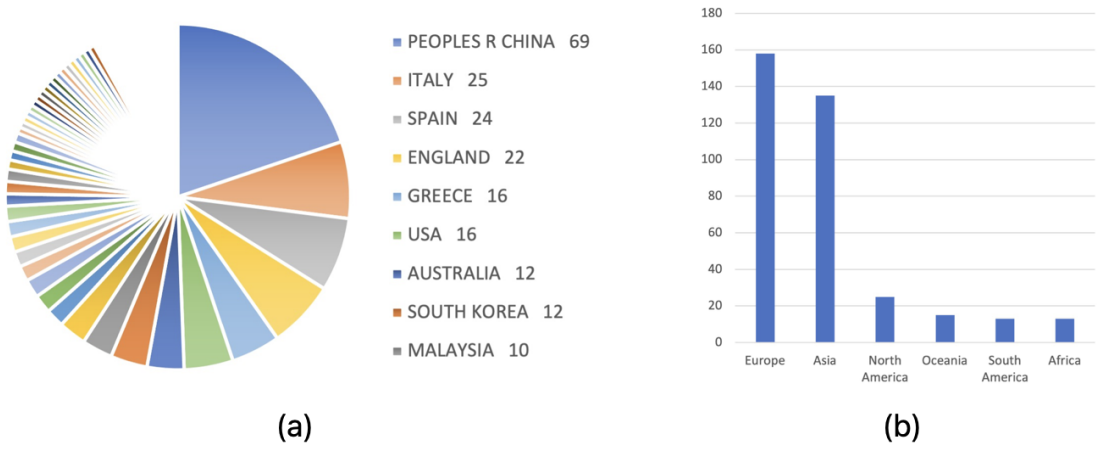

Figure 3. Number of scientific publications. (a) Countries/regions distribution. (b) Intercontinental distribution.

3.1.2. Countries/regions distribution analysis

Figure 3(a) shows the number of scientific publications in this field from each country/region, with publications from 72 different countries. Among these countries, China has the highest number of published articles (69), followed by Italy (25) and Spain (24). It is evident that China is the leading country, which indicates its significant contribution to this field. Italy, Spain, and the United Kingdom are all prominent European countries within the top 20. This may be due to various factors, such as their historical significance in this field or renowned research institutions within these countries/regions. The presence of Greece indicates a strong connection between this country and the field, possibly due to its rich cultural heritage and continuous efforts to protect and promote its cultural assets. The United States and Australia are the only two non-European countries in the top 10, indicating their important resources and expertise in publishing in this subject area.

Figure 3(b) shows the number of scientific publications in this field by continent. The research in this field is mainly concentrated in Europe (158) and Asia (135), with Europe having the highest number of published papers, followed by Asia. Half of the top ten countries with the highest number of publications are European countries.

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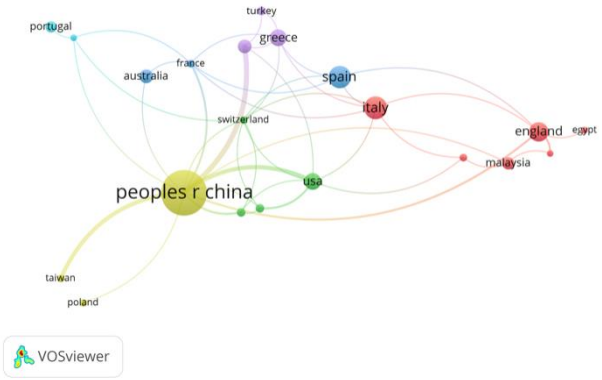

Figure 4. Demonstrates the collaboration network between countries/regions.

Figure 4 shows that the VOSviewer software was used to analyze the network visualization of co-authorship relationships between countries/regions. Only countries/regions with a minimum of 4 articles were included. Among the 21 countries and regions that met the threshold, China is at the center of the research field and has close collaborations with Taiwan and South Korea.

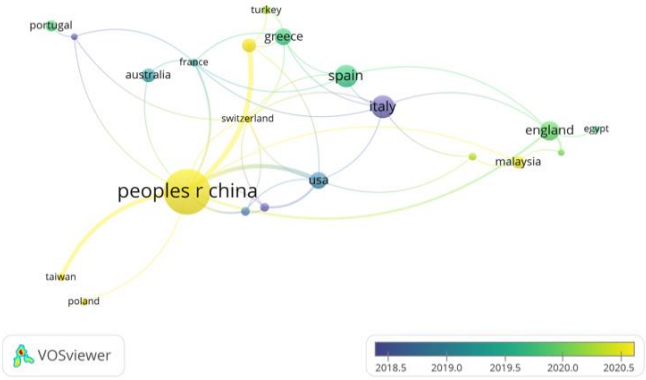

Figure 5. Demonstrates the collaboration overlay between countries/regions.

Figure 5 shows that the VOSviewer software was used to analyze the overlay visualization of co-authorship relationships between countries/regions. Initially, countries/regions such as Italy, Canada, and the USA were active in this research field. However, currently, most of the active countries in this field are in Asia, such as China, South Korea, Malaysia, and others. Moreover, the number of articles published by Asian countries is rapidly increasing every year, indicating a trend of catching up with the leaders.

3.1.3. Institutions and their collaboration network analysis

Table 1 presents the top 5 most productive institutions. The Polytechnic University of Milan (Italy) and the University of Aegean (Greece) are ranked first with 6 publications each in terms of TP. Following closely are the Hong Kong Polytechnic University (Hong Kong SAR, China), the Polytechnic University of Turin (Italy), and the University of London (UK), all with 5 publications. In terms of TC, the University of London ranks first with 124, followed by the Polytechnic University of Turin with 92.

