Comparative Analysis of Information Design Research at China and Abroad Based on VOSviewer and CiteSpace

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Abstract

The progress and status of information design at home and abroad is comparative analysis. Based on the Web of Science and CNKI databases, the relevant documents of foreign and domestic information design were obtained as data resources, and bibliometric analysis methods and content analysis methods were used to draw knowledge maps combined with the visualization functions of VOSviewer and CiteSpace software, and systematically analyzed the distribution of cooperation networks. Three aspects of hot topic distribution and time zone evolution analysis reflect the research status of this field. The research hotspots and trends in the field of information design at home and abroad are different. The foreign research in this field is earlier, the research institutions are closely connected, the research content is more detailed, and the human-oriented concept of information is concerned; the domestic research in this field is relatively late, there is a lack of connection between research institutions, and the research content is relatively scattered, focusing on the technology and method research of information design. The research in the field of information design in China should return to the human-oriented concept of metacognition, start from the information ontology, establish a research chain to explore human needs, and at the same time promote the research on intelligent information dissemination, and use innovative thinking to reconstruct more complex information problems. More detailed cross-cutting research, to establish rich information design context logic, to meet the more specific information needs of users.

Keywords: information design; Visual analysis; Research trends; VOSviewer. CiteSpace

Introduction

The research on information design developed rapidly around the 1980s, and now it has entered the information age of constructing diversified solutions for complex problems. Scholars at home and abroad have carried out a lot of practical and theoretical exploration in the field of information design. However, the domestic research in the field of information design mainly focuses on technology, method and practice, and many researches cannot analyze the research focus and characteristics of this field from a higher perspective, especially the lack of comparison and analysis of similarities and differences between domestic and foreign information design research. Therefore, sorting out the development trend of information design at home and abroad is helpful to find the deficiencies of domestic research in this field in the differentiation of research, and promote the breakthrough and innovation of the research paradigm and way of thinking of domestic information design theory and method. This paper makes a visual analysis of knowledge graph of information design literature at home and abroad by using bibliometric method, in order to provide reference for further research of information design in the future.

Data Sources and Research Methods
The data source

The databases of Web of Science (WoS) and China National Knowledge Infrastructure (CNKI) were selected as the most influential and authoritative academic journal databases at home and abroad, respectively. The search time range ended on May 30, 2022. In order to comprehensively collect all literature data, the professional terms "information design" and "information design" were respectively used as the subject words for retrieval, and the CNKI "all journals" were used as the source, and a total of 2614 Chinese literatures were obtained. The citation index mode was "All" as the English data source, a total of 1062 foreign literatures were obtained, and the literature reviews, conference abstracts and other literatures not related to the theme were deleted.

The research methods

In order to systematically compare and analyze the differences and development of information design research at home and abroad, this paper uses the methodology framework shown in Figure 1 to analyze the distribution of cooperation networks, hot topics and discipline evolution of research institutes in this field from multiple perspectives and dimensions.

First of all, according to the research theme, the false detection literature of "information design" in WoS and CNKI database was manually excluded, and Data cleaning was carried out through the article mining software of Thomson Data Analyzer, including merging inconsistent keywords, institution names, repeated keywords, integrated countries, etc. Finally, the normalized data visualization data are obtained. Then, based on the social network analysis method, the differences of collaborative networks of information design research at home and abroad are compared from the two dimensions of country and institution. By using co-word analysis method, the hot topics of information design research are mapped, and the hot topics of information design are summarized and analyzed by content analysis method. Finally, the development map of the field research is drawn through time zone analysis to understand the evolution and future trend of information design.

Distribution of cooperative network

The distribution of cooperative network is based on the social network analysis method, which analyzes the countries and institutions of information design research at home and abroad, and shows the cooperation between the country and the publishing institution in this field. Therefore, the research level of the country and the publishing institution can be analyzed through the distribution of cooperative network. VOSviewer and CiteSpace software were used to analyze the cooperation network. The size of nodes was directly proportional to the number of publications issued by the issuing country and the institution, and the thickness of nodes was the cooperation intensity of the country and the institution. The larger the node, the larger the number of publications, and the thicker the connection, the higher the cooperation intensity. From the visual analysis, we can get the major countries and institutions in the field of information design, and the connection between nodes can get the cooperation degree of the countries and institutions.
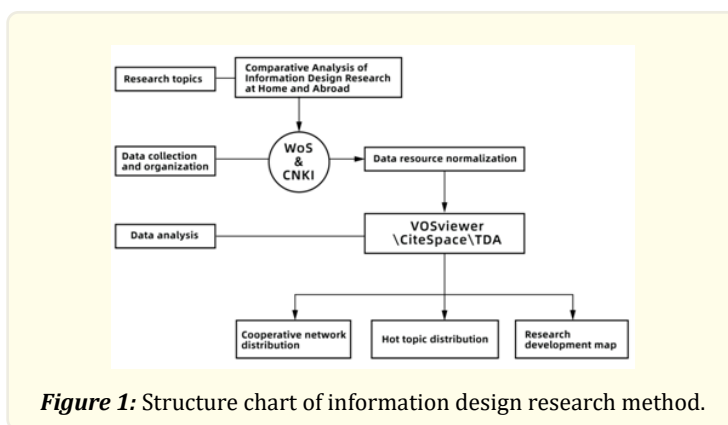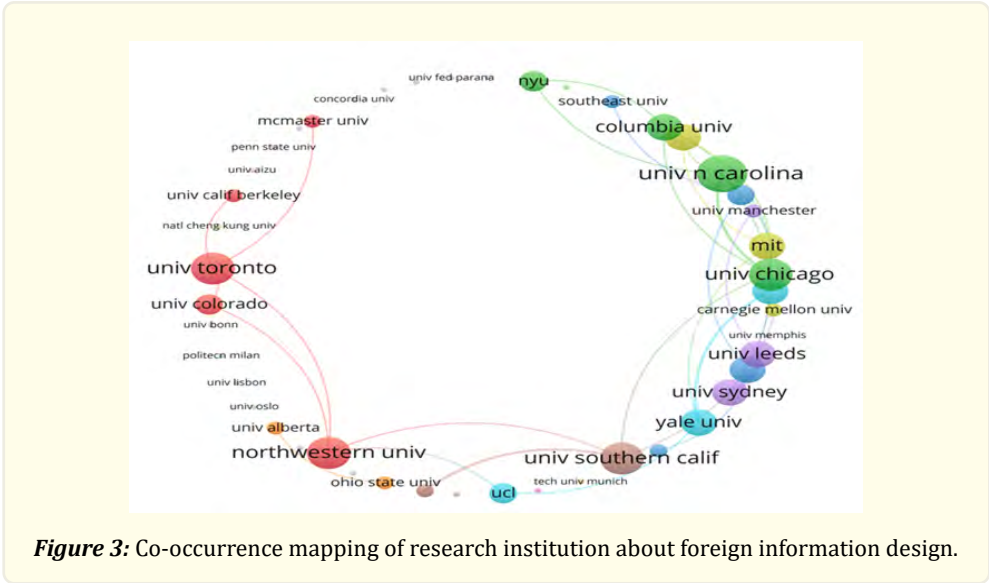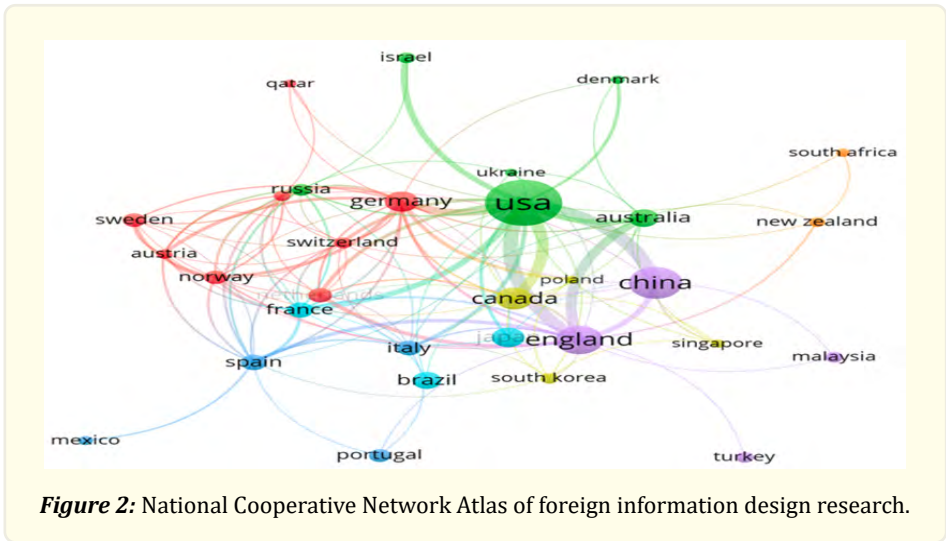

