



Progress of Bibliometric-Based Research on Aesthetic Experience in Design

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Abstract. Purpose: To sort out and analyze the current research status of aesthetic experience in the field of design at home and abroad. Methods: Starting from the concept of aesthetic experience, we used well-known domestic and foreign literature databases to locate authors and research institutions; we used bibliometric methods to analyze research hot spots and research trends, classify research results, and conduct a comprehensive analysis based on relevant literature. Results: The results of bibliometric analysis show that the annual publication volume of aesthetic experience research literature in the field of domestic and foreign design is on the rise, and the research content intersects with computer science, psychology, and education. Delft University of Technology and Jiangnan University School of Design are influential research institutions at home and abroad. According to the keyword clustering analysis summary, both domestic and foreign research can be summarized into three major categories; the overall trend of development from practical application to theoretical research and gradual refinement.

Keywords: Aesthetic Experience; Design Research; Bibliometrics; CiteSpace; Knowledge map

1 Introduction

Although the primary goal of design remains functionality, historically, art and design originally stemmed from the same root[1]. Good design works, whether in architecture, industrial products, or graphic posters, possess significant aesthetic value. Outstanding design works emphasize aesthetic experience (AE), with designers acknowledging the significant impact of a product's appearance on consumer purchases. As product functionality and ergonomics evolve, aesthetic quality has increasingly become a key element in delightful design[2]. Predicting consumer reactions to design products before their market launch is often challenging. Thus, researchers are guiding designers and evaluating the aesthetic experience of products using neuroscience, physiological measurements, and quantitative methods[3]. Aesthetic experience involves four dimensions related to art, namely perception, emotion, cognition, and communication[4]. It

is widely believed that emotion plays a crucial role in the processing of art and design works, especially in the enjoyment associated with them. Previous research on aesthetic experience has mostly focused on art, rather than design products closely related to our daily lives, such as industrial products, architecture, and clothing.

A previous study by Adelabu et al. proposed a definition of aesthetic experience in design, hereinafter referred to as AE-D[3,5]. They defined AE as the emotionally sensitive elements and emotional cognitive processes that occur during the interpretation of product value. Building on Norman's three-tier theory of AE[6], they further explained the process of AE in product design: superficial aesthetics, functional aesthetics, and symbolic aesthetics. In recent years, relevant foreign scholars have continued to innovate in research on AE-D and published a large number of scientific documents with high impact factors. Over the past thirty years, various Chinese scientific aesthetic schools have been seen merely as temporary aesthetic phenomena from scientific intrusion into aesthetics, with no lasting impact on contemporary aesthetic history. Therefore, understanding the current state and trends of domestic research, further analyzing the differences between domestic and international AE-D studies, and learning from others' strengths is particularly important.

Bibliometrics helps researchers quantitatively analyze large volumes of academic literature, providing a macro view of research trends, major themes, and theoretical frameworks in relevant research fields. CiteSpace is a bibliometric software tool designed to visualize and analyze trends and patterns in scientific literature. It is widely used in scientometric research, literature reviews, and research evaluation. However, bibliometric research methods represented by CiteSpace are not widely used in the field of aesthetic research in China. Therefore, this study utilizes the CiteSpace 6.1.R6 software to analyze the annual publication volume, co-occurrence networks, and keywords of aesthetic experience research literature in the field of design both domestically and internationally. It also generates visual network maps that swiftly summarize the global state, key areas, and progress of aesthetic experience research in design. Moreover, it highlights the differences in research focus between Western and Chinese design studies on aesthetic experience and forecasts their future trends to understand the direction of related research.

2 Data Sources and Research Methods

2.1 Data Sources

This study selects the Web of Science and CNKI databases as tools for literature retrieval, with data collection dated March 25, 2024. Chinese literature is sourced from the CNKI literature database, using the advanced search window with the following search criteria: the theme 'aesthetic experience' (exact) and including 'design' (exact), with no limit on the start date of the search. The scope of resources is set to academic journals. After retrieval, by assessing abstracts for relevance, non-related and non-research literature is manually excluded, resulting in 203 valid documents for the research sample. Foreign literature data are sourced from the WOS Core Collection, including databases such as SCI-E, SSCI, A&HCI, CPCI-S, and CPCI-SSH, with no limit on the

start date of the search. The search was conducted using topic retrieval, with the criteria: ("aesthetic experience*") AND ("design*"). After reviewing abstracts and removing off-topic and non-research documents, 167 relevant articles were identified and imported into CiteSpace for visualization analysis.

2.2 Research Methods

This study carried out bibliometric analysis using the process shown in Figure 1. Documents were collected in WOS and CNKI, and after excluding documents irrelevant to the topic, the valid documents were imported into CiteSpace (6.1.R6) to generate a related network of publication volume, institutions, journals, and keywords. Then describe the macro structure of the research field based on the statistical results, and further read the literature, conduct analysis from three aspects: research status, research hot spots and development trends, and predict the subsequent development of the research.