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Table 1. The top 5 most productive institutions.

R	Affiliation	Country	TP	TC	TC/TP	H
1	Polytechnic University Of Milan	Italy	6	67	11.17	3
2	University Of Aegean	Greece	6	41	6.83	4
3	Hong Kong Polytechnic University	Hong Kong, China	5	54	10.80	3
4	Polytechnic University Of Turin	Italy	5	92	18.40	3
5	University Of London	United Kingdom	5	124	24.80	3

*Source: Own elaboration based on WoS database (2023). Note: R = Ranking; TP = Total number of papers; TC = Total number of citations; TC/TP = Average Citations per Article; H = H-index.

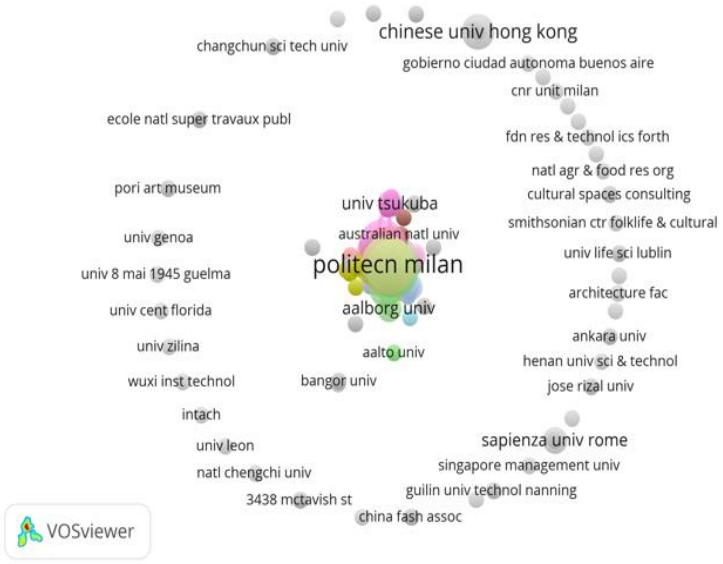

Figure 6. The collaboration network of all 400 institutions.

Based on the bibliographic data, we identified 400 institutions. Figure 6 presents the collaboration network visualization of all the institutions by setting the minimum number of documents per institution as 1. The size of the nodes represents the number of articles completed by the corresponding institution, and the nodes are colored dark gray if the authors belong to the same institution and have not collaborated with other institutions. It can be seen that authors tend to seek collaboration within their own institutions.

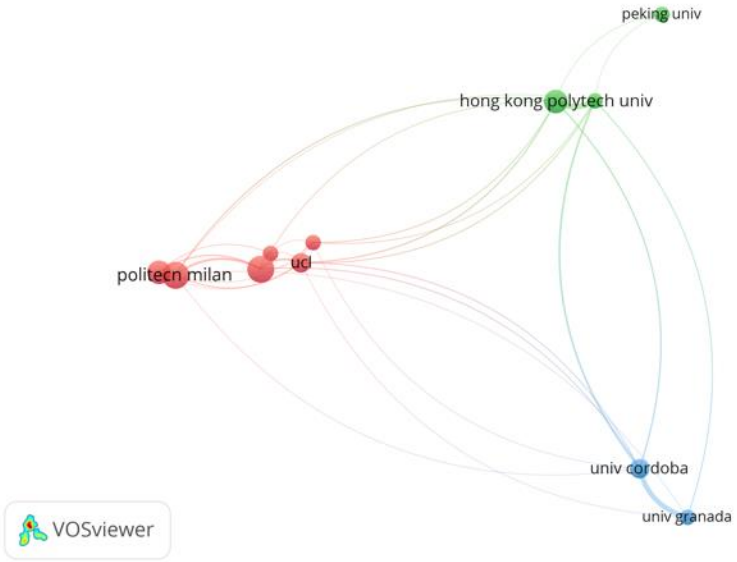

Figure 7. The collaboration network of all 11 institutions.

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In the same way, by setting the minimum number of documents per institution as 3, we obtained 11 institutions visualized in Figure 7. Among the most collaborative institutions, Jinan University ranked first with 3 publications and 67 citation counts, and established 7 connections with other institutions. Additionally, Hong Kong Polytechnic University was also among the collaborating institutions.

3.1.4. Journals and authors analysis

Table 2 presents key indicators for the top 9 journals in the field. From the editorial perspective, it can be observed that MDPI has three journals in the field, with Sustainability and Heritage ranking higher in terms of JQ. In terms of JCI, a new indicator representing a journal's citation count and impact, there is a significant difference among the journals. ACM Journal on Computing and Cultural Heritage and Heritage have a relatively high relative impact in terms of their JCI values. In terms of the JCI Category, the relevant articles are distributed across different fields, and the journals cover a diverse range of fields such as engineering, humanities, psychology, education, and environment, but with a focus on humanities, heritage, and sustainability. In terms of Category Quartile, the journals have different levels of influence in their respective fields, with four of them belonging to Q1, including Heritage, ACM Journal on Computing and Cultural Heritage, International Journal of Heritage Studies, and the International Journal of Intangible Heritage. Regarding article output and citation count, there is a significant difference between them, with Sustainability having the highest article output and the International Journal of Heritage Studies having the highest citation count. However, the International Journal of Heritage Studies has the highest Average Citations per Article.

