ASIA MARKETING JOURNAL

ASIA MARKETING JOURNAL

Volume 26 | Issue 1 Article 5

April 2024

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Hansol Choi
Ewha Womans University, Seoul, South Korea

Hyemi Lee
Ewha Womans University, Seoul, South Korea, hyemilee@ewha.ac.kr

Recommended Citation

Choi, Hansol and Lee, Hyemi (2024) "Literature Review of Extended Reality Research in Consumer Experience: Insight From Semantic Network Analysis and Topic Modeling," *Asia Marketing Journal*: Vol. 26 : Iss. 1 , Article 5.
Available at: https://doi.org/10.53728/2765-6500.1627

Literature Review of Extended Reality Research in Consumer Experience: Insight From Semantic Network Analysis and Topic Modeling☆

Hansol Choi, Hyemi Lee *

Ewha Womans University, Seoul, South Korea

Abstract

Extended Reality (XR) technology, the umbrella term covering hyper-realistic technologies, is known to enhance consumer experience and is therefore developing rapidly and being utilized across various industries. Growing studies have examined XR technology and consumer experience; however, the literature has failed to fully explore hyper-realistic technology through a holistic perspective. To fill this gap, we analyzed 720 Korean and international articles through semantic network analysis and topic modeling and identified the literature on XR research in consumer experience. As a result, we extracted six main topics: "Tourism," "Buying Behavior," "XR Technology Acceptance," "Virtual Space," "Game," and "XR Environment." The results provide comprehensive insight on XR technology in consumer experience, whereas the literature is bounded on the production side as revealing a lack of academic discourse on consumer rights and responsibilities. Research reflecting the consumer welfare perspective is, therefore, recommended for future studies.

Keywords: Extended reality (XR), Virtual reality (VR), Augmented reality (AR), Consumer experience, LDA algorithm

1. Introduction

As an advanced computing platform, extended reality (XR) is becoming popular in business and has caused notable changes in various industries (Chuah 2018). XR refers to hyper-realistic technologies encompassing virtual reality (VR), augmented reality (AR), and mixed reality (MR), which allow consumers to experience and interact with both virtual and physical content in a highly immersive and interactive environment (Bekele et al. 2018; Fast-Berglund, Gong, and Li 2018). An example of an XR technology-based product is Oculus Rift, the first VR device for consumers (The New York Times 2016). The emergence of Pokémon GO, an AR-based game, created a worldwide sensation (Tang 2017). In addition, the COVID-19 outbreak in 2020 has further accelerated the spread of XR because of the demand for non-face-to-face interaction across industries. In 2020, AR and VR spending, including devices and services worldwide, totaled $12 billion, an increase of 50% from 2019 (Forbes 2021).

XR has gained attention in business because it is known to significantly contribute to consumer involvement in products, brands, and corporations. To manage relationships and interactions with current and potential consumers, corporations used to emphasize customer relationship management (CRM), which manages customers by focusing on the point of purchase (Schmitt 2010). Recently, the attention of corporates has shifted to customer experience management (CEM), which focuses on every interaction and touch point with consumers throughout processes, including the decision-making, buying, and using stages (Schmitt 2010). CEM refers to the process of managing customers by interacting with them not only at the time of purchase but also before and after the purchase, so customers can have a memorable experience with a company or product (Schmitt 2010). The importance of experience was also emphasized in the 2020 CES keynote speech by Samsung Electronics,

☆ This article is a developed version of a "Study1" in the first author's doctoral dissertation submitted to Ewha Womans University.

Received 10 September 2023; accepted 13 March 2024.
Available online 8 April 2024

* Corresponding author.
E-mail address: hyemilee@ewha.ac.kr (H. Lee).

https://doi.org/10.53728/2765-6500.1627

such that the next 10 years are referred to as the "Age of Experience" (Samsung Newsroom 2020).

XR is known to enhance the consumer experience by providing complete immersion and a feeling of enrichment in both physical and virtual environments (Bekele et al. 2018; Jung et al. 2023). In this sense, XR is becoming increasingly prevalent in business and has led to significant shifts across various domains and industries (Chuah 2018). That is, XR technology plays a crucial role in improving the experience of consumers in this era of experience.