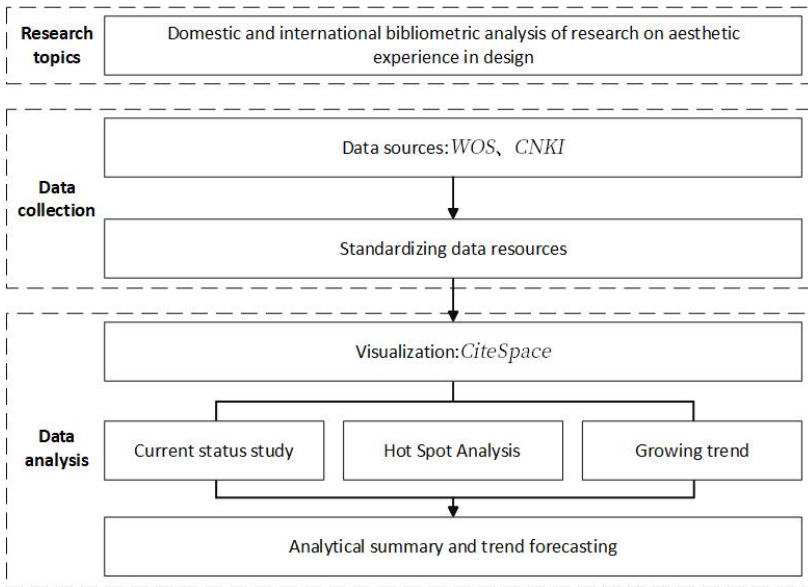


Fig. 1. Research Methodology Flowchart (Self-drawn by the author)

3 Research Status

3.1 Trends in Publications

The first Chinese literature on aesthetic experience in the domestic design field appeared in 2002, and since then, the volume of publications has shown an annual increasing trend, which gradually stabilized after 2018. As of March 25, 2024, a total of 203 articles were counted, with the annual publication volume distributed across three

phases. From 2002 to 2009 was a quiet period, with fewer publications; from 2010 to 2018 was a period of rapid growth, during which the volume of publications saw an explosive increase; from 2019 to the present has been a stable period, with the annual publication volume remaining at around 16 articles. The English literature for this study first appeared in 2006, and the annual publication volume is also divided into three phases. From 2006 to 2015 was a quiet period, during which the volume of publications was small and growth was slow; from 2016 to 2018 was a period of rapid explosion; from 2019 to the present has been a stable period, with the annual publication volume maintained at around 16 articles. Overall, AE-D has increasingly garnered the attention of researchers, and the growth trends in publication volume between Chinese and English literature are quite similar. The publication volume of Chinese and English literature in the field of design aesthetic experience research from 2002 to 2024 is shown in Figure 2.

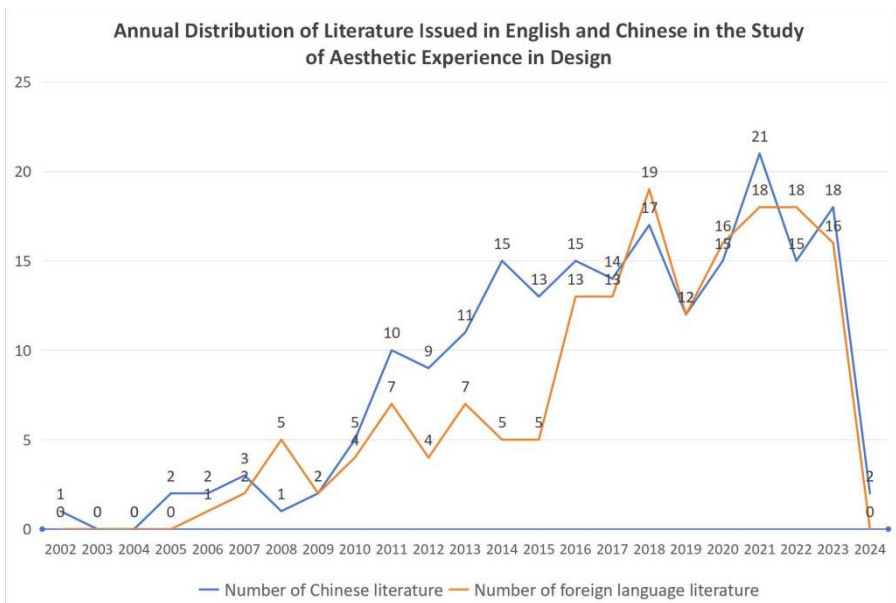


Fig. 2. Annual distribution table of the number of publications in English and Chinese on AE-D research from 2002 to 2024(Self-drawn by the author)

3.2 Status of Journals

A statistical analysis was conducted on the journals that publish the results of aesthetic experience research in design. From the perspective of the number of publications, the top ten important domestic journals that publish AE-D research papers are: *Packaging Engineering* (14 articles), *Mass Culture and Art* (10 articles), *Design* (7 articles), *Art and Design* (7 articles), *Art Education Research* (5 articles), *Art Science and Technology* (5 articles), *Art Panorama* (4 articles), *ZHUANG SHI* (4 articles), *Designs* (3 articles), *Art Education* (3 articles). Most of the journals are professional art journals, and

a few are multidisciplinary comprehensive journals and engineering science and technology journals. Among domestic research journals, the interdisciplinary characteristics mainly involve research fields such as engineering and education. During the same period, the top ten foreign journals with the most published AE-D research papers are: *International Journal of Design* (8 articles), *Design Journal* (5 articles), *Frontiers in Psychology* (5 articles), *Psychology of Aesthetics, Creativity and the Arts* (4 articles), *Design Studies* (3 articles), *ACM Transactions on Computer-Human Interaction* (3 articles), *PLOS ONE* (3 articles), *Empirical Studies of the Arts* (2 articles), *Leonardo* (2 articles), *New Ideas in Psychology* (2 articles). It was found that English literature is primarily published in professional journals related to the arts and humanities and social sciences. In international research journals, the interdisciplinary characteristics mainly involve fields such as psychology and education.