Table 1 The top 9 productive journals.

R	Journal	Editorial	JCI	JCI Category	CQ	TP	TC	TC/TP	MCA
1	Journal Of Cultural Heritage Management And Sustainable Development	MDPI	0.18	GREEN & SUSTAINABLE SCIENCE & TECHNOLOGY(ESCI)	Q4	32	68	2.13	[31]
2	Sustainability	Emerald Group Publishing	0.65	ENVIRONMENTAL STUDIES(SSCI)	Q3	25	207	8.28	[32]
3	Heritage	MDPI	4.12	HUMANITIES, MULTIDISCIPLINARY(ESCI)	Q1	11	21	1.91	[33]
4	Asian Education And Development Studies	Taylor & Francis	0.32	EDUCATION & EDUCATIONAL RESEARCH(ESCI)	Q3	7	9	1.29	[34]
5	Acm Journal On Computing And Cultural Heritage	National Folk Museum of Korea	4.08	HUMANITIES, MULTIDISCIPLINARY(AHCI)	Q1	6	31	5.17	[35]
6	Frontiers In Psychology	Association for Computing Machinery	1.03	PSYCHOLOGY, MULTIDISCIPLINARY(SSCI)	Q2	6	1	0.17	[36]

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7	International Journal Of Heritage Studies	Emerald Group Publishing	3.28	HUMANITIES, MULTIDISCIPLINARY(AHCI)	Q1	6	142	23.67	[37]
8	International Journal Of Intangible Heritage	Frontiers Media	1.36	HUMANITIES, MULTIDISCIPLINARY(AHCI)	Q1	6	26	4.33	[38]
9	Applied Sciences Basel	MDPI	0.59	ENGINEERING, MULTIDISCIPLINARY(SCIE)	Q2	5	14	2.80	[39]

*Note: JCI= Journal Citation Indicator ™(2021); CQ=Category Quartile; TP = Total number of papers; TC = Total number of citations; TC/TP = Average Citations per Article; MCA=The most cited articles.

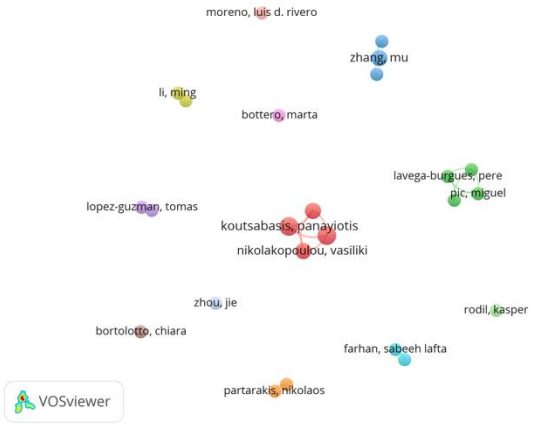

Figure 8. The collaboration network of all 24 authors.

The authors with more than 2 papers are rare, indicating that from the author's point of view, the published papers are scattered. Figure 8 shows that The VO Sviewer software was used to analyze the network visualization of co - authorship relationships between authors. By specifying the minimum number of publications per author as 2, we identified 24 authors out of 726 authors. There is a cooperative relationship among these authors, most of the authors gather together to form small groups, and there are 7 small groups with more than two nodes. This suggests that there is a degree of collaboration between authors, and that some authors collaborate more

3.1.5. Citation analysis

In this section, we conducted a citation and co-citation analysis to identify the most influential authors and journals in the field. We used citation links to measure the frequency of a paper being cited and co-citation links to measure the frequency of two papers being cited together in the same article.

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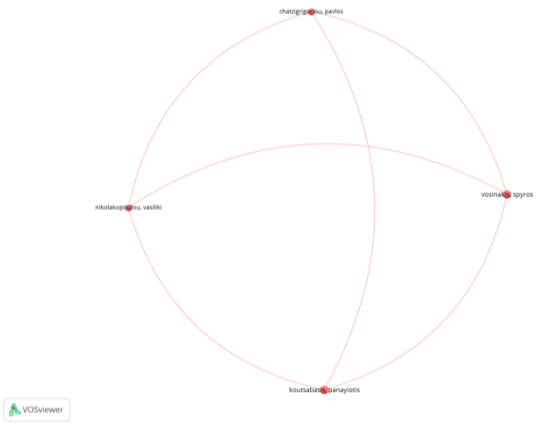

Figure 9. The citation network of authors.

We selected 123 authors out of 726 by setting the minimum number of citations per author to 24. Figure 9 displays the citation structure, in which four authors out of 24 are shown to have a less close citation network. This suggests that the citation relationship between these authors or papers is not very frequent, and they are relatively independent in the field of study.

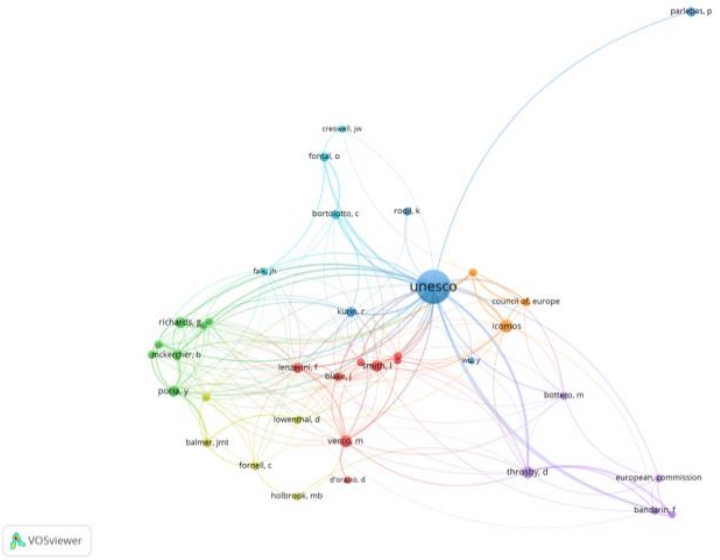

Figure 10. The co-citation network of authors.

