Trend Analysis of Research Hotspots in the Field of Universal Design Based on CiteSpace Knowledge Graph

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ABSTRACT

In order to fully understand the hot topics and development trends in the field of universal design, this paper uses Citespace, a scientometrics software, to research and visually analyze relevant academic papers in the Core collection database of Web of Science, it is found that the research in the field of universal design in the past ten years is concentrated in following five aspects (1) urban environment (2) product design (3) education and teaching (4) human-computer interaction (5) society and policy. Research and application in these fields directly reflect the diversified application value of universal design. This research also combines the literature content analysis method to make prospects for the emerging development trends in this field to provide ideas for related research at home and abroad.

Keywords: Universal design, Inclusive design, CiteSpace visual analysis, Research hotspots, Development trend

INTRODUCTION

Universal design (UD) was put forward by Professor Ronald L. Mace of North Carolina State University in the early 1980s. Its core idea is to comprehensively consider different cognitive abilities and physical characteristics, and provide society with the ability for anyone to Good design to use in your own way. International concepts similar to UD also include "inclusive design, design for all". In order to fully understand the research hotspots and academic trends in the field of UD, this article uses "design for all, universal design, inclusive design" as keywords to conduct a literature search. The articles are all SCI articles from the core collection of Web of Science. Through checking the title, abstract, keywords and other content of the article, 207 articles closely related to the theme of UD were retained. Then input these articles into CiteSpace for visual analysis of the articles.

VISUALIZATION ANALYSIS

Keywords can reflect the research hotspots in this field. CiteSpace emergent words are calculated based on the frequency of keywords, reflecting the degree of activity in the research field, and revealing this Research topics that have received high attention in a specific period; by exploring the evolution path of emergent words, potential and valuable research directions can be explored. According to a measure of similarity, the classified objects are classified to extract cluster labels. Through keyword clustering, UD research hotspots are clearer. In this paper, through the keyword co-occurrence map, cluster map and emergent words of CiteSpace, we can discover important research directions in the field of UD and the evolution trend of research hotspots in recent years.Using the keyword analysis function of CiteSpace, the co-occurrence map of keywords in UD field, the main research hotspots in this field scientifically. The top 15 keywords with high frequency are " UD, access, disability, inclusion, design for all, UD for learning, Student, Architecture Design, Accessibility Evaluation, Higher Education, Ergonomics, Assistive Technology, Built Environment, Usability, Building Evaluation, among them, "UD, access, disability" are the three keywords with the highest frequency, which are the important research hotspots of universal design in recent years.

According to the strongest bursts keywords mapping, we can see early topics of interest in the field of UD are "information, usability, assistive technology, and disability". In recent years, the research topics that have received attention include "design, students". Keywords with high emergence intensity are important turning points for research in this field. There are "assistive technology, accessibility assessment, design for everyone, higher education, performance, environment, experience", and the topic of "design for everyone" has attracted attention. For as long as five years, the topic of "students" has attracted attention for as long as four years. Next, we subjected the keywords to cluster mapping analysis and obtained 12 tags, including"#0 UD; #1 UD for learning; 2# experience; #3 elderly; #4 architectural design, #5 accessibility; #6 case study; #7 blind; #9 built environment; 10# factor analysis; #14 intelligent infrastructure; #15 touch pane", the s value of all cluster labels is greater than 0.5 Therefore, its research content can basically cover the hot spots and directions in the field of UD in recent years.

MAIN RESEATCH DIRECTIONS IN THE FIELD OF UNIVERSAL DESIGN

According to the content analysis method, combined with the CiteSpace knowledge graph, the main research directions in the field of UD in recent years are qualitatively summarized including (1) urban environment; (2) basic theory; (3) product design; (4) education and teaching; (5) human-computer interaction; (6) Social policy; (7) Other aspects.

Urban Environment

The urbanization process has increased the complexity of the city. At present, there are still many areas for improvement in the urban environment. This

refs to the man-made environment, including street landscape, community infrastructure, entertainment functions, and land use. The government is also facing increasing challenges in solving this complexity and various citizen needs. For this reason, Nataša Rebernik proposed the CMA (combined methodological approach). The main idea is to combine various technologies to provide users with Analyze the spatial environment, enhance the understanding of user needs and behaviors, and encourage the government to take action on inclusive urban design to meet diverse needs. Jennifer A. Gray conducted research on 95 instruments for measuring walkability, cycling and entertainment, and suggested that UD principles should be incorporated into the built environment guidelines Ko-Chiu Wu investigated the needs and views of users of different ability levels on parks and public facilities, helping to promote the development of parks and public facilities in a diversified and inclusive direction. The application of UD in the urban environment has gradually shifted from removing the physical barriers of the disabled to allowing everyone to integrate into the environment. Integrating the methods and concepts of UD into the actual design process will help make the urban environment truly a paradise for the masses of people to rest and entertain.