3.3 Research Institutions

By summarizing the publication records of major domestic and international research institutions, the aim is to grasp the distribution of relevant research institutions and rank these institutions based on the number of publications in this field according to the valid literature. The top 10 research institutions in terms of publication volume both domestically and internationally are shown in Table 1.

Table 1. Top 10 Domestic and International Research Institutions in terms of Number of Publications (Self-drawn by the author)

Research organization	Nations	Volume of papers	Research organization	Volume of papers
Delft Univ Technol	Netherlands	4	School of Design, Jiangnan University	4
Natl Chengchi Univ	Taiwan, China	3	College of Landscape Architecture, Nanjing Forestry University	3
KTH Royal Inst Technol	Sweden	3	Zhengzhou University of Light Industry	3
Univ Teknol MARA	Malaysia	3	Harbin Institute of Technology, School of Architecture	3
North China Elect Power Univ	China	3	Academy of Arts & Design, Tsinghua University	2
Zhejiang Univ	China	3	College of Design and Art, Hunan University	2
Eindhoven Univ Technol	Netherlands	3	Jingdezhen Ceramic University	2
Aalborg Univ	Denmark	3	The Guangzhou Academy of Fine Arts	2
Max Planck Inst Empir Aesthet	Germany	2	CAUP Tongji University	2
MIT	USA	2	Wuhan University of Technology	2

The table data indicates that no single institution dominates this research field; influential institutions are primarily universities. Internationally, the top ten most influential institutions include two from the Netherlands, with Delft University of Technology leading in publications, having started as early as 2007. It is worth mentioning that the only research institution listed in the table is the Max Planck Institute for Empirical Aesthetics in Germany. Among the top ten domestic institutions by publication volume, most are design schools or fine arts colleges within comprehensive universities. The institution with the largest number of publications is the School of Design at Jiangnan University, which first published in 2010.

4 Analysis of Research Hotspots

4.1 Keyword Heat Analysis

Keyword co-occurrence is based on the analysis of the joint occurrence of words or noun phrases in a set of literature, identifying the connections between different research themes within the subject area of the literature. This method helps to determine the core themes, trends, and potential areas for further research in specific fields or across disciplines. Literature data were imported into CiteSpace, with the time span set to unlimited and the time slice to 1, selecting 'Keyword' as the object of study. The Chinese literature ultimately generated a keyword co-occurrence map with 372 nodes and 629 connections, indicating that the concept of aesthetic experience has many research hotspots in the field of design, as shown specifically in Figure 3. Sorted by the frequency of keyword occurrence, 'aesthetic experience' appears 70 times, with a centrality of 0.79, ranking first. Subsequent frequencies in order are 'aesthetics', 'product design', 'packaging design', 'experience', 'emotion', 'design aesthetics', 'experience economy', 'aesthetic ability', 'art design'. By analyzing the literature represented by these keywords, it can be inferred that domestic AE-D research predominantly focuses on product and packaging design, and shows co-occurrence relationships with other keywords.

The English literature ultimately generated a keyword co-occurrence map with 353 nodes and 994 connections, showing closer relationships between nodes, indicating that this concept also has many research hotspots in the foreign design field (see Figure 4). 'Aesthetic experience' appears 29 times, with a centrality of 0.27, ranking first. Subsequent frequencies in order are 'appreciation', 'model', 'emotion', 'design', 'experience', 'judgment', 'art', 'perception', 'response'. An analysis of the literature represented by the above keywords reveals that foreign AE-D research is more reflected in the exploration and proposition of theoretical models. At the same time, the international academic community also attempts to explore more about how the public engages in aesthetic experiences with design, including through appreciation, experience, judgment, perception, etc.; as well as what kinds of responses are generated, such as various emotions.



Fig. 3. Keyword co-occurrence information mapping of Chinese literature for AE-D studies (Self-drawn by the author)



Fig. 4. Keyword co-occurrence information mapping for AE-D studies in English literature (Self-drawn by the author)

Centrality reflects a keyword's core position in co-occurrence. Information on the top 10 keywords by frequency in AE-D research for both Chinese and English literature is shown in Table 2. Data from Chinese literature indicate that following the keywords 'aesthetic experience' and 'aesthetics,' 'product design' has the strongest centrality at 0.1. This is followed by 'packaging design,' with a centrality of 0.08. Combined with the aforementioned frequency analysis, domestic design research that primarily focuses on aesthetic experience shows co-occurrence relationships with related design fields such as product and packaging design. Meanwhile, the centrality of 'design aesthetics' also reaches 0.07. Alongside the literature analysis represented by this keyword, the research it represents is more concerned with the application of aesthetic experience in design

aesthetics courses offered in various types of universities and the resulting educational reforms. In summary, the introduction of theories related to aesthetic experience has enriched the dimensions of aesthetic research in China's field of art and design, particularly in product design, packaging design, and design aesthetics. It also provides aesthetic value references for research related to design education and experience design in China.