Using a minimum co-citation threshold of 8, we identified 37 authors out of a total of 8956, and the resulting co-citation structure is depicted in Figure 10. This included 39 authors, grouped into 5 clusters. It can be observed that the UNESCO node is particularly large, while the other nodes are relatively similar in size, indicating a relatively balanced citation relationship among these authors or papers. However, the prominence or influence of UNESCO is more significant, implying that the organization plays a crucial role in this field and that its work is widely cited and strongly associated with other authors or papers. From the average and range of total link strength (54.27, 4-414), it appears that the citation strength in the network is varied, with some nodes having more concentrated

As shown in Table 3, Koutsabasis is one of the most influential authors, with 4 papers written and 30 citations received. Digitalization of non-cultural heritage and the application of digital technology in museums are topics of great interest [40,41]. As shown in Table 4, UNESCO is the most co-cited author in the network of co-citations, with 159 citations from 33 authors and a total link strength

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of 414. This suggests that researchers in this field widely recognize UNESCO as having high authority and influence in non-cultural heritage protection and management.

Table 2 The top 5 most cited authors.

R	Author	TP	TC	Links	Total link strength
1	Koutsabasis, Panayiotis	4	30	3	6
2	Vosinakis, Spyros	4	30	3	6
3	Zhang, Mu	3	67	0	0
4	Chatzigrigoriou, Pavlos	3	10	3	6
5	Nikolakopoulou, Vasiliki	3	10	3	6

Table 3 The top 5 most co-cited authors.

R	Author	Cita-tions	Links	Total link strength
1	UNESCO	159	33	414
2	Icomos	22	13	82
3	Throsby, D	20	15	113
4	Vecco, M	20	20	64
5	Smith, L	19	13	49

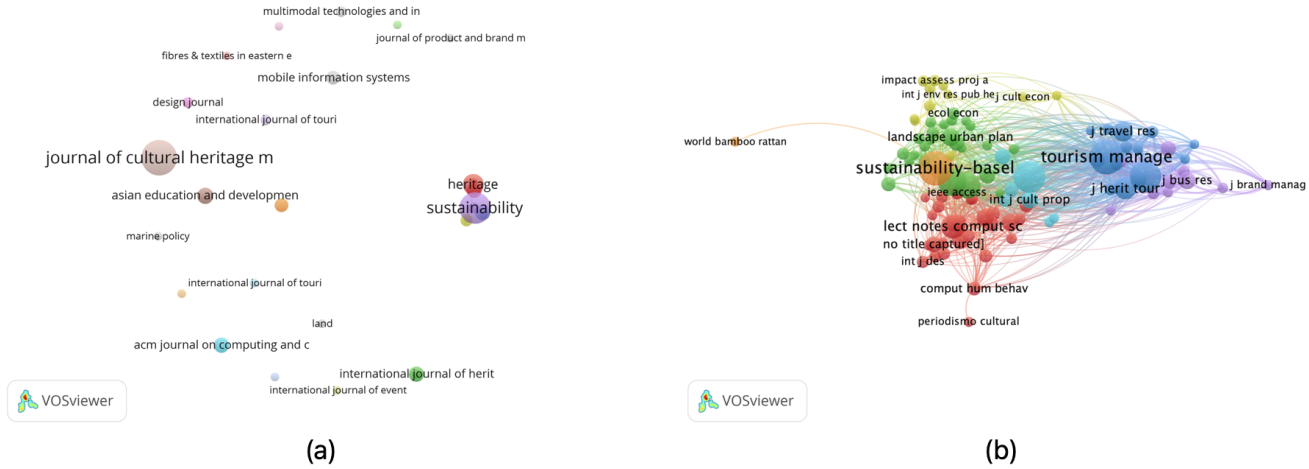

Figure 11. Network of source. (A) The citation network of sources. (B) The co-citation network of sources.

The citation network of journals is presented in Figure 11(a). It is evident that the journals with the most citations include Sustainability, International Journal of Heritage Studies, and Journal of Cultural Heritage Management and Sustainable Development. The co-citation network of journals is illustrated in Figure 11(b). It is evident that the journals with the highest total co-citations include Tourism Management, Annals of Tourism Research, and Sustainability (Basel).

Based on the above analysis, we recommend that researchers in this field choose journals such as Sustainability, Heritage, Journal of Cultural Heritage Management and Sustainable Development, ACM Journal on Computing and Cultural Heritage, International Journal of Heritage Studies, and International Journal of Intangible Heritage. These journals have a significant impact in this field, are widely cited, and some are high-impact journals. Publishing in these journals can increase research impact and citation frequency.

3.2. Content analysis

Insights into the research domain can help visualize the dimensions and evolution of Intangible Cultural Heritage Design and identify research gaps and future directions. In this regard, we focus

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on the second question: RQ2. What are the primary themes and current issues in Intangible Cultural Heritage Design research?