The practical adoption and utilization of XR technology in enhancing consumer experience has advanced rapidly in the international market; however, scholarly discussions on how XR technology can contribute to the consumer experience remain fragmented and provide limited insights. For example, studies have primarily focused on the individual technology level of XR (Chiang, Shang, and Qiao 2022; Hoffmann and Mai 2022; Riar et al. 2022) or placed a narrow emphasis on specific utilizations such as tourism (Akhtar et al. 2021; Sung 2022). This implies that there is a significant gap in academic literature. To address this gap, we attempt to provide a broad overview of significant issues within the XR literature in the consumer experience domain, encompassing both Korean and international journals for a more inclusive analysis.

South Korea is one of the leading countries in the global XR market (Statista 2023). According to Statista (2023), the B2C revenue from AR and VR in 2024 is predicted to be 879.2 million USD, and it is also expected to increase annually by 10.5% on average by 2028. This suggests that the potential of the XR market in Korea is promising, so it is necessary to comprehensively review research discussions by integrating South Korean literature with international literature.

For the research purpose, we aimed to conduct a literature review via the semantic network analysis and topic modeling methods. We used the semantic network analysis method to compensate for the shortcomings of traditional content analysis. Content analysis has widely been used to classify contents and derive meanings, but this method can contain the subjective bias of the coder, and information can be lost during the manual coding process (Danowski 1993). In addition, topic modeling is used in various studies as a method to effectively capture issues by deriving hidden topics (Jiang, Qiang, and Lin 2016; Lee, Kim, and Han 2022). Using these methods, we strive to provide a holistic view of XR technology in consumer experience while minimizing subjective bias.

To comprehensively identify the literature on XR technology in consumer experience, we formulated research questions to unveil study characteristics, keywords, and current issues. The specific research questions are as follows:

Research question: What is the research discourse on XR in consumer experience?

1.1. What are the general characteristics of the selected studies?
1.2. What keywords were used in the studies on XR in consumer experience?
1.3. What is the semantic network structure of the area of XR in consumer experience?
1.4. What are the main research topics regarding XR in consumer experience?

2. Conceptual background

2.1. XR technology in consumer experience

Fast-Berglund, Gong, and Li (2018) defined extended reality (XR) as "all real-and-virtual combined environments and human-machine interactions generated by computer technology and wearables" (p. 32), and it encompasses VR, AR, and MR. This XR is characterized by providing immersive experiences that differentiate themselves from physical reality (Margetis et al. 2021) and is increasingly being adopted in industries such as sports, gaming, health care, agriculture, and disaster management (Qamar, Anwar, and Afzal 2023). The need for XR technology has been particularly emphasized since the COVID-19 pandemic as an alternative to face-to-face interactions (Cho, Yun, and Ko 2023).

As a subtechnology of XR, VR is defined as "a real or simulated environment in which a perceiver experiences telepresence" (Steuer 1992 p. 76–77). The main characteristics of VR include presence, interactivity, and immersion (Walsh and Pawlowski 2002). Meanwhile, AR is understood as part of the concept of the "virtuality continuum" that Milgram and Kishino (1994) proposed. Milgram and Kishino's virtuality continuum places real and virtual environments on opposite sides, and the authors further explained that AR is a technology that is more biased toward the real world among real and virtual environments. Azuma (1997) argued that AR is the technology that integrates virtual objects into the user's physical space and supplements reality rather than replacing it. AR is characterized by combining the real and the virtual, interacting in real time, and implementing in three dimensions (Azuma 1997).

Understanding the basic concepts of these technologies is important for exploring discussions on XR in consumer experience. In particular, because the scope of XR technology has expanded rapidly after the pandemic, consumers have become more familiar

with the technology and more commonly experience XR technology. Therefore, examining the issues of XR technology in consumer experiences can provide useful foundational information for future relevant studies.

The characteristics or functions of XR technology affect the consumer experience, which in turn has an impact on the consumer response. For example, "interaction" and "augmentation," which are attributes of XR technology, have a positive effect on the consumer experience (Hoffmann and Mai 2022). In addition, VR attributes such as "vividness," "novelty," "visual appeal," and "interactivity" have a positive effect on the consumer experience which is known to be then positively affect attitudes and behavioral intentions (Le, Chen, and Nguyen 2024). According to the results of these previous studies, XR technology can help enhance the consumer experience, which, in turn, affects the consumer response.