Data from English literature indicate that the keywords 'aesthetic experience' and 'perception' have relatively high centrality, at 0.27 and 0.11 respectively. They are followed by 'appreciation' and 'experience,' with centralities of 0.09 and 0.08 respectively. Reviewing the literature reveals that these keywords all relate to interactive behaviors with art during the aesthetic experience process, such as attitudes, perceptions, experiences, or attention behaviors observed during the viewing of art[7]. It is worth mentioning that the subsequent keyword 'model' also has a relatively high centrality, reaching 0.06. Combined with the frequency analysis, this further indicates that hypotheses and discussions about theoretical models in foreign AE-D research have significant influence and importance within the entire research field.

Table 2. Information on the top 10 keywords in terms of research frequency in Chinese and English literature(Self-drawn by the author)

No.	Frequency	Centrality	Year	Chinese keywords	No.	Frequency	Centrality	Year	English keywords
1	70	0.79	2002	aesthetic experience	1	29	0.27	2010	aesthetic experience
2	17	0.19	2006	aesthetics	2	14	0.09	2017	appreciation
3	11	0.1	2007	product design	3	9	0.06	2013	model
4	7	0.08	2005	packaging design	4	8	0.05	2011	emotion
5	7	0.07	2005	experience	5	7	0.04	2013	design
6	5	0.04	2013	emotion	6	7	0.08	2015	experience
7	5	0.07	2010	design aesthetics	7	7	0.05	2006	judgment
8	5	0.07	2005	experience economy	8	7	0.02	2016	art
9	4	0.02	2018	aesthetic ability	9	7	0.11	2006	perception
10	4	0.05	2002	art design	10	6	0.05	2010	response

4.2 Keyword Cluster Analysis of Chinese Literature

In CiteSpace, keyword clustering relies on the interrelationships among keywords across documents in the research field, forming clusters. This literature data is clustered

using the Log-Likelihood Ratio (LLR) algorithm. The keywords from the Chinese literature form seven clustered networks, resulting in a keyword clustering information map for AE-D Chinese literature, as seen in Figure 5. The cluster numbers are ordered from 0 to 6; the smaller the number, the more keywords are contained within the cluster. Clusters are formed from closely related words, with closer cluster distances indicating stronger keyword relationships. Figure 5 shows a clustering modularity index Q value of 0.7759 and a silhouette index S value of 0.9673, suggesting significant and efficient clustering. Based on the clustered model keywords (see Table 3), the seven clusters can be categorized into three related research directions: design aesthetics and aesthetics, applied design, and experience design and economics.

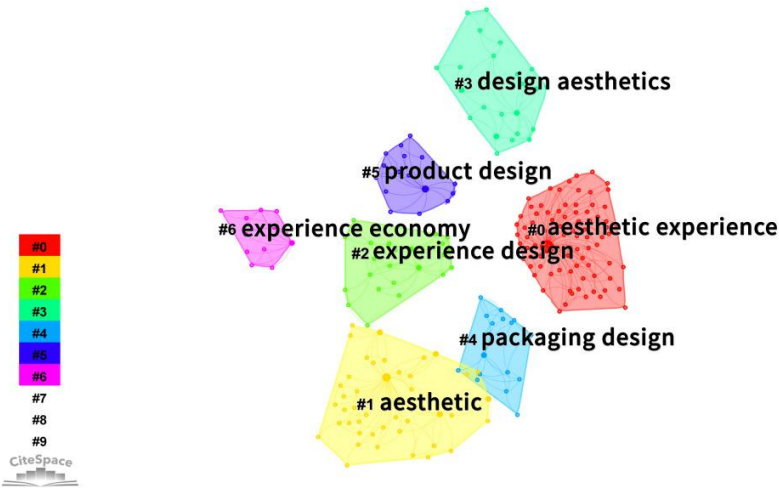


Fig. 5. AE-D Chinese Literature Keyword Clustering Information Mapping (Self-drawn by the author)

Design Aesthetics and Aesthetics

Clusters 0, 1, and 3 have extracted keywords summarized as aesthetic experience, aesthetics, wearable sensors, public art, environmental emotional perception, art, emotion, design aesthetics, and education, indicating that research related to aesthetic experience is closely linked to living environments, emotional experiences, and design education. An analysis of the related literature reveals that such research first appeared in aesthetic studies related to art and design education[8,9], such as exploring the distinctive operation of art and design programs in general universities and aesthetic experiences in the design creation process from the perspective of standardizing art design education management and educational reforms. Some scholars have specifically targeted this research on individual design courses, examining the aesthetic experience involving the five senses (sight, hearing, smell, taste, touch), and proposing innovative ideas for content, methods, and assessment in design aesthetics courses[10]. Research on aesthetic experience has expanded into human living environments and public art

design. Initially, scholars argued that a common mistake in public art was overemphasizing form at the expense of content and emotion. They advocated for a deeper appreciation of public art's artistic value through aesthetic experience[11]. Research has also been applied to landscape design, interpreting industrial tourism experiences through aesthetic perspectives and suggesting experiential design strategies for tourism-focused industrial parks[12]; Advances in physiological signal measurement have deepened studies on aesthetic experiences in human environments. For example, a study validated using wearable biosensors to assess real-time emotional responses to landscapes[13]; another study also conducted experiments in real urban settings to confirm the feasibility of using wearable devices to gather physiological feedback data for assessing the impact of lighting environments on emotions[14].