Figure 1: Structure chart of information design research method.

Research Status abroad

A visual analysis was conducted on 1062 foreign publications in the field of information design, as shown in Figure 2. The research in this field was mainly distributed in 31 countries in the world. As shown in Figure 3, foreign information design research institutions are concentrated in comprehensive science and engineering and humanities and social science colleges, and the relationship strength of European and American countries is higher than that of other regions.

Figure 2: National Cooperative Network Atlas of foreign information design research.

Figure 3: Co-occurrence mapping of research institution about foreign information design.

Serial number	Country	Total number of papers	Core institutions
1	America	353	University of Chicago, University of Washington, Pennsylvania State University College Park, University of Michigan, Massachusetts Institute of Technology
2	China	151	National Cheng Kung University, City University of Hong Kong, North China Electric Power University, Shanghai Ocean University, Second Institute of Oceanography of the State Oceanic Administration
3	Britain	113	University of Leeds, University College London, University of Manchester, University of Cambridge Institute for Manufacturing, University of York
4	Canada	60	University of Toronto, Concordia University, McMaster University, University of Alberta
5	Germany	51	University of Bonn, Technical University of Munich, University of Saarbrücken, Max Planck Institute for Human Development in Berlin
6	Japan	47	Toyo University, University of Tokyo, AIDS University, Nara Institute of Science and Technology, Public Hakodate Mirai University
7	Australia	39	University of Sydney, Australia, University of New South Wales
8	Brazil	36	Federal Polytechnic University of Paraná, São Paulo State University
9	Spain	27	University of Seville, Politecnico University of Valencia, Polytechnic University of Catalonia, University of Malaga
10	France	26	Morocco Mohammed V University, Nancy University, European Business School

Table 1: Top 10 foreign information design research forces.

Will post the number in the top 10 countries, such as shown in table 1, the United States is published in international journals information design domain research results most populous country, issued a total of 353, accounts for about 33% of the total number of the cut in the field of articles, accounts for about 39% of the total number of the dispatch in the top 10 countries articles, declared the United States, attaches great importance to the design of information research institutions. Among them, Ohio State University optimized the data deviation problem of encoding and decoding in the field of communication based on the information interaction design criteria through the cross research of informatics and communication [1].

Relying on the "participatory design" of users and other stakeholders, the College of Information Science and Technology at Penn State University, College Park, conducts challenging research from the information design paradigm [2], and ultimately relates human social and life impacts through information design.

It should be emphasized that this paper conducts literature study on the three papers with the highest citations among the top ten publishing institutions, which can clearly include five research topics: "Awareness Connection," "Optimization of Environmental Resources," "Medical System Design. Design), "Social media", "Age of a Society", "Research Methods".

"Consciousness interconnection", Sapporo Medical University in Japan tries to provide a Communication environment to enhance awareness of connectivity and construct a benign and intuitive information interaction mechanism in view of the problem of "Communication Overflow" [3]. Environmental resource optimization: Based on climate, energy, cost and renewable issues, the University of Ostral in Chile has established an information design model aiming at cost control and reliability [4]. According to the flood mapping network [5], Shanghai Ocean University of China imported information to improve the accuracy and stability of information, and accurately drew the flood warning information caused by hurricanes. The publishing organizations in this direction are not related to

research methods but to research objectives, and they all focus on the reliability and validity of information. In medical system design, the University of Michigan found that patients did not fully believe the "objective facts" reflected by data, and then tried to prove that graphics representing thoughts could reduce the improper influence of experience on treatment selection through testing of words, hieroglyphs, graphs and symbols [6].

The University of York and the University of Leeds found that the excessive text in the patient "participant information sheet" would affect the transmission efficiency, so they carried out quantitative testing and visual design for the target group to optimize and formulate the patient information sheet [7]. The research in this direction is generally based on visual creativity to solve the problem of information transmission. Social media. Shenzhen University of China and Hong Kong Polytechnic University point out that nowadays it is urgent to construct the influence of social media on work efficiency through knowledge system [8], which is the research direction of knowledge communication to improve work efficiency in digital media life and work. An aging society, the free university of Amsterdam in the Netherlands and the London school of economics in the light of the elderly population is expected to grow and local government budget cuts, by analyzing the "information accessibility", "the household design", "regional accessibility" three factors to find out effective methods to maintain and improve quality of life of the old people, reduce social service cost [9], serve the society with design. Research methods: the university of Tokyo and the public hakodate mirai university in Japan attempted to solve four problems based on the creative principle of information interaction to increase information in the design level [10]: (1) the influence of information externalization on designers' decisions; (2) Information form expression and interaction relationship; (3) External expression explains information connotation; (4) Modify the meaning of information from the expression level. The University of Cambridge, the University of Bath and the University of Plymouth integrated the "Proof of concept" test in the field of multimedia [11], and summarized the "diary study" method that is more suitable for the engineering field. Most of this direction explores the possibility of solving the problem of "the huge volume of documentation" through design.