Keywords summarize the content of the literature, and high-frequency keywords can reflect the research hotspots in a certain research field during a certain period. The topical heat of keywords is used to identify research hotspots. We selected a word co-occurrence network analysis based on text data because the nodes are more concentrated and the network density is higher. Based on the Title and Abstract fields in the original text data, we identify keywords and topic words using the full counting method to help understand the topics and content.

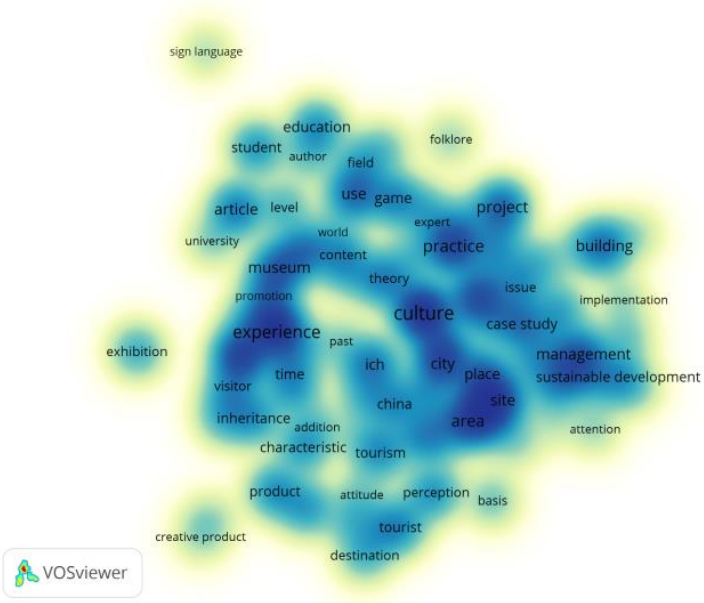

Figure 12. The theme density of the keywords.

3.2.1. Theme hotpot analysis

Figure 12 presents a word co-occurrence network with high density, indicating a high level of research interest in the field. The network displays several large clusters of nodes, such as those centered around "tourist" and "education." This suggests that new research directions are emerging in this field that are worth paying attention to. Within each topic cluster, we also observe the appearance of many new terms, such as "digital technology" and "game." This indicates that related research topics are expanding and becoming increasingly intertwined with new technologies and concepts. However, the internal framework is relatively dispersed, and emerging research directions continue to emerge, with hot topics expanding. Despite the high research interest and the increasing relevance of new technologies and concepts in this field, the research coverage still needs to be expanded.

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3.2.2. Theme evolution analysis

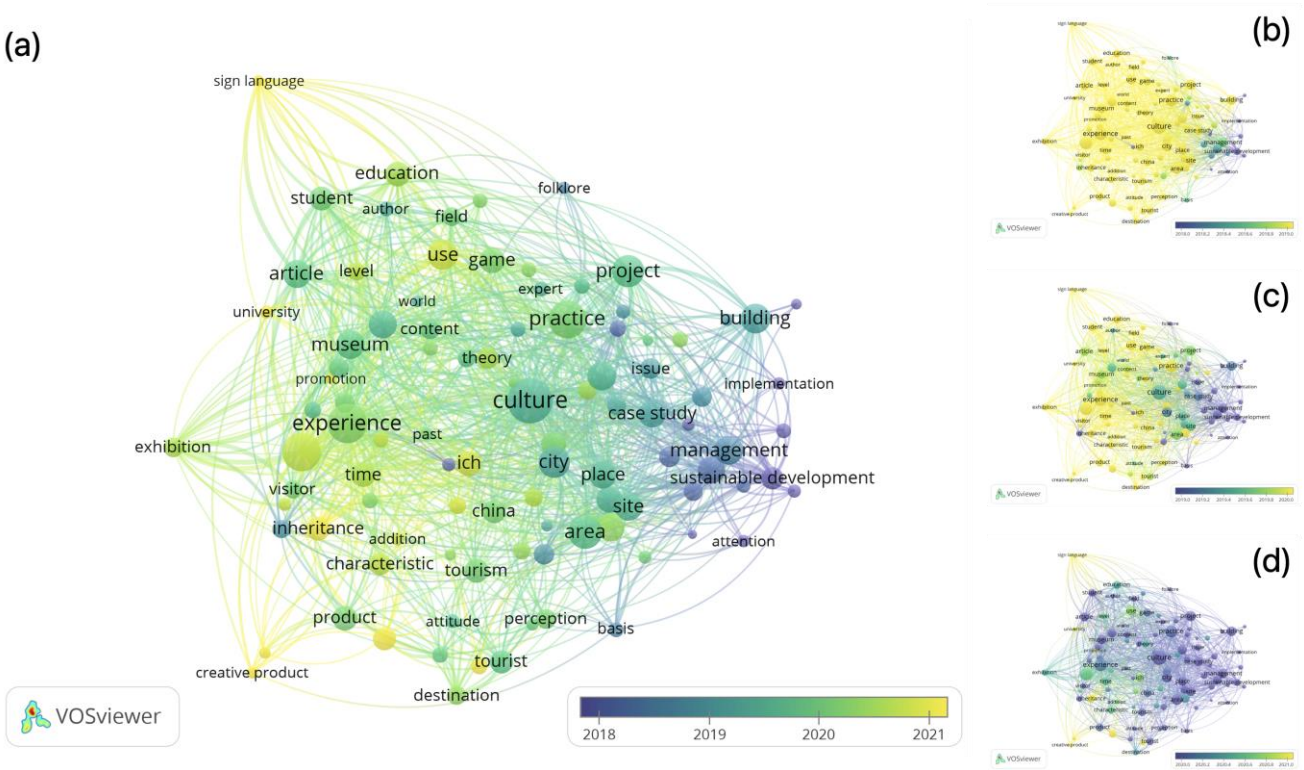

Figure 13. The theme overlay of the keywords. (a): 2018-2021; (b): 2018-2019; (c): 2019-2020; (d): 2020-2021.