Applied Design

Clusters 4 and 5 extracted keywords mainly include packaging design, design, humanization, needs, product design, aesthetic characteristics, materials, and design aesthetics. These keywords show that domestic design research on aesthetic experience mainly focuses on applied design. Earlier studies begin with aesthetic experience theories, using various perspectives to emphasize the importance of incorporating affinity in modern packaging design[15]. There are also analyses from the perspectives of materials, form, function[16], overall visual perception, and emotional responses[17], discussing the unique aesthetic experience brought by the texture[16] and mood[17] in packaging design, thereby achieving the effects of shaping product brand image and generating a sense of belonging and immersion. Li Dongjin previously suggested that in product design, aesthetic experience influences perceptions of product performance, evaluations, and purchase intentions through spillover, contagion, and contrast effects[18]. Scholars have summarized previous research identifying factors that influence consumer aesthetic experiences in product design, such as graphics, structure, product novelty, and individual design acumen[19]. Moreover, excellent aesthetic experiences brought by commercial products positively influence consumer purchasing decisions[19,20] and expectations of high product performance[20].

Experience Design and Economy

Clusters 2 and 6 extracted keywords mainly include experience design, art design, patterns, integration, tangible interfaces, experience economy, historical industry types, and farm stays. These keywords reveal that domestic design research increasingly focuses on experience design and user experience. The rise of the experience design concept signifies a shift from standardized to humanized design, moving from a product-centric to a consumer experience-centric approach, and from prioritizing functionality and economy to emphasizing experiential qualities[21]. The scope of design research in this area is broad, for example, starting from the perspective of improving audience aesthetic experience, exploring physical interface design strategies in interactive devices across different experiential stages, and ultimately summarizing three design strategies: creating informational cues, introducing appropriate metaphors, and eliminating interaction barriers[22]. There is also research on landscape aesthetic experience,

introducing the concept of 'caring clues' and discussing how the application of caring clues can enhance people's aesthetic experience of ecological and healthy landscapes[23].

Table 3. Research Keyword Clustering Information for Chinese Literature (Self-drawn by the author)

NO.	Amount	Year	Label (LLR)
0	77	2017	Aesthetic experience(11.16, 0.001); Aesthetics(5.58, 0.05); Wearable Sensors(4.54, 0.05);Public art(4.54, 0.05); Environmental emotional feeling(4.54, 0.05)
1	45	2014	Aesthetics(27.08, 1.0E-4);Aesthetic experience(11.12, 0.001); Art(7.48, 0.01);Emotion(7.48, 0.01); fashion design(3.71, 0.1)
2	23	2014	Experience design(10.37, 0.005); Art design(10.37, 0.005); Paradigm(5.13, 0.05);incorporation(5.13, 0.05); physical interface(5.13, 0.05)
3	23	2015	Design aesthetics(15.37, 1.0E-4);Five senses(10.14, 0.005); Experiential(10.14, 0.005);Pedagogical(5.02, 0.05); Reform of teaching(5.02, 0.05)
4	16	2009	Packaging Design(11.14, 0.001);Design(5.84, 0.05); Humanization (5.5, 0.05); Demand(5.5, 0.05); Packaging(5.5, 0.05)
5	15	2015	Product design(17.9, 1.0E-4);Esthetic quality(5.8, 0.05); Materials(5.8, 0.05);Design aesthetic(5.8, 0.05);n270(5.8, 0.05)
6	11	2017	Experience economy(13.39, 0.001);History of Industry(6.57, 0.05);Industrial heritage revitalization(6.57, 0.05); Homestead (6.57, 0.05); Roof(6.57, 0.05)

4.3 Keyword Cluster Analysis of English Literature

The keywords from the English literature formed ten clusters, creating a keyword clustering information map for AE-D English literature, as shown in Figure 6. In Figure 6, the clustering modularity index Q value is 0.6952 and the silhouette index S value is 0.874, showing significant and efficient clustering. The ten clusters, detailed in Table 4, are divided into three research directions: aesthetic models, architectural aesthetics, and interactive aesthetics.

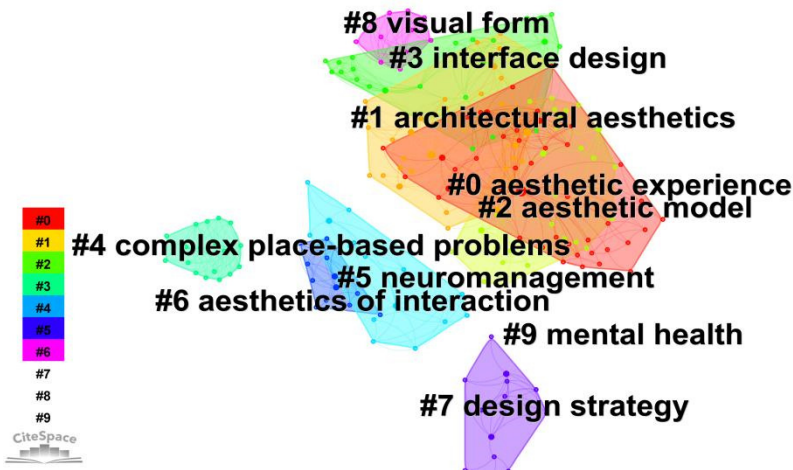


Fig. 6. AE-D English Literature Keyword Clustering Information Mapping(Self-drawn by the author)