Domestic Research Status

In the CiteSpace software, a threshold coefficient of 2 is set for "Institution", as shown in Figure 4, with a total of 761 nodes and 198 lines, and a density of only 0.0007, indicating that cooperation between domestic institutions is rare and researchers prefer independent research or cooperation within their own institutions.
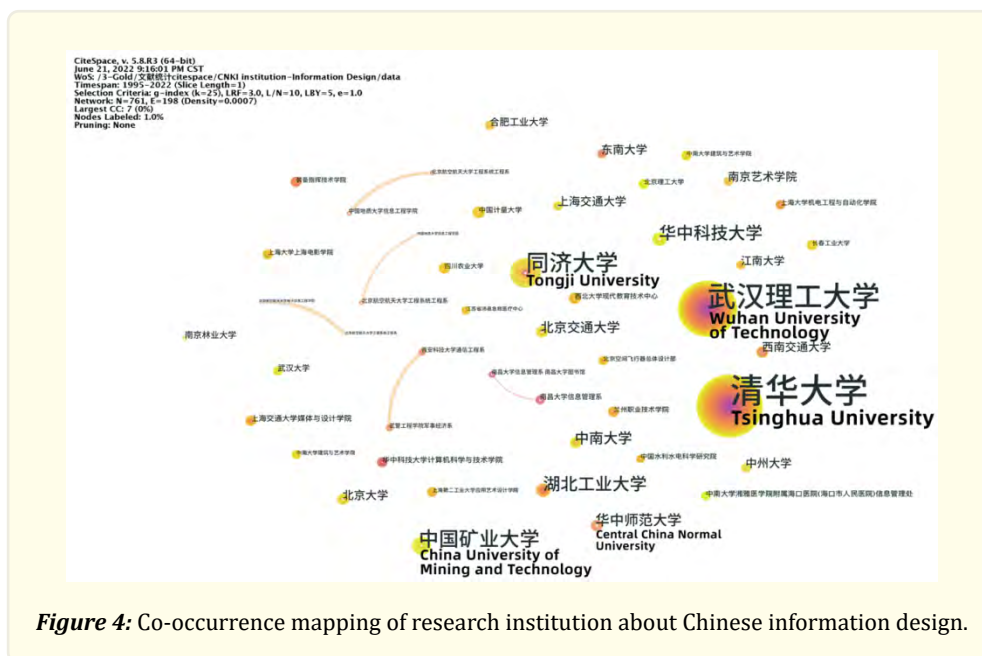

Figure 4: Co-occurrence mapping of research institution about Chinese information design.

Serial number	Research institute	Published volume/article
1	Tsinghua University	45
2	Wuhan University of Technology	32
3	Tongji University	24
4	China University of Mining	19
5	Huazhong University of Science and Technology	17
6	Hubei University of Technology	17
7	Huazhong Normal University	17
8	Central South University	16
9	Beijing Jiaotong University	15
10	Shanghai Jiaotong University	14

Table 2: Top 10 core research institutions with Chinese published papers.

There is no obvious direction category in the research direction of domestic information design institutions. As shown in Table 2, Tsinghua University ranks first, and its Art and Technology (Information Art Design) is the earliest major established in China to study art design innovation under new technological conditions. On the one hand, the main research direction is to understand human-computer interaction technology from the humanistic perspective, and to develop interactive products or new media art works for the future [12]. On the other hand, from the perspective of "system thinking", it tries to design a reasonable information architecture and build a powerless digital environment, and carries out innovative practices in the prevention of cross-integration of design disciplines [13]. The second is Wuhan University of Technology, whose main research direction is information interaction design based on design thinking, digital media design, visual communication design, cognitive psychology, etc. In particular, the future application of interactive texture in information art design, the exploration of digital information design methods, and the framework structure strategy of information system [14] are discussed in a more diversified way. The third-ranked tongji university, and its research direction more based on the global economy to the digitization, the background of low carbon transformation, system builds for visual arts, information design theory of semiotics, communication, media and other professional knowledge system [15], focus on the narrative structure, and from the information path design principles to explore the methodology and the innovation practice. The publication volume of these three institutions accounted for about 30 percent of the top 20, with high influence.

To sum up, the main institutions of information design research at home and abroad are mainly colleges and universities, which can be divided into two categories: comprehensive colleges and universities of science and engineering, generally science and technology universities, engineering colleges, vocational and technical colleges; Art and design colleges are generally based on the College of Fine Arts, College of Art, and College of Art and Design. The degree of cooperation between foreign institutions is significantly higher than that of domestic institutions, and the research direction of research institutions can be clearly summarized into five theme directions, which is similar to the following keyword co-occurrence analysis, indicating that a relatively stable research trend has been formed in foreign countries. In contrast, the cooperation relationship between domestic information design publishing agencies is weak, and no clear research cluster has been formed. There is still a lot of room for improvement in the cooperation and exchange between domestic and international research institutions.

Distribution of subject research topics based on co-word analysis

Co-word analysis is one of the most commonly used content analysis methods in scientometrics. By mining the research core topic of the paper through keywords co-occurrence, the research hotspots and characteristics of this field can be summarized, and the important basis can be grasp. It is of great value to analyze and summarize the development evolution and development trend of this field. In the keyword co-occurrence analysis of VOSviewer, the larger the circle node and the larger the font, the more frequent the keywords

appear, which can reflect the research hotspots in this field. The line of nodes represents the connection strength relationship between keywords. The thicker the line is, the more frequently the two words co-occur in the same paper. Node colors represent clustering categories, which are different research directions in this field.