VOSviewer allows us to incorporate the time dimension by overlaying the visualization of keywords, enabling us to track the evolution of research topics and assess the development and changes of knowledge structures. Figure 13 displays the time scale corresponding to nodes of different colors, and we further evaluated the evolution of the most frequently used keywords during the periods of 2018-2019, 2019-2020, and 2020-2021 to understand the evolution of topics. The results show that research topics have undergone significant changes. Initially, scientific literature focused on core topics such as conservation management and policy research, with an emphasis on international and local community perspectives. Later, culture, cultural heritage, cultural identity, and innovation became the focus, and multiple research perspectives and methods were used for in-depth analysis. Recently, based on previous research, the focus has shifted to practical applications, with an emphasis on utilization and conservation, involving the education industry, sustainable development, tourism, and technological changes. The research scope is also constantly expanding and beginning to impact related fields and industries.

In addition, edge nodes may also vary in different time periods, indicating changes in research breadth and depth. The emergence of new nodes means that the research scope is further expanding, requiring researchers to continuously explore new knowledge and promote learning. The layout of nodes and networks may also differ, leading to changes in clustering and the framework structures of topics. Therefore, researchers need to re-examine the correlations between topics, promote knowledge reconstruction, and integrate innovation. It is worth noting that the frequency and impact of research topics may also vary over different time periods, which will directly affect the overall framework and direction of research topics.

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3.2.3. Theme cluster analysis

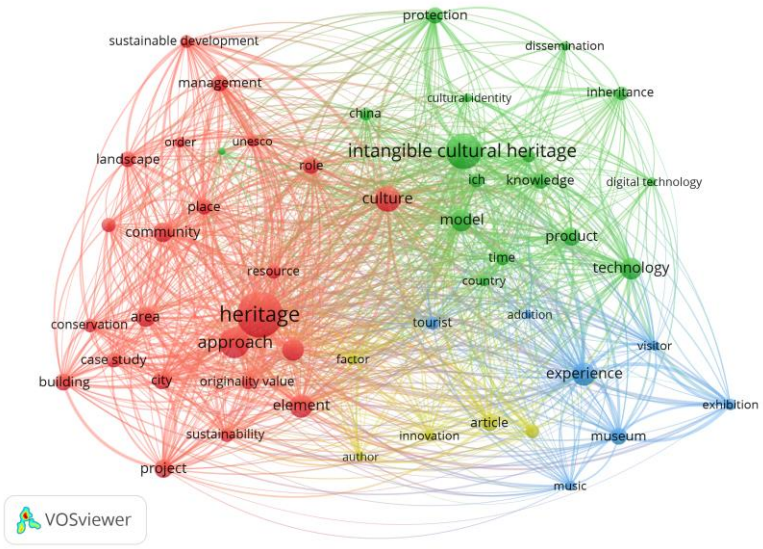

Figure 14. The theme network of keywords.

By setting the minimum number of co-occurrence of keywords to 20, we obtained Figure 14. A total of 51 keywords were identified. These words were classified into 4 large clusters（red，green，blue and yellow）：Cluster 1: Management and Sustainable Development of Cultural Heritage (Red). Cluster 2: Protection and Transmission of Intangible Cultural Heritage (Green). Cluster 3: Museum Management and Visitor Experience (Blue). Cluster 4: Education and Academic Research (Yellow).

The analysis identified four main themes that encompass all the knowledge concepts related to Intangible Cultural Heritage Design during the study period (2007-2023). These four themes are considered the focal points of the field and can provide valuable insights. By conducting a comprehensive literature review of articles within each cluster, we can gain a better understanding of how the topics in this field have evolved over the past decade.

- Management and Sustainable Development of Cultural Heritage

As shown in Table 5, it can be seen from Links, Total link strength, and Occurrences that this cluster group of research focuses heavily on cultural heritage and cultural concepts, as indicated by Links, Total Link Strength, and Occurrences. From Avg. pub. Year, it is evident that the number of related studies increased rapidly from 2015 to 2020, and is on an upward trend, but decreased in 2021. This indicates that although the research topic is active, the pace of development has slowed, and researchers need to update their theories and expand their research paths.

To understand the correlation of high-frequency words in cluster 1, we selected them as the research objects. As shown in Appendix Table 1, it indicates that there is a positive impact mechanism among these six variables. The correlation between heritage and culture, as well as sustainable development and management, is the strongest. This provides important clues for understanding the internal mechanisms of the research topic. The high correlation between heritage and culture indicates that the study and understanding of cultural heritage cannot be separated from the consideration of cultural attributes. The high correlation between sustainable development and management indicates that the realization of the concept of sustainable development depends on the effective implementation of daily management. The high correlation between approach and other variables indicates that the choice of research methods has an important impact on research outcomes.

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Table 5. The typical keywords of cluster 1.