Meanwhile, in a limited number of studies researchers have reviewed previous studies using big data methods in research related to XR technology in consumer experience, and previous researchers have focused on specific areas or narrowed their scope to individual XR technologies. For example, Sung (2022) used Korean news data to compare changes in virtual tourism discourse before and after the COVID-19 pandemic. Similarly, Akhtar et al. (2021) focused on digital tourism after COVID-19 and conducted a systematic literature review on it. Moreover, Heller et al. (2023) analyzed the co-authorship of consumer behavior research focused on AR. Although these studies provide useful information by focusing on detailed technologies, they illuminate a need for a comprehensive and inclusive discussion on XR technology in consumer experience in the academic field. This means that a comprehensive study is needed to more broadly examine the current issues regarding XR technology in consumer experience, considering the expansion of the usage areas of XR technology.

2.2. *Semantic network analysis*

Social network analysis is a method used to identify the relationships among social entities as a network, with nodes that represent actors and links that show the connections between nodes (Wasserman and Faust 1994). Semantic network analysis is an extension of principles of social network analysis, which explores the relationships among words in textual data by assigning them as nodes (Doerfel 1998).

Compared to traditional content analysis, semantic network analysis has several advantages. Because content analysis depends on researcher judgement and ability, this method can cause a loss of information and coder bias during the categorization of contents (Danowski 1993). However, semantic network analysis can minimize coder bias and analyze objectively by preserving and using the original words (Danowski 1993).

To understand the role and position of words in the network structure, we use the "centrality" measure in semantic network analysis. Centrality is a key concept of social network analysis and is an indicator of the relative importance of notes within a network (Freeman 1979; Wasserman and Faust 1994).

Centrality can be measured with several indexes, such as degree centrality, closeness centrality, betweenness centrality (Wasserman and Faust 1994), and eigenvector centrality (Bonacich 1987). Degree centrality is an index that measures the extent to which a word is connected to another word within the network, and words that are more connected to another word are considered to be more central (Wasserman and Faust 1994). Closeness centrality indicates the degree of closeness of words to other keywords, and words that are closely placed to other words and can interact quickly are considered more central (Wasserman and Faust 1994). In this regard, centrality is inversely correlated with distance, meaning that the larger the total of the distances to other words, the lower the centrality (Wasserman and Faust 1994). Betweenness centrality assesses the degree to which a word mediates the relationship between other words, and words with high betweenness centrality are considered to have more control over the information flow (Wasserman and Faust 1994). In addition, eigenvector centrality is an index measured by evaluating the centrality of a word that is related to a certain word, and when the word is associated with a word that has high centrality, the value of eigenvector centrality rises (Bonacich 1987, 2007; Ruhnau 2000).

The analysis of centrality provides an understanding of the keywords within the network. In addition, it contributes to the structural understanding of the issues of XR technology in consumer experience by considering the relationships between words.

2.3. *Topic modeling*

This study adopted the Latent Dirichlet Allocation (LDA) algorithm, a popular topic modeling method, to identify the main topics across research. Blei, Ng, and Jordan (2003) developed the LDA method to classify topics based on the probability of occurrence of a particular set of words. It is based on the assumptions that documents include a mixture of hidden topics, and each topic has a distribution of words (Blei, Ng, and Jordan 2003). This method can be used to find hidden topics in observable documents (Blei 2012).

Table 1. Procedure for performing semantic network analysis and topic modeling.

Procedure		Details
Step 1	Searching for and collecting articles	Search and collect articles using keywords from the database (Web of Science, Research Information Sharing Service, Korean studies Information Service System)
Step 2	Screening and data integration	Select articles to be studied, and collect and integrate data on English titles, keywords, and abstracts of selected articles.
Step 3	Data preprocessing	Tokenize and extract nouns from the integrated data. Remove stopwords and unite words with the same meaning.
Step 4	Frequency analysis and selecting keywords	Term frequency (TF), term frequency-inverse document frequency (TF-IDF), and keyword selection.
Step 5	Creating a network	Create a network of keywords using the NetMiner program.
Step 6	Semantic network analysis	Centrality analysis (degree centrality, closeness centrality, betweenness centrality, eigenvector centrality) and visualization.
Step 7	Topic modeling	Latent Dirichlet allocation (LDA) algorithm.

3. Methodology

3.1. Procedure

The procedure of this study is illustrated in Table 1. First, we entered keywords related to XR in consumer experience into the database to search for and collect relevant articles. Second, we screened and classified the collected articles to select the articles for analysis. After selecting the final articles, we collected and integrated the English titles, keywords, and abstracts of the selected Korean and international studies. We extracted nouns from the integrated data using the NetMiner program and removed stopwords. After preprocessing the data, we analyzed the term frequency (TF) and term frequency-inverse document frequency (TF-IDF) using NetMiner. In addition, we created a network and identified relationships between keywords based on centrality value. Then, we used the LDA topic modeling algorithm to derive the main topics.