Research Status abroad

In VOSviewer, select "co-occurrence" for Type of analysis, "All Keywords" for Unit of analysis, and "Full Counting" for Counting Method. 397 keywords with frequency ≥3 were selected to draw the co-occurrence network knowledge map. Remove the three common words "information design", "information" and "design", and rank the top 10 high-frequency keywords, as shown in Table 3. "Communication", "bayesian Persuasion, Model, Usability, impact, disclosure, knowledge, quality, visualization, and health are key words that occur more than or equal to 18 times.
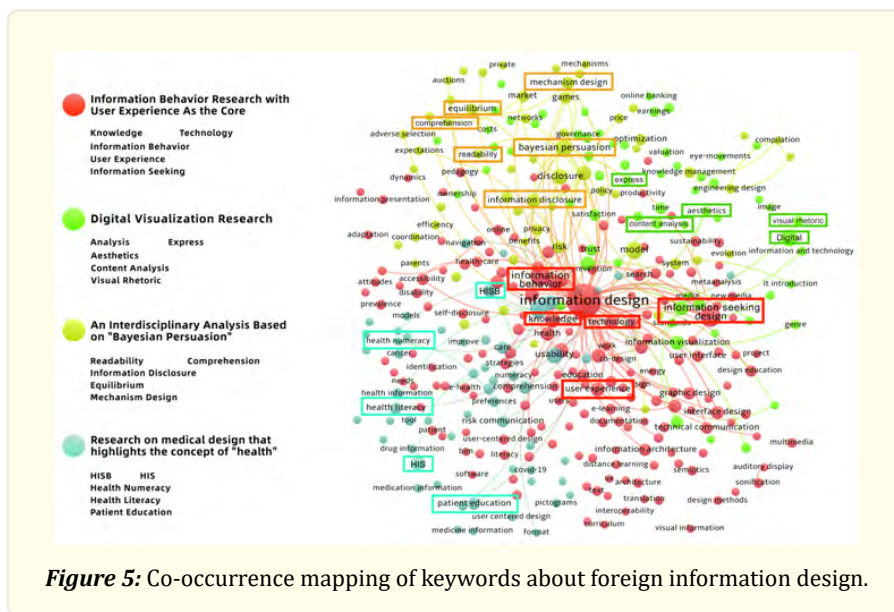

Figure 5: Co-occurrence mapping of keywords about foreign information design.

Hot words	Frequency	Association strength
communication	39	166
bayesian persuasion	34	103
model	31	83
usability	27	126
impact	24	107
disclosure	24	92
knowledge	22	93
quality	21	75
visualization	19	53
health	18	75

Table 3: Citation counts tables of keywords about foreign information design.

In the knowledge graph of co-occurrence network shown in Figure 5, clustering of foreign information design research through content analysis is four major themes, which constitute an important scientific research direction in the field of foreign information design.

1. Research on user experience and information behavior. The development of science and technology drives researchers to pay attention to the profound influence of information behavior and user experience on information design, which is analyzed from knowledge and technology levels. At the knowledge level, it focuses on information behavior, connects "user needs" and "user behavior", and introduces research in marketing, psychology, medicine and other fields. From the perspective of knowledge, Wilson T D defined "information behavior" as the sum of user behaviors related to information sources and channels. From a macro perspective, information behavior is centered on information seeking [16], which generally refers to purposeful information seeking. The micro perspective refers to concrete actions, such as finding advice by clicking links with the mouse. Pettigrew K E et al. pointed out that information search also involves a new research field related to affective issues, acting on the affective paradigm of information behavior in different cultures and environments [17]. It mainly includes Usability [18], Information architecture [19], cognition [20], Adaptation [21], User-centered design (UCD: User-centered Design) [22], etc. At the technical level, information design research focuses on user experience, as Hassenzahl M and Tractinsky N pointed out: Since the end of the 20th century, "user experience" has become a hot word in human-computer interaction (HCI) and information interaction design [23]. Therefore, with the support of mature technology, the research on information behavior of user experience can bring users multi-dimensional information perception, making communication fashionable and fascinating. The main research in this field includes interaction design [24], universal design [25], visual perception [26], Interoperability [27] and so on.

2. Visualization of digital trends. More foreign information research is exploring the possibility of communication based on digital interface, and the research on digital assistant or mobile terminal is increasing day by day. Therefore, Albers M et al. Point out that: The diversified phenomenon of user needs makes users' ability to access digital information, including defining information, understanding information, building models, memorizing information and other information behaviors change in a qualitative way [28]. Visualization shows the characteristics of digital trend in analysis and express. At the analytical level, The research contents mainly include Information visualization [29], Data visualization [30], satisfaction [31] and content analysis Analysis) [32] et al. Keywords that are closely related to design appear frequently, and most of them discuss visual paradigm expression from the perspective of design methodology. Moys J L believes that researchers are trying to promote the influence of big data and seek ways to display and express massive data [33]. Design methodology research on Visual rhetoric can reflect the concept that "big data is exploration without preconceptions". Information rhetoric will be an important research topic. Moys J L also mentioned that Margolin V explored the ideological and action relationship between visual rhetoric and information transmission from another perspective [33], and finally determined the "democratic color" attribute of data. The research in this direction mainly includes digital media [34], digital curation [35], aesthetics [36], Information Presentation [37], etc.

3. Interdisciplinary analysis based on Bayesian persuasion. Bayesian persuasion is a cross-over study based on communication methods. Kamenica E and Gentzkow M proposed the "Bayesian persuasion" model in 2011 [38], which is regarded as one of the important breakthroughs in information ontology theory. It also represents the frontier of economics, computing science and design. This model emphasizes the balance of two game players: information sender and receiver. As The Sender with Information Advantage, The Design is Generated through information disclosure, Which guides the behavior choice of the information receiver as the decision maker, and enables the sender to maximize the utility of obtaining information. There are many studies related to "Bayesian persuasion" [39-41], It mainly focuses on information disclosure [42], equilibrium [43], self-disclosure [44], Mechanism design [45], etc. At the same time, the cross-research between information design based on this model and other disciplines also includes decision-making [46] and risk communication Communication [47], readability [48], comprehension [49], etc.

4. Research on medical information of health data. The research interest of health information design in foreign countries started in 2015 and has continued till now. This clustering reflects the social responsibility consciousness of information design. Starting from "big health", it analyzes and studies the health and medical data obtained by users in the process of communication.

Health Information design is mainly based on health information seeking behavior (HISB: The research was conducted in two directions: Health information-Seeking Behavior and HIS: Hospital Information System. In terms of health information seeking behavior, Lambert SD investigated about 100 published papers and 5 reports in this field [50], concerned that more and more literatures have recorded the research on personal health information, which plays a role in promoting the strategy of innovative service in psychological and social aspects of diseases. It also emphasizes that "Principle-based Method of Concept Analysis" provides important Method support for HISB. On the other hand, Haux R emphasized that although "hospital information system" has an obvious and positive impact on the development of the medical care field in general, the research and development of relevant data still accelerates the pace of the aging society [51] and has an impact on the future development of the medical care system. Foreign studies in this field mainly include health numeracy [52], human factors [53], health Literacy [54] and medication information Information [55], Patient Education [56], etc.