Typical keywords	Links	Total link strength	Occurrences	Avg. pub. year
heritage	50	5304	363	2019.2039
approach	50	3167	184	2019.0924
culture	50	2644	138	2019.4275
element	50	1814	112	2020.2321
role	50	1554	70	2018.6
practice	50	1497	102	2020.0784
city	48	1445	74	2019.2027
project	50	1397	78	2019.7308
community	49	1360	87	2019.2414
management	44	1280	64	2018.6562
area	49	1223	86	2019.7209
sustainable development	46	1177	43	2015.7674
building	40	1101	68	2019.1471
sustainability	47	1057	50	2020.1
landscape	45	1030	60	2018.3167
originality value	48	1023	49	2020.1429
place	49	932	59	2019.4746
case study	49	908	58	2019.1379
resource	49	896	52	2019.8077
conservation	48	850	49	2018.0612
identity	49	773	53	2019.434
unesco	48	597	37	2018.2973
order	46	529	33	2018.2424

- Protection and Transmission of Intangible Cultural Heritage

As shown in Table 6, it can be seen from Links, Total link strength, and Occurrences that this cluster focuses on the application of digital technology in the protection of intangible cultural heritage, while emphasizing the importance of intangible cultural heritage protection for cultural identity and inheritance. From the Avg. pub. Year, it can be seen that the average publication year of the keywords is from 2019 to 2021, indicating that this is a very active research topic and a cutting-edge field. Relevant research is in a stage of rapid development, requiring a large amount of theoretical accumulation and technological innovation.

To understand the correlation between the high-frequency words in Cluster 2, the high-frequency words were selected as the research object. As shown in Appendix Table 2, the vast majority of the correlation coefficients are positively correlated, indicating that there is a positive impact mechanism between variables. The strongest correlation is between technology, protection, and model. This provides important clues for understanding the internal mechanisms of the research topic and indicates that the use of technological means has a significant impact on the protection effect. The high correlation between model and other variables indicates that the selection and optimization of theoretical models are crucial to research outcomes.

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Table 6. The typical keywords of cluster 2.

Typical keywords	Links	Total link strength	Occurrences	Avg. pub. year
intangible cultural heritage	50	3555	236	2020.5975
technology	50	1957	106	2020.6132
model	50	1511	105	2020.3048
protection	50	1366	63	2020.2857
knowledge	50	1155	63	2020.5079
product	48	1139	80	2020.75
inheritance	42	840	47	2021.9787
time	48	839	48	2020.4792
ich	47	815	54	2020.7407
effect	48	744	45	2021.0444
china	46	671	46	2020.0652
country	47	599	35	2020.0286
cultural identity	46	510	25	2019.88
dissemination	46	420	28	2020.75
digital technology	42	393	24	2020.1667
authenticity	39	354	18	2020

- Museum Management and Visitor Experience

As shown in Table 7, it can be seen from Links, Total link strength, and Occurrences thatthis cluster is centered around the operation and visitor experience of museums, involving exhibition planning, visitor services, and cultural experience design, which is a specialized field in museum research. From the Avg. pub. Year, it can be seen that the average publication year of keywords is from 2018 to 2020, but the recent discussions related to this topic have decreased, and the citation frequency of keywords has also decreased, indicating significant individual differences.

To understand the correlation of the high-frequency words in cluster 3, high-frequency words were selected as the research objects. As shown in Appendix Table 3, there is a positive influence mechanism among the variables. Among them, the correlation between tourists and music is the strongest, reaching a complete correlation. This indicates a close relationship between visitor visits and music performances, and they may be influencing factors for each other. The exhibition is highly correlated with other variables, indicating that exhibition activities play an important role in museum operation and visitor experience.

Table 7. The typical keywords of cluster 3.

Typical keywords	Links	Total link strength	Occurrences	Avg. pub. year
addition	44	330	18	2020.6667
exhibition	36	1096	36	2020.4444
experience	50	2162	112	2020.1786
museum	42	1194	67	2019.806
music	45	678	30	2018.8333
tourist	47	663	45	2019.8222
visitor	45	889	31	2020.0323

- Education and Academic Research

As shown in Table 8, it can be seen from Links, Total link strength, and Occurrences that this cluster revolves around academic research and innovation. This includes paper writing, analysis of influencing factors, and innovative design, which belong to the fields of higher education and academic research. From Avg. pub. Year, it can be known that the average publication year of the keywords is from 2019 to 2020. Currently, researchers studying this direction are not active.

To understand the correlation between the high-frequency words in cluster 4, we selected them as the research objects. As shown in Appendix Table 4, there is a very strong positive impact mechanism between the variables. The correlation between "article" and "student" is the strongest, approaching perfect correlation, indicating a close relationship between paper writing and students,

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which may be mutual influencing factors. "Factor" is also highly correlated with other variables, indicating that the identification and analysis of influencing factors are crucial to the research topic.

Table 8. The typical keywords of cluster 4.

Typical keywords	Links	Total link strength	Occurrences	Avg. pub. year
article	48	1039	63	2019.8095
author	46	472	22	2019.3182
factor	48	690	37	2020.3514
innovation	46	601	35	2019.8571
student	40	940	48	2020

4. Discussion

A bibliometric and content analysis provides a comprehensive assessment of research on Intangible Cultural Heritage Design and its evolution over time. A summary of the main findings for RQ1 and RQ2 is provided in Table 9.

Table 9. Summary of the main findings.