Aesthetic Models

Clusters 0, 2, and 9 extracted keywords are summarized as aesthetic experience, aesthetics, food aesthetics, behavioral models, aesthetic preferences, aesthetic models, semantics, design aesthetics, mental health, fMRI, happiness, cortisol, etc. This indicates that foreign AE-D research closely relates to behavioral models, aesthetic models, and mental health. For example, an earlier study on web design tested and expanded an established aesthetic experience model to develop a new model for evaluating web page interactions[24]. Subsequently, other scholars have proposed a four-stage aesthetic experience model for everyday design products through experimental research[25]. This research later expanded into landscape design, finding that 'astonishing factors' make people appreciate colorful flowers in public spaces. Studies noted that when colorful flower coverage exceeds a critical threshold (27%), it leads to higher aesthetic preferences[26]. Foreign AE-D research, linked with psychology and neuroscience, increasingly incorporates interdisciplinary methods to study how the brain's sensory, cognitive, and emotional processes influence art and beauty appreciation. It often connects depression symptoms with dysfunctions in various neural systems, including the emotional, reward, and default mode networks. Research related to the neuroaesthetics model[27] suggests that these systems make critical contributions to aesthetic experience, thereby predicting atypical aesthetic orientations in depression. Other studies have demonstrated specific negative aesthetic biases towards faces in depressed patients through electroencephalogram monitoring experiments [28].

Architectural Aesthetics

Clusters 1, 4, and 5 extracted keywords summarized as architectural aesthetics, visual aesthetics, architectural facade design, facades, advertising, place-based complex

issues, urbanization, biodiversity conservation, globalization, landscape sustainability, neuro-management, event-related potentials, architecture, neuro-industrial engineering, environmental psychology, etc. From this, it can be seen that foreign AE-D research in its development is also greatly related to architectural design, urban landscapes, and environmental psychology. Architecture can also be viewed as a form of artistic creation and design, with many studies related to aesthetic evaluation within architectural aesthetics. For example, studies have shown that people prefer cultural and museum buildings with architectural exterior designs that are easy to understand due to a higher level of understanding of the design[29]. Also, people tend to prefer buildings with abstract descriptions over concrete ones[29]. Other studies have also investigated how natural scenery in hotel architecture affects people's aesthetic experience[30]. With the maturation of physiological measurement technologies, research methods for architectural aesthetic experiences have been further optimized. For example, eye-tracking technology has been used to examine the differences in visual preferences, exploratory behaviors, and cognitive experiences caused by architectural facades among observers with different professional backgrounds, thereby demonstrating the impact of facades on the aesthetic experience of architectural design[31]. Additionally, research using event-related potentials has explored the implicit aesthetic processing of different buildings, finding that the aesthetic processing of architecture involves positive emotional responses and novelty perceptions.

Interactive Aesthetics

Clusters 3, 6, 7, and 8 extracted keywords summarized as interface design, usability, qualitative research, websites, hedonic quality, interaction aesthetics, tourism design, artistic experience, authenticity preferences, design strategies, 3D environments, multimodal cognition, customer experience, virtual reality, visual experience, etc. This indicates that foreign AE-D research has shifted towards broader areas such as interaction design, user experience, and interface design. An important concept within this realm, 'interaction aesthetics' is defined as: the foundational emotional activities that occur in our interactions with artificial objects, which can trigger branches of other processes (such as meaning creation, symbolic chains, complex emotions, expectations, etc.)[32]. Ioannis Xenakis and others discussed this concept earlier, suggesting that participants evaluate interaction potential through aesthetic experience to shape appropriate design performances. Designers integrate interaction potential as a capacity into artifacts to confirm the dynamic premises of interaction and reduce design uncertainty[32]. Other related studies also explore the impact of digital device interfaces on aesthetic experiences. Meanwhile, aesthetic experience has also developed in the field of user experience research; for example, higher quality AR in museums can enhance immersion, while aesthetic experience can enhance the reality escape experience in AR environments. Moreover, the aesthetic experience during museum visits contributes to the perception of usability.

Table 4. Research Keyword Clustering Information for English Literature(Self-drawn by the author)