Domestic Research Status

The co-occurrence analysis of keywords in domestic information design research was conducted in VOSviewer. The three common words "information design", "information" and "design" were removed, and the top 10 high-frequency keywords with frequency were ranked, as shown in Table 4. "Information system", "management information system", "information platform", "system design", "database", "information art design", "interaction design" and "information visualization" are all keywords with frequency ≥30, which constitute the basic framework of domestic information design field. As shown in Figure 6, the co-occurrence atlas of domestic information design keywords is analyzed and summarized by content analysis method, and four research directions are obtained, which constitute important scientific research directions in the field of domestic information design.
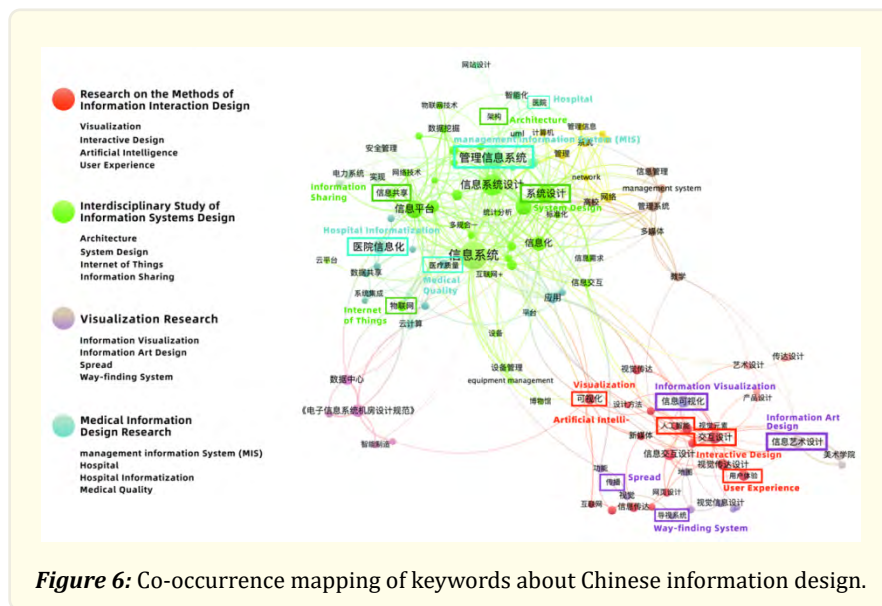
Figure 6: Co-occurrence mapping of keywords about Chinese information design.

Hot words	Frequency	Connection strength
The information system	350	585
Management information system	173	265
Information platform	104	221
The system design	101	161
The database	76	146
Information art design	38	47
Interaction design	36	84
Visualization of information	31	56
Visual communication design	28	53
The Internet of things	26	80

Table 4: Citation counts tables of keywords about Chinese.

1. Research on information systematization. Information systematization is a research topic about man-machine collaboration, a collaborative innovation integrating computer technology, Internet technology, communication technology, etc., and includes the content of users and ethics [57], so it has a strong interdisciplinary feature. The domestic information systematization research combines the design, analysis and security research of geography, electric power and other fields, with many disciplines, and has not formed the trend of "radiating the periphery with the focus". Among them, Song Guanfu et al. expounded the concept and technical basis of GIS from the perspectives of astronomy and earth science, summarized the characteristics of component-type GIS, and discussed the possibility of future design of GIS [58]. Wen-bin li summary and open interconnected power system such as the characteristics of electric power information system, emphasizes the future electric power information system should focus on management of interconnected electric power information security and system design of research trends, the contact Song Guanfu research is not a paradigm, but the link on the concept, inherit the characteristics of the information system have merged, look for patterns in the fuzzy of disciplinary boundaries. The co-occurrence keywords in the field of information design and information system in China include architecture [59], data mining [60], informatization [61], system design [62], Internet of Things [63], information sharing [64], etc.

2. Research on information interaction design. The development of information design enables the interactive change of information in the process of communication, which plays an important role in promoting the research of information design field. LuXiaoBo transfer information and interaction design integration analysis, emphasize information interaction design should be accurate content to users of the special demand of complex information [65], interactive information "needs" should include the design to improve the efficiency of data analysis and processing, to meet the data in the process of converting information takes the form of beauty and transfer function. Qin Jingyan combed the development process and design methods of interactive information design based on the era of big data, and finally summed up the "meaning-centered" eco-sustainable large interaction design method based on the practical research of information interaction design in the fields of Internet, mobile terminals and games, such as politics, economy and social culture [66]. The co-occurrence keywords in the field of information design and interaction design in China include user experience [67], interaction design [68], visualization [69], artificial intelligence [70], new media [71], etc.

3. Visualization research. Visualization under the discipline of design is the process of visual expression of data and information. Visualization is mainly divided into data visualization, knowledge visualization, information visualization and scientific visualization. Hong Wenxue and others define visualization as the chain of two information processing ports of human and computer. Application of analytical visualization in data mining, data analysis, data technology and other fields [72]. Yang Yanbo etc, in the visual horizon, emphasis on visual information for data effect visual enhancement effect, the purpose is to let users realize the observation of the data in the form of direct interaction and access to, should be "visualizations, associated, artistic, interactive"

four aspects of the data inside and outside contact logic and cognitive [73]. The research of Hong Wenxue and others is relatively macroscopic, but Yang Yanbo starts from the perspective of visual perception, which is more targeted to the design research in the field of information design. As an important cross-research direction in the field of information design, the co-occurrence keywords of visualization and information design include frame [74], map [75], communication [76], information visualization design [77], information art design [78], Academy of Fine Arts [79], and visual guidance system [80], etc.

4. Research on medical information design. As the focus of "smart hospital" construction gradually shifts to "medical digitalization", the research on information system and collaborative innovation oriented to medical ontology becomes more and more important.

The design and stability of medical information system can maximize the use of limited medical and health resources, reduce medical costs and improve medical quality. Tang Kai et al. tried to solve the "regional medical data conversion problem" in the process of medical digitization through scientific information technology [81], and finally proved the feasibility, reliability and effectiveness of the construction and design of regional medical data exchange. By analyzing the development status of digital medical information system, Duan Huilong finally put forward the vision of "visual medical" for the form of digital hospitals in the future [82]. The research of Tang Kai and Duan Huilong is based on medical data resources, which provides an important foundation for the construction of digital archives of health information, and has practical significance for the research of "big health" information design. The co-occurrence keywords of medical information system and information design include design principles [83], management information system [84], cloud computing [85], architecture design [86], hospital informatization [87], medical quality [88], database [89], etc.

In summary, as shown in Figure 7, hot topics of information design research at home and abroad are similar, showing the characteristics of knowledge intersection. However, compared with the more focused and detailed research characteristics of foreign research institutes, domestic research in this field is more scattered.