3.2. Searching and collecting data

We entered keywords into the database to identify and collect studies related to XR technology in consumer experience. We targeted research published between January 2016 and April 2023 because consumers have widely adopted VR and AR technologies since 2016, making it possible to identify the discourse on XR in consumer experience. In addition, we analyzed both international and Korean journals because Korea is recognized as a dynamic and promising hub for the market and research on XR technologies in terms of consumer experience. The scope of this quantitative study includes observational and experimental research on XR technologies in consumer experience among Korea Citation Index (KCI)-listed (candidate) journals and Social Science Citation Index (SSCI)-listed journals. KCI is the system that uses information from Korean journals, papers, and references to examine citation relationships across Korean journals (Korea Citation Index n.d.). Based on citation results, the KCI can be used to evaluate the quality of journals.

We employed several databases to compile research articles. We used the Web of Science database for international literature, the Research Information Sharing Service (RISS), and the Korean studies Information Service System (KISS) for Korean literature. We used combined keywords with the Boolean operators “OR” and “AND” to search for and gather relevant studies. We applied the string to search for title, abstract, and author keywords in the Web of Science and for all in KISS and RISS. The basic search string is as follows.

For the Web of Science:

(“extended reality” OR “virtual reality” OR “augmented reality” OR “mixed reality”) AND (“consumer experience” OR “customer experience” OR “user experience” OR “purchase intention” OR “satisfaction” OR “consumer (behavior OR behaviour)” OR “customer (behavior OR behaviour)” OR “experiential value”).

For the RISS and KISS:

(“extended reality” OR “확장현실” OR “virtual reality” OR “가상현실” OR “augmented reality” OR “증강현실” OR “mixed reality” OR “혼합현실”) AND (“고객” OR “소비자” OR “사용자”) AND (“경험” OR “체험” OR “만족” OR “구매” OR “의도” OR “행동” OR “경험가치”)[1].

[1] The translated version of Korean keywords into English is as follows: (“extended reality” OR “virtual reality” OR “augmented reality” OR “mixed reality”) AND (“customer” OR “consumer” OR “user”) AND (“experience” OR “satisfaction” OR “purchase” OR “intention” OR “behavior” OR “experiential value”).

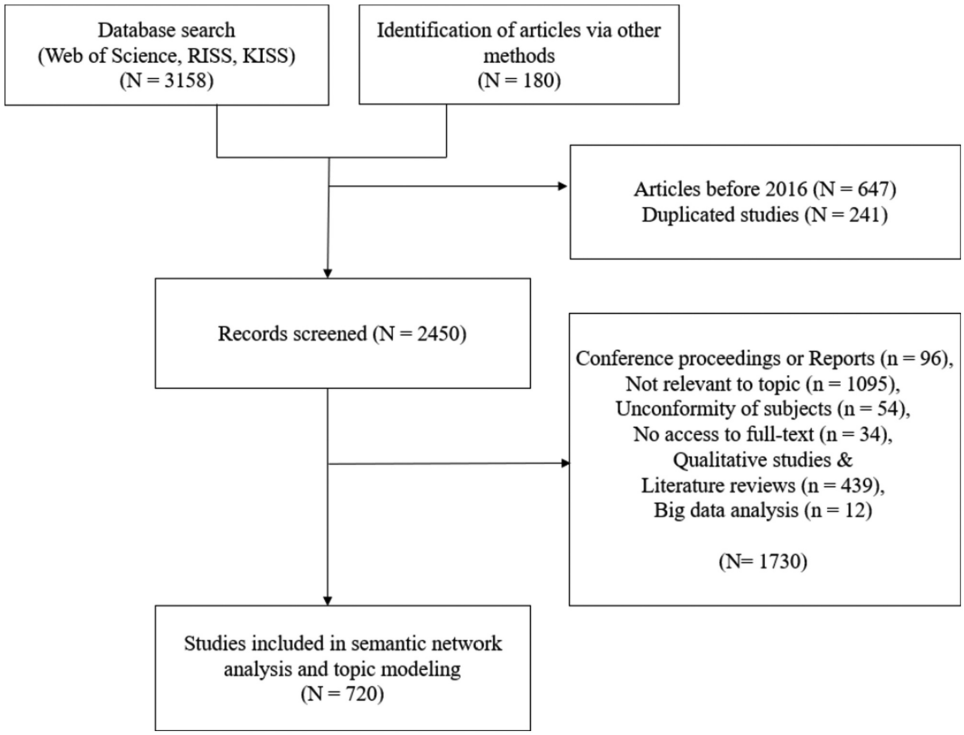

Fig. 1. PRISMA flowchart.