NO.	Amount	Year	Label (LLR)
0	45	2017	aesthetic experience (6.35, 0.05); aesthetics (6.28, 0.05); food aesthetics (2.68, 0.5); pedestrian behavior model (2.68, 0.5); aesthetic preference (2.68, 0.5)
1	34	2018	architectural aesthetics (6.8, 0.01); visual aesthetics (3.38, 0.1); architectural appearance design (3.38, 0.1); facade (3.38, 0.1); advertising (3.38, 0.1)
2	28	2015	aesthetic model (4.38, 0.05); semantics (4.38, 0.05); design aesthetics (4.38, 0.05); popular illustration (4.38, 0.05); classroom design (4.38, 0.05)
3	23	2013	interface design (9.78, 0.005); usability (4.84, 0.05); qualitative research (4.84, 0.05); web site (4.84, 0.05); hedonic quality (4.84, 0.05)
4	18	2010	complex place-based problems (6.28, 0.05); urbanization (6.28, 0.05); biodiversity conservation (6.28, 0.05); globalization (6.28, 0.05); landscape sustainability (6.28, 0.05)
5	16	2016	neuromanagement (9.78, 0.005); event-related potentials (6.13, 0.05); architecture (6.13, 0.05); neuroindustrial-engineering (4.84, 0.05); environmental psychology (4.84, 0.05)
6	13	2017	aesthetics of interaction (11, 0.001); tourism design (5.43, 0.05); art experience (5.43, 0.05); authenticity liking (5.43, 0.05); visitor-employed photography (vep) (5.43, 0.05)
7	13	2017	design strategy (6.08, 0.05); 3d environments (6.08, 0.05); multimodal cognition (6.08, 0.05); customer experience (6.08, 0.05); virtual reality (6.08, 0.05)
8	11	2006	visual form (7.78, 0.01); motivational issues (7.78, 0.01); visual experience (7.78, 0.01); design space (7.78, 0.01); animated pedagogical agents (7.78, 0.01)
9	9	2012	mental health (5.43, 0.05); fmri (5.43, 0.05); wellbeing (5.43, 0.05); heritage (5.43, 0.05); cortisol (5.43, 0.05)

4.4 Keyword Emergence Analysis

Keyword emergence analysis identifies shifts in research hotspots over time and pin-points potential trends and cutting-edge research (see Figures 7 and 8). "Begin" and "end" mark the start and finish of the keyword's emergence, while "strength" indicates its intensity, with higher intensity suggesting greater influence.

Setting the emergence coefficient $y [0,1] = 0.4$, nine prominent terms appear in the Chinese literature, with early research hotspots sustaining over time, while recent research hotspots have gradually shortened in duration. From 2005 to 2013, domestic AE-D research gradually shifted from application-oriented design such as packaging and product design to human habitat environment design represented by spatial design, landscape design, and interactive installations. Subsequently, research unfolded on aesthetics (2010 to 2013), exhibition design (2015 to 2017), emotions (2016 to 2017), aesthetic competence (2018 to 2022), the experience economy (2020 to 2021), and museums (2022 to 2024). Reviewing related literature reveals that since 2013, many studies on aesthetic experiences in human environments have shifted their focus from more

traditional areas such as landscape design, urban squares, commercial spaces, and interior design to more modern and diverse directions, including exhibition design, interactive installations, experiential gardens, experiential landscapes, museums, forest parks, and subway station spaces. Concurrently, iterative and innovative research methods have kept the content of research up-to-date. From 2020 to 2023, domestic AE-D research methods gradually shifted from relying mainly on surveys, qualitative research, and ethnographic studies to empirical research and physiological measurement techniques, addressing the previous lack of evidence in design research.

Twelve emerging terms appear in the English literature, which, unlike the Chinese literature, generally start later and are more concentrated, with the earliest emergence beginning in 2013. From 2013 to 2017, international AE-D research gradually shifted from the field of product design to AE-D model research, subsequently initiating studies on Art (2016 to 2020), Appearance (2016 to 2020), Appreciation (2017 to 2021), Response (2017 to 2019), Model (2019 to 2021), Brain (2021 to 2023), Pleasure (2021 to 2023), Experience (2021 to 2023), Attention (2021 to 2023), and Appraisal (2021 to 2023). Reviewing related literature reveals that from 2007 to 2012, international AE-D research had a low volume of publications, thus not generating a significant number of keywords. During this period, the main focus of research was on more conventional areas such as product design, experience design, and landscape design. From 2013 to 2017, many studies in international AE-D research on product design and interaction design shifted towards more cutting-edge directions, including interaction aesthetics, electronic aesthetics, and multisensory interaction. These avant-garde research directions more broadly correspond to the ways in which aesthetic experiences are generated, including appreciation, experience, judgment, and perception. After 2017, international AE-D related research more prominently reflected in the exploration and proposal of theoretical models, with physiological measurement technologies increasingly being used in related studies.

Top 9 Keywords with the Strongest Citation Bursts



Fig. 7. AE-D keyword emergence mapping of Chinese literature(Self-drawn by the author)

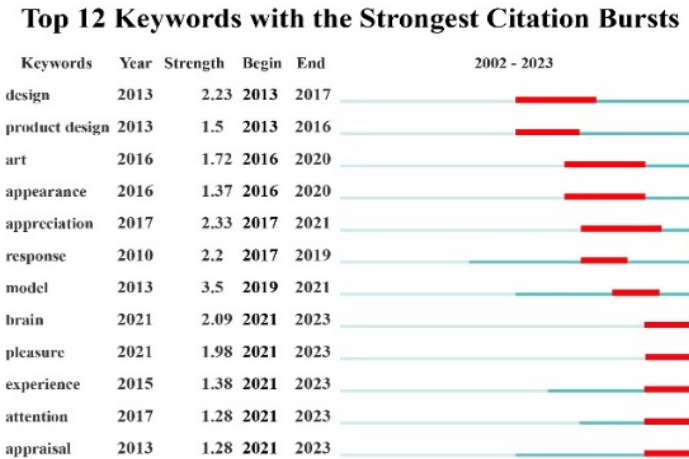


Fig. 8. AE-D keyword emergence mapping of English literature (Self-drawn by the author)

5 Results and Discussion

5.1 Research Status

Based on Chinese literature from the CNKI database and English literature from the WOS database over the past nearly 20 years, this article utilizes CiteSpace information visualization software to perform a visual analysis of the volume of literature on aesthetic experience research in the design field both domestically and internationally, the distribution of journals carrying these articles, research institutions, research hotspots, and research outcomes, leading to the following conclusions.