Figure 7: Relationship mapping of research hotspots in the field of information design at Chinese and abroad.
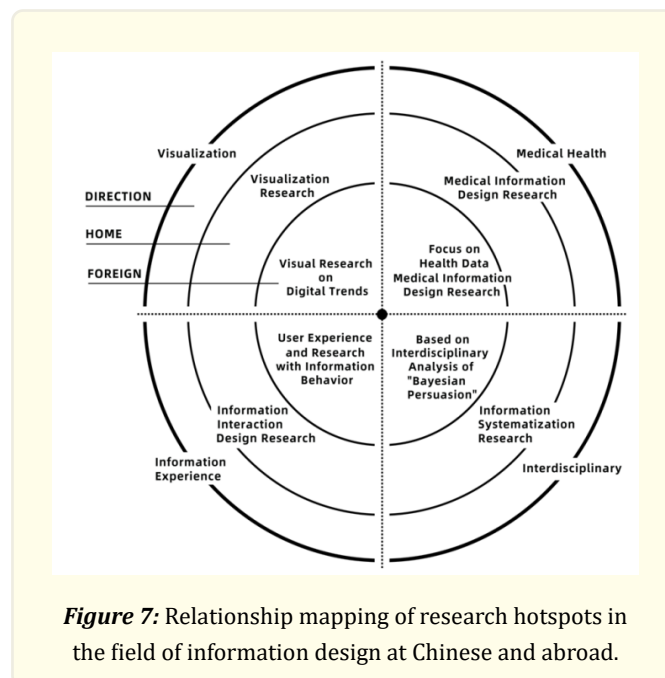
First of all, the domestic interdisciplinary direction aims at the macro narrative perspective of systematic information, and establishes the "open interconnection" research mode of information and computer science, astronomy, physics, communication, etc., with complex interdisciplinary situation. Foreign countries mainly focus on the "Bayesian persuasion" model, which is an interdisciplinary study of information design and economics, with a small cross-border scope. The intensity of "Bayesian persuasion" in 2019 is very high, indicating that this theory plays a supporting role in the stability of data networks in the field of information design abroad, and forms a trend of "focusing on the global radiation". Moreover, the domestic research in the direction of visualization is based on computer graphics and image processing technology, and the theory, method and technology are applied to the descriptive, relational, artistic and strategic thinking of generalized data. Based on the special context, foreign visualization research emphasizes the trend of digitalization and considers the possibility of establishing a chain between digital terminals and users' information behavior with big data. In addition, the domestic research in the direction of medical health is aimed at the research of information quality, cost, stability and reliability in the broad medical field. However, foreign countries analyze the long-term influencing factors of information on "health" from the two dimensions of information ontology and people, explore the curative results of medical information in the process of patient demand, and redefine the future trend of health.

Finally, the domestic research in the direction of information experience is the result of the deep integration of intra-design interaction and information design, covering the analysis of user needs and information transmission. Abroad is the law of information perception and behavior of user experience research in communication, psychology, neuroscience, artificial intelligence and other important field of study, this once again proved that the foreign information design and other subjects crossover study characteristics of strong, and the interdisciplinary research model detailed the information interaction design research scope, target and the results more clearly.

Evolutionary path analysis based on time zone graph

The CiteSpace software is used to visually analyze the time zone map of information design keywords at home and abroad, which can show the distribution and evolution of keywords in this field in different time regions. This is to divide the research direction into different periods through the life cycle theory. Grasp the hot spots and development trends of the research field from the time dimension [90]. Figure 8 and Figure 9 respectively show the time zone maps of foreign and domestic information design research fields. The evolution paths of domestic and foreign information design fields are sorted out through content analysis method, and the evolution path analysis based on time zone graph is obtained as shown in Figure.
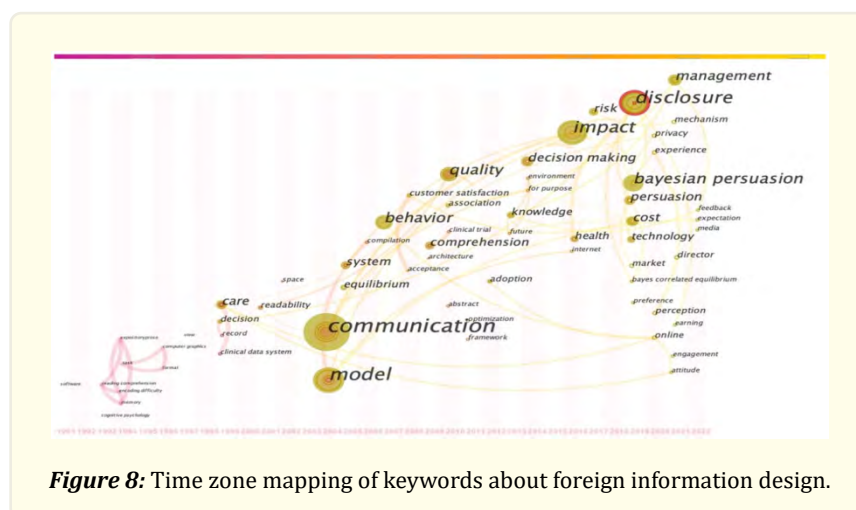
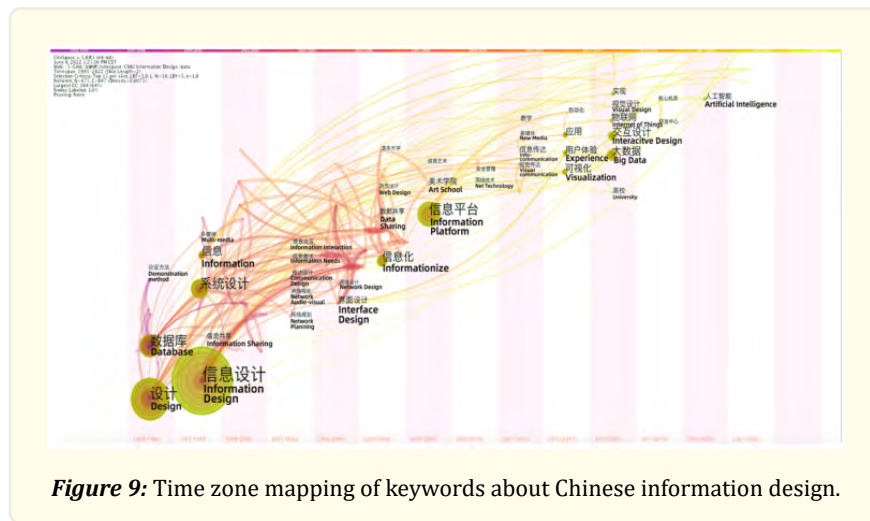*Figure 8:* Time zone mapping of keywords about foreign information design.