Product Design

The principles of universal design have been widely used in product design. The user's sensory, motor and cognitive abilities all affect the degree of interaction with the product. In order to promote designers' understanding of users and improve the usability of products, scholars have put forward many suggestions and methodological by continuously discovering usability and accessibility issues in products and environments, further improving and expanding these methods. For example, in order to better understand users and help increase the possibility of products meeting user needs and make design more inclusive, Russell Marshall and Keith Case of Loughborough University proposed two computer-based tools. SAMMIE (Human-Machine Interaction Assessment Assistant System) and HADRIAN (Human Body Measurement Data Demand Investigation and Analysis), these two tools support designers and ergonomics scientists to understand complex requirements and ergonomics issues in a CAD environment. James A. Lenker proposed RAPUUD based on the seven principles of UD. This tool is very sensitive to differences in functional capabilities and product characteristics, and helps identify product usability issues. Anna Mieczakowski proposed the "goal-action-belief-goal GABO modeling" to help understand the cognitive process of users and evaluate the characteristics and usability of different products. Amjad Hussain proposed a six-step framework. The ergonomic risk assessment helps to use the least harmful and most suitable work method as the recommended work strategy. These UD methods and models help establish empathy with users to understand user cognition, identify product usability issues and ergonomic issues to develop more inclusive products.

Education and Teaching

The development of technology has provided more possibilities for education, but the success rate of students with disabilities, language barriers and low

socioeconomic status in schools is usually not as good as that of ordinary students. Proponents of inclusive education believe that learning obstacles do not stem from the learner's abilities, but occur in the interaction between the learner and the curriculum. Therefore, the curriculum needs to bear the responsibility for change, and educators in various fields also need to change their Way of thinking. The concept of UD is of great significance to educational practice and guidance. As early as 1995, after the publication of "Universal Design Strategy", 25 universities across the United States successively introduced "universal design" education courses. The research of Norwich and Lewis believes that the "universal curriculum" or "inclusive curriculum" guided by the concept of UD supports teachers to choose teaching strategies based on teaching content and improve teaching quality. Carol Rogers-Shaw, MA, MS, Davin J. Carr-Chellman, PhD and other scholars showed that UDL can also enhance learners' ability to acquire knowledge, get greater accessibility, effectiveness and fun. Therefore, the author encourages the design of learning environment to adapt to the growing diversity of learner groups (especially the online environment), and supports curriculum design and educational practice to solve the problem of fairness and inclusiveness. Burcak Altay & Halime Demirkan emphasized the positive and negative aspects of the university environment from the perspective of users with disabilities, and revealed many aspects that need to be changed. Based on this issue, an empathy model was also established to deepen the understanding of the multi-dimensional challenges faced by users with disabilities, to help enhance the inclusiveness of the educational environment.

Human-Computer Interaction

Case studies and longitudinal analysis reports in France and Portugal show that there are still a high percentage of websites and modern web applications that cannot meet the most basic accessibility standards. Christian Fuchs & Marianna Obris discussed the interrelationship between the sociological concepts of human-computer interaction and design and called for attention to the social needs in the research of human-computer interaction, and put forward the concept of developing and establishing a "participation, cooperation, and sustainable information society (PCSIS)". The speech recognition system for games proposed by Moyen Mohammad Mustaquim helps to realize the UD and accessibility of games. He also suggested combining other forms of interaction to provide a better operating experience. In addition, museums are also part of an interconnected knowledge society. Belén Ruiz showed that the museum environment follows MGA (The Multimedia Guides) for All method of equipment will be revolutionary in terms of content access methods for all visitors. This means that the museum will help all users, especially users with disabilities, to experience in a more independent or adaptable way by providing access to everyone.