RQ	Objective	Methods	Findings
1	Publications and Citations by year	Analysis of Publications and Citations by year.	publications and citations have grown exponentially in recent years.
	Publications by Subject areas	Analysis of Publications by Subject areas.	Focus on sustainable science and technology, comprehensive humanities, environmental research, etc.
	Publications by countries/regions	Firstly, an analysis of the number of publications by country/regions and Intercontinental. Then, use network visualization and overlay visualization of co-authorship analysis in VOSviewer.	Mainly European and Asian countries, of which China is the largest output country.
	Publications by Institutions and their collaboration network	First, analyze what institution the publication comes from using the Bibliographic coupling analysis method in VOSviewer. Then, network visualization is performed by setting different Minimum number of documents for an organization's parameters.	Polytechnic University Of Milan, University Of Aegean, and Hong Kong Polytechnic University are the top-producing institutions in this field. There is also some level of collaboration between institutions, but they tend to collaborate more internally.
	Publications by Journals and authors	First, we will analyze the journals with the highest number of published articles. Next, we will use the collaborative relationship network analysis method in VOSviewer to show the cooperative relationship between authors.	Research articles related to this field are published in various journals in different fields. Journals under the MDPI publishing house have a significant influence in this field. The researchers in this field are relatively dispersed, and although there is some collaboration, the degree of collaboration is not high.
	Citation analysis	Using VOSviewer, first analyze the citation and co-citation structures. Then, analyze the authors with the highest	Based on the analysis, there is a certain degree of knowledge

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		citation and co-citation counts. Finally, analyze the resources with the highest citation and co-citation counts.	dissemination and exchange, but overall, it is not very tight.
2	Theme hotpot analysis	By using VOSviewer, a co-occurrence network analysis of textual data was conducted to obtain the topic density of keywords.	The research interest is high and increasingly following new technologies and concepts, but the research coverage needs to be expanded.
	Theme evolution analysis	By using VOSviewer to analyze the co-occurrence network of terms in textual data, we have obtained a superimposed view of the main topics of the keywords in different time periods.	The research topics in this field have shifted from protection management and policy studies to culture, cultural heritage, cultural identity, and innovation, and then to practical utilization and industrial development. This adjustment process involves a shift from macro to micro perspectives and a greater focus on practical applications.
	Theme cluster analysis	From the VOSviewer software, a co-occurrence network analysis was conducted on the text data, and key themes, networks, and clusters of keywords were identified. A selection of high-frequency words from the clusters was used to build the basic data for correlation analysis. The Pearson correlation coefficient was calculated using the Pearson correlation analysis method to examine the significance of the correlation coefficients between variables.	Four clusters are identified. Cluster 1: Management and Sustainable Development of Cultural Heritage; Cluster 2: Protection and Transmission of Intangible Cultural Heritage; Cluster 3: Museum Management and Visitor Experience; Cluster 4: Education and Academic Research.

Here, we focus on RQ3: What are the theoretical and practical implications of our research, and what are the future research directions for this field?

From a theoretical perspective, our work provides a systematic overview of the knowledge system in the field of Intangible Cultural Heritage Design research, contributing to understanding the current state and development trends of the field. By using bibliometric and content analysis methods, we identified the hotspots, evolutions, and clusters of research topics, providing theoretical references for researchers to choose research directions. Furthermore, we explored the underlying mechanisms of influence within different topic clusters, laying a foundation for understanding the interactions between each cluster.

From a practical perspective, our research findings can provide research ideas and topic references for researchers in this field. Our research discoveries can also guide policymakers in optimizing resource allocation and enhancing the practical impact of research outputs. Moreover, we identified shortcomings in the research field, which are useful for researchers to promote knowledge reconstruction and disciplinary innovation.

This paper discusses the development trends in the field of Intangible Cultural Heritage Design. Our findings provide some inspiration for those studying Intangible Cultural Heritage Design. For example, expanding the research time frame and adopting a longer-term development perspective to understand the overall characteristics of the research field; selecting different research methods to test results and increase research credibility, such as expert interviews and empirical research; focusing on a particular topic cluster, conducting in-depth analysis of key concepts, research path selection, and future development direction, guiding researchers in developing research plans and promoting relevant theoretical and technological innovations. Additionally, we explored the roles of different

disciplines, countries, and institutions in the knowledge production and dissemination process, identifying their influencing factors.

5. Conclusion

Intangible Cultural Heritage Design is a field with great research potential that has gained attention from society, government, and academia in recent years. Against this backdrop, this paper employs bibliometric methods to explore the development of the field of Intangible Cultural Heritage Design. Literature data was retrieved from the Web of Science database from 2007 to 2023, and 269 publications were ultimately analyzed. We examined the annual and disciplinary distribution of the publications, followed by citation analysis to identify prominent scholars, journals, institutions, and countries. Next, we conducted theme and content analysis to capture popular keywords and their evolution. Finally, the research findings have important theoretical and practical implications for the field, and future research directions are proposed. This article contributes to a better understanding of the global trends in Intangible Cultural Heritage Design and provides insights and assistance for its growth and Sustainable development.

Like all research, this study inevitably has some limitations. The first limitation arises from the relatively short period of study, as scientific publications in this field have not been available for long. Second, the main collection of WOS used in this study is considered one of the most relevant for research, although other databases were not considered. Third, the database does not include normative documents or documents from international organizations, so the study is based solely on academic background without in-depth analysis of research content and regional differences. Future research should expand the time frame, integrate multiple databases, adopt mixed research methods, and consider regional differences to obtain more comprehensive, in-depth, and reliable research conclusions.

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