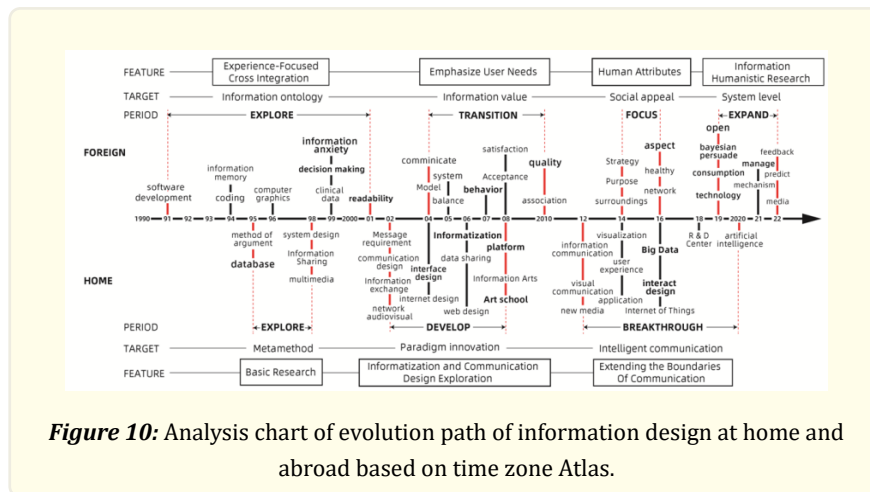*Figure 9:* Time zone mapping of keywords about Chinese information design.

Figure 10: Analysis chart of evolution path of information design at home and abroad based on time zone Atlas.

Analysis of foreign evolutionary paths

As shown in Figure 10, by observing the time zone diagram of keywords in the research literature in the field of information design from 1991 to 2022, foreign information design research has roughly experienced four stages: exploration period, transition period, focus period and transformation.

1. Exploration phase, 1991-2001. This decade is a period of exploration in the field of information design abroad. This period did not focus on the research of information design theory and method, but focused on the Interdisciplinary comprehensive research of "information experience". Abroad in the 1960 s, into the information society, the Labour structure of fundamental change, computer, automation technology mature gradually, living mode in the Internet presents a diversification characteristic under the action of rapid development, for free time also dramatically increased, resulting in foreign information in the early stages of design highlights hot word is "information anxiety", Is an information ontology problem that needs to be faced in the development of information society. Peter Bangoz once proposed in 1994 that information design should drive information to be transformed into an expression form suitable for understanding and acceptance by specific groups [91].

Therefore, the keywords of "decision making" and "readability" in the literature data also indicate that the research has changed

from "information" to "receiver" at this stage.

2. Transitional phase, 2004-2010. During this period, the research focused on meeting the "special needs of users" was evident. Specifically, during 2004-2007, foreign information design mainly aimed at providing efficient solutions to the problems of "communication", "behavior", "satisfaction" and "acceptance" in the process of information transmission. In 2010, Information Design Workbook [92] written by Baer K defined Information Design as "effective communication is the core essence and essence of Information Design", which also indicated that foreign researchers began to focus on providing efficient Information communication methods for human beings. The prominence of the keyword "quality" in this period is also related to this research path.

3. Focus stage, 2014-2016. Shorter the time, in order to "influence" to highlight the hot research direction is also activated the "health", "strategy" and other heat keyword research in the field of information design, and "purpose" for information, and information behavior of the "environment" are based on individual and group in a collaborative, dependencies, such as level of social research, It reflects the strong humanistic attribute characteristics. Therefore, during this period, there appeared a lot of research contents opposing quantification and algorithmic analysis. MA Net realized that the information aesthetic model generated by computation was a radical way, and this seemingly "supreme" mathematical formula was about to come to an end in the unpredictable society [93]. Filonik D and Baur D also stressed that quantitative metrics of information visitors do not seem to capture all aspects of user experience [94].

4. Expansion stage, 2019 till now. The year 2019 is an important year for foreign information design research. The "Bayesian persuasion" model and the key word "open" of information that is most closely related to the model have become the largest hot words highlighted in the literature database, and the visual analysis can also see their large appearance in a short period of time. "Consumption", "science and technology", "management" and so on also reflect that the study of this period focuses on the impact of information in the social, economic, technological and other fields at the system level; Since 2020, the emergence of "feedback", "prediction", "mechanism" and "perception" also indicates that foreign information design field has paid attention to the research of information ontology and people, and more focus on the "primitive" research of information mechanism and strategy. During this period, Ware C analyzed the design principles of neuroscience applicable to maps, cognitive neuroscience and pattern perception based on perception and vision science, and summarized the information perception theory to improve clarity, practicality and persuasive visualization effect [95].

Analysis of domestic evolutionary path

As shown in Figure 10, by observing the time zone diagram of keywords in research literature in the field of information design from 1995 to 2022, the process of domestic information design research can be summarized as the evolution process of design thinking on information ontology research, which roughly goes through three stages: exploration period, development period and breakthrough period.

1. Period of exploration. The domestic research on information design field recorded in the database began in 1995, which is a little later than that of foreign countries in 1991. The exploration period lasted for a short time: from 1995 to 1998, the key words were mainly based on "argumentation method" under "database", and also involved in "system design", "information sharing" and other basic research and exploration starting from information ontology and design method respectively.

2. Development period. The period from 2002 to 2008 is an important development period of domestic information design research, especially in 2006, the 60th session of the United Nations General Assembly resolution on May 17 every year for the "World Information Society Day", which marks the impact of information on human society has entered a new stage. In May 2006, the relevant departments of the state issued the National Informatization Development Strategy 2006-2020, which made a comprehensive deployment for informatization development and vigorously promoted the process of domestic informatization. Therefore, since 2006, the research of information design in China has shifted from "interface design", "communication design", "information interaction", "network design" and so on, to the direction of "informatization", "information platform" and "data sharing", which mainly focus on computer science and information technology. But it should be pointed out that, in 2008, with the highlight words "information platform" is closely related to the art of "information", "the fine arts institute" the emergence of

keywords, design and other subjects at this stage shows the characteristics of relatively obvious cross fusion research, in view of the information transmission model of innovation, and from the aspects of functional and aesthetic thinking.

3. Breakthrough period. Since 2012, research in the field of information design in China has begun to transform from the translation of traditional paradigms to the more challenging, futuristic and unpredictable intelligent communication paradigms. Domestic researchers realize the value information design in society, so from the classic "message", "visual communication", "new media" direction quickly turned to closer to the user's own "visualization", "user experience" research, and discusses in the context of "big data" information interaction design, and the influence of design for the "Internet of things". What should be noted is that in 2020, "artificial intelligence" appeared in the co-occurrence of keywords in the field of information design for the first time, indicating that the boundary of information communication has been broken, and the research heat of intelligent communication will continue to rise and become an important research trend in the future.