In terms of annual publication volume statistics, the total volume of domestic and international literature is relatively low (203 and 169 papers, respectively), but generally shows a rising trend. Both domestic and international academic communities experienced explosive growth in 2010 and 2016, respectively, and then tended to stabilize in 2019. This indicates that related research is in a phase of steady progress, and the academic community is showing interest in various research fields. In terms of journal distribution, domestic journals that publish AE-D research are mainly concentrated in art and design publications and industrial engineering journals, such as *Packaging Engineering*, *Mass Culture and Art*, *Design*, etc. Internationally, journals that publish AE-D research are primarily focused on art and design publications and psychology journals, such as *International Journal of Design*, *Design Journal*, *Frontiers in Psychology*, etc. In the international academic community, the institution currently making the largest contribution to this research is Delft University of Technology in the Netherlands, but the gap in publication volume with other institutions is small, indicating significant potential for future research. Domestically, the institutions making significant contributions to this research are mostly design schools or fine arts colleges within comprehensive universities, with the School of Design at Jiangnan University currently having

the highest publication volume. Overall, both domestically and internationally, the institutions contributing significantly to this research are predominantly universities, with only one research institution among the top ten in publication volume, namely the Max Planck Institute for Empirical Aesthetics in Germany.

5.2 Domestic and International Development Trends

Cluster analysis shows that domestic and international AE-D research have different focuses. Both started early and developed gradually, covering a wide range of topics. Overall, the research in both areas can be divided into three phases: (1) Foundational phase: Towards the end of the last century, aesthetic theories related to aesthetic experience gradually entered China from abroad. In 2002, domestic AE-D research first appeared in studies related to packaging design, while simultaneously expanding into product design and furniture design. In 2006, international AE-D research first appeared in studies related to animation teaching design. Subsequent research in both domains has seen development in product design, landscape design, interaction design, and exhibition design, among others. (2) Development Phase: Around 2010, as the study of aesthetic experience theories advanced both domestically and internationally, scholars in related fields in China began comprehensive research in applied design areas such as exhibition design, experience design, book design, and interaction design. During this phase, Chinese scholars with backgrounds in design and education explored design education issues, with many studies concentrating on integrating aesthetic experience into university design aesthetics courses and related educational reforms. International AE-D research rapidly advanced from 2016, introducing numerous cutting-edge topics like product aesthetics, user experience, multisensory interaction environments, and architectural aesthetics. The research methods also showed a trend towards diversification and gradually leaned towards empirical research methods and physiological measurement techniques. At the same time, during this phase, the international academic community produced several aesthetic experience models for product aesthetics and user experience. (3) Maturity Phase: Since 2015, with the iteration of design aesthetics theories, domestic AE-D research has gradually focused on human habitat environment design studies, such as museums, home environments, rural landscapes, and public spaces. There has also been a shift in some research towards more cutting-edge arts and design mediums, such as service design, game art design, and digital cultural and creative design. During the same period, a number of scholars specializing in art philosophy and art theory in China have also emerged, conducting in-depth discussions on AE-D research issues from the perspectives of design aesthetics, art philosophy, and aesthetic psychology. International AE-D research entered a stable phase beginning in 2019.

5.3 Research Outlook

Comparative analysis of nearly 20 years of domestic and international literature shows that China has made significant advances in applying aesthetic experience in design. Research and development started slightly earlier and has shown certain advantages in

outcomes compared to the international academic community. In terms of the content of aesthetic experience research in the design field, both domestic and international academic communities show consistent trends. Initially, both domestic and international AE-D research began with applied design fields such as product design, packaging design, and landscape design, before gradually extending to studies in architecture and human habitat environments, and finally evolving towards digital design directions like user experience, interaction design, and game design. However, from the perspective of AE-D theoretical research, there is a significant gap between domestic and international academia, specifically reflected in the lack of research and discussion on AE-D theoretical models in China. Due to the regional differences in cultural backgrounds and aesthetic education, the study of various AE-D theoretical models suitable for the domestic environment holds academic value and practical significance. Personally, I believe that future domestic AE-D research could benefit from a deeper exploration of this aspect.

6 Conclusions

This article, through statistical analysis of domestic and international literature on aesthetic experience research in the design field, outlines the current state of development, research hotspots, and trends both domestically and internationally. However, there are some limitations: Firstly, the domestic literature obtained includes all academic journal articles in the design field available on CNKI, including those in general publications, resulting in varying quality of literature. Secondly, a number of master's and doctoral theses on aesthetic experience in the design field were not included in this effective literature set. Despite these limitations, this study has constructed a knowledge system combining aesthetic experience with design research, providing researchers with valuable references for understanding the development of this research direction.

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