Society and Policy

UD transforms the social purpose into a clear design focus, emphasizing different stakeholders and the broader environment, paying attention to

macro-level interactions and relationships, such as behaviors and attitudes with social value, which are socially responsible the design. UD has been vigorously promoted by the civil rights movement since its inception, and has had an important impact on legislation. In 1961, the United States formulated the world's first accessibility standard "Enable Buildings to be Accessed and Used by Physically Disabled", the United Kingdom, Canada, Germany, Japan, Denmark and other countries and regions have also successively formulated and improved laws and regulations on barrier-free design. Since the 1980s, China has successively promulgated the "Code for Design of Accessible Urban Roads and Buildings" and other relevant laws further define that the built environment, product facilities accessible to everyone. In addressing social issues, Olga Peek focused on how users can flexibly renovate, adapt or compete for space in resettlement housing projects, and finally suggested fostering user-based design and housing mechanisms to promote inclusive urban transformation. H.Filiz Alkan Meşhur investigated the disability cognition throughout the historical process from a sociological perspective, and also analyzed the principles of UD in the external space of Konya City Center, expounding the concept, principles and importance of universal design.

RESEARCH TRENDS

Design disciplines are inherently cross-cutting and open. In particular, UD faces mostly integrated social problems, so it is more necessary to consider the changes brought about by social progress and technological development. For example, image generation, voice interaction, virtual reality, data mining, cloud computing and other technologies are important for the development and application of universal design, combined with the CiteSpace map and literature content analysis, we summarizes the emerging development trends in the field of UD in recent years, includes the following three areas.

Cross-Border Collaboration

In the context of digital life, the communication and cooperation between various fields are getting closer and closer, UD has been widely used in industrial engineering, medical rehabilitation, education, building environment and other fields in recent years. Even Juyeon Park evaluated the applicability of UD principles in the development of apparel products, providing users with flexible fit and size through various wearing and shaping methods, as well as expressing the wearer's personality. The study also shows the UD concept is an effective framework that encourages designers to explore creativity and critical thinking skills, and find innovative design solutions for flexible and multifunctional clothing products. Chana Yiang kamolsing's research is to identify customers' requirements for UD in flexible packaging. According to the principle of UD, a matrix for screening user needs is proposed, and customer requirements are used as an important indicator to evaluate the ease of use and versatility of flexible packaging UD, so that the packaging design can better accommodate users of different ages and abilities. It can be seen that through cross-professional and cross-field collaboration, it is possible to

effectively integrate UD and other superior resources in different fields, so as to provide scientific, systematic, complete and comprehensive solutions.

Artificial Intelligence

The rapid development of Internet technology and artificial intelligence has brought new development space for UD. The content covered by the development of artificial intelligence at this stage can be roughly defined as four parts, machine learning, natural language processing, image recognition and interaction, namely the ability of algorithms to drive the development of artificial intelligence from computational intelligence to perception and cognition. Based on this possibility, the combination of artificial intelligence and design has received widespread attention, and many researchers have used artificial intelligence technology in the field of design. Through design drive and technology integration, it provides more possibilities for the healthcare industry and education and teaching industry. Zachary Walker focuses on how educators use mobile devices and the principles of augmented reality to apply UDL, and combines the principles of augmented reality and UDL to help educators create easy-to-understand, engaging and powerful courses for a variety of learners. In addition, with the support of artificial intelligence technology, human-computer interaction is also entering a new era, and its important role is manifested in creative display experience, content service experience, and contextual interaction experience. Improve service experience and other aspects. In general, the application of artificial intelligence helps UD to develop in the direction of specialization, science, standardization, and programming.

Big Data Application

UD focuses on all users and involves a more complex and costly design process. Therefore, it is difficult to conduct research on such a large sample, especially when it is difficult to find the needs of users with diseases or obstacles. But through big data, this situation can be effectively avoided. The reason is that the acquisition of big data is often more hidden, so the information obtained by the designer is more true and accurate. For example, Alex Penlandt, director of the MIT Human Dynamics Laboratory, found in his research that when people are sick, their behavior changes regularly and predictably, and these behaviors are measured by sensors in mobile phones. There are already a series of research and products that use big data mining and analysis techniques. Moloud Abdar designed a general model DKDAR that can help designers better understand users without a large number of users. It supports collecting user feedback from service websites. Raw data, dynamic analysis and mining of generated content, thereby reflecting the differences in group preferences and behaviors. In addition, there is also IBM's DeepQA project, which integrates cognitive computing, embedded NLP, correlation training, custom annotations, extraction models and other methods. It obtains and analyzes massive amounts of data from scientific reports, web pages and social media. Combining design positioning and user preferences, assist the designer to complete the design. Big data technology based

on scientific research algorithms makes complex design innovation activities more rigorous and efficient, and injects new vitality into the solution of UD problems, which is mainly reflected in helping designers accurately insight into massive amounts of information and shortening product development and design cycles. Deal with the timeliness and complexity of data in the Internet era.

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