From the time dimension analysis, the development paths of information design research at home and abroad overlap to some extent, but there are also obvious differences. The development of information design in foreign countries is earlier than that in China, and the four development cycles are also more than the three development cycles in China. The two periods from 2004 to 2008 and 2014-2020 are the rapid development periods of information design at home and abroad, and a large number of keywords come from these two periods. Foreign keywords such as "communication", "behavior", "satisfaction", "public", "privacy", "health" and "influence" are from the perspective of "human" as the subject of information, which have a strong color of "humanistic care" and reflect the social value of information design. In China, "interface design", "informatization", "information platform", "big data", "interaction design" and other keywords are still in the research mode based on science and technology and design methods.

Conclusion

Based on WOS and CNKI database, this paper uses VOSviewer and CiteSpace data analysis and visualization tools to compare and analyze domestic and foreign information design research from four dimensions, including publication country, cooperation network, thematic relationship and development process. According to the analysis, the following conclusions are drawn: from the perspective of publication countries, the United States has absolute advantages in the number and breadth of information design research, followed by China,but the number of publications is about half of that of the United States. This also shows that there is a certain potential for domestic information design research in the future. From the perspective of cooperation network, the cooperation density of foreign research institutions is obviously higher than that of domestic research institutions. Domestic research on information design is mostly carried out in small teams or independent ways, and the cooperation mode between universities and international perspectives has not been better expanded. From hot spot content, interdisciplinary research in the study of information design, visualization, medical health, the theme of the interaction is a common concern at home and abroad scholars, but foreign research content is refined, it also makes the direction of the theme of the research in this field abroad are more abundant, purpose more clearly, domestic research is relatively macroscopic, the research content is scattered; From the point of the development process, the foreign information earlier than the domestic design study, and on time division is divided into four stages, high heat period study, starting from the transition period, reflects the obvious characteristics of "humanism" and "humanity" in the development stage mining information ontology in the system level, the influence of the country is divided into three period, development period and breakthrough research during the period of high heat, At present, it focuses on the research direction of intelligent communication path, but more is the research of technology and method.

In view of the above conclusion, the status quo of information design research at home and abroad, and put forward the following suggestions for the research and development of information design in China.

Return to the humanistic concept of metacognition

Research in the field of national information design in the future need to strengthen the institutions, team and individual, as well as the interdisciplinary integration of international research way, this is the information design itself is determined by the intersection of

attribute, this property can also assign the possibility research paradigm of diversity, more determined the close cooperation between research institutions in this field. At the same time, the foreign information design research has return information ontology and humanistic research, domestic also should return to new thinking, this is not a "retro", but based on cross information ontology philosophy, semantics, cognitive psychology, media studies, and other areas of the interdisciplinary, truly from the perspective of "people" thinking structure of knowledge update, focus on information influence factors in the field of economy, society, science and technology, This is the exploration of information humanism at the system level to achieve greater benefit and value of information. Science and technology are very important for information design research, but no amount of technology should return to human beings. In information design, this is mainly reflected in the adaptability of technology in the process of human perception of information. Too much iterative technology research can only weaken the efficiency of information elimination for uncertain things. The research on information behavior and experience around "people", such as "information nature", "semantic resonance", "information culture" and "cognitive salience", is the innovation of deep link information design in the "meta" basis.

Promoting research on intelligent information dissemination

Will close relation with design information design co-occurrence keywords coefficient (table 5) are arranged according to the center, you can see "artificial intelligence", "interaction design", "user experience" as keywords in the domestic research on information design, "artificial intelligence" in the time zone of the heat continues today, will be the future research trend. However, on the other hand, it can be seen from the visual analysis theory that the inflection point of keywords with high Centrality coefficient is basically above 0.1 (namely Centrality>0.1), and high-frequency words with greater coefficient are generally recognized to have great influence in this field [96], while the Centrality coefficient of "artificial intelligence" is only 0.01. It SHOWS THAT THE research HAS not yet formed the scale heat, the influence to the information design field is still not big enough, or has a very large supplementary possibility.

Hot words	Center	Coefficient
frequency information system	0.38	298
Network design	0.19	3
Information design	0.16	243
Network video	0.16	4
The database	0.13	64
design	0.10	110
The system design	0.08	68
The user experience	0.05	14
Interaction design	0.03	28
Artificial intelligence (ai)	0.01	28

Table 5: Centrality tables of keywords about Chinese information Design.

Therefore, the emphasis on sensory interaction experience of information intelligent innovation will become a very valuable research direction, intelligent technology has a stronger driving force for the development of information design. Foreign research in this direction emphasizes communication innovation "to meet diverse needs", relying on the feasibility of scientific technology and intelligent communication, and emphasizing the solution of more complex and unknown problems in the process of human experience of information. Domestic research in this field is still limited to the paradigm of active information transmission and passive user acceptance. This linear thinking is actually a transmission path for users to read information according to content Settings. The future trend of the traditional linear narrative path, with the help of algorithm and the blessing of work force, and technology, to realize the spread of the "sensual" innovation, change the traditional research paradigm, the possibility of complete information dissemination iteration to systematic approach to help humans to adapt to the information age, to optimize the communication, the static thinking

into dynamic thinking, Using information design to reconstruct the deep social problems that are not clearly defined.

More detailed cross-sectional research

Domestic information design research needs to focus on more focused, more targeted issues to conduct in-depth research. While integrating generalized information design with other disciplines, collaborative research with deep integration within disciplines should also be carried out. Information design and other subjects crossover, surface is under design category add a more specific modifiers, narrowing the scope of research, but in fact is to increase the possibility of information design in other areas, diversity, enrich the research content, meet the demand of more detailed and specific human communication, maximizing the value of information in society.

Such as the rapid development in the digital economy in recent years, scholars began to focus on the field of digital culture, but at present domestic "culture" information design study universal macro narrative system characteristic, lead to research on visualization "homogeneity" as a result, if you can narrow range, collaborative innovation culture research in the field of other disciplines, Information design will break through the bottleneck of "serving society" from the cultural perspective. On the other hand, foreign visualization studies focus more on "digital" context. Lupi G's "Digital Humanism" [97] once proposed that information design should pay more attention to the transmission of micro things, and strengthen the analysis of context in narrative expression in data interpretation. Only by narrowing the research scope can "context" logic be established more easily. Therefore, narrowing the scope of subject research defines the information design innovation should be present a variety of possibility, the result is not an isolated as a result, "interdisciplinary - narrow range - refining the theme - widening value" is in fact the research path the context information in different media, the media, to establish a more rigorous, exquisite logic, To help people transform the world and perceive the world through the designed information.

Finally, this paper has certain research limitations: in academic papers and the main literature can represent a certain degree of information design domain research results, but the information design of project practice, the scientific research practice should also is an important part of information design research, not with those from multiple data sources were analyzed, and it can be used as the field in the future research direction and supplement.

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