3.3. Data screening and integration

In this study, we selected studies in compliance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines as illustrated in Fig. 1. In the first step, we collected a total of 3,338 studies, including 3,158 studies using search strings from the database and 180 studies using references from previous studies. We screened the collected studies. We excluded 647 studies published prior to 2016 and 241 duplicate studies. In addition, we excluded 96 conference proceedings or reports and 1095 studies unrelated to the topic of this study. In the data screening phase, we carefully reviewed the title and abstract to select only studies that were related to XR technology in consumer experience. Furthermore, we excluded 54 articles because they were designed to educate specific professional groups, such as firefighters and physicians, or their subjects were not adult consumers who had experienced XR. Moreover, we excluded 34 studies with no full text, 439 qualitative studies including interviews and literature reviews, and 12 studies that performed big data analysis. A total of 720 studies to be included in the analysis were retained through this process. After selecting the final articles, we collected and integrated English titles, keywords, and abstracts of Korean and international studies.

3.4. Data preprocessing and selecting keywords

After the English titles, keywords, and abstracts of the chosen studies were merged, we converted all text to lowercase letters. From the integrated text data, we extracted nouns using NetMiner. Then, we removed stopwords and unified words with similar meanings. For example, we deleted words such as “purpose,” “background,” and “implications,” which are commonly used in abstracts, because they could distort the content, and we made all pluralized words, such as games and platforms, singular. In addition, we unified terms referring to the same concept. For example, we changed “Oculus” and “HTC Vive” to “HMD (Head-Mounted Display).”

The words were automatically separated during the tokenization process which was then reviewed to ensure the tokenization was done properly. The inappropriate tokenization was manually fixed. For example, the word, “COVID-19” was divided in “COVID” and “19”, which was not proper because “COVID-19” delivers the meaning of a global pandemic brought in 2019 when both words are together. In this sense, the separated words, “COVID” and “19” were combined manually to retain the original meaning. In this way, we combined several other cases of words and abbreviated them as one word such as “technology acceptance model” (TAM), “user experience” (UX), “virtual reality” (VR), and “augmented reality” (AR).

Table 2. Formula for the final keywords.

$n = (-1 + \sqrt{1 + 4D})/2$
n = the lowest frequency value among the words with high frequency
D = total number of words

Sources: Sun, Shaw, and Davis (1999)

We performed keyword selection to choose the final words to be used for semantic network analysis. There are two methods to measure the keyword frequency or importance of a keyword: term frequency (TF), which represents the simple frequency of a word, and term frequency-inverse document frequency (TF-IDF), which indicates the importance of a word. The formula for TF-IDF is the frequency of a particular term in a document (TF) multiplied by the inverse of the number of documents in which the particular word appears (IDF; Kim and Gil 2019). The value of TF-IDF increases when the frequency of a specific word in a specific document increases, and the number of documents containing the specific keyword in all documents decreases (Kim and Gil 2019). To determine the final number of keywords, we employed the formula that Sun, Shaw, and Davis (1999) used. The formula is shown in Table 2.

The number of extracted words was limited to words with a frequency of two or more, except for words with a frequency of one. Therefore, the number of words with a frequency of two or more was calculated to be 2,125, and the number of words to be ultimately analyzed was 46.

3.5. Data analysis

We calculated TF, TF-IDF, and centrality values for the selected 46 words. In addition, LDA was conducted as a topic modeling analysis technique. The topic coherence index is commonly used to determine the number of topics when performing LDA (Data Science Plus 2018). To decide the number of topics suitable for topic modeling, we used the coherence c_v and U_mass index that NetMiner provided. Hyperparameters alpha and beta were set to 0.1 and 0.01, respectively, based on previous studies (Naili, Chaibi, and Ghézala 2017; Zhao, Chen, and Zou 2015). When determining the number of topics, the researcher should also consider whether the topic content is semantically well classified along with the coherence index. As a result of examining the index, it was found that the U_mass value of Topic 6 was the highest, and Topic 8 was the lowest, whereas the c_v value of Topic 8 was the highest, and the value of Topic 5 was the lowest. We then performed LDA for each number of topics, and we selected six topics that were classified well and seemed to accurately represent the meaning. We compared the classified topics with the contents of the articles and named them by reflecting the context.

4. Results

4.1. Study characteristics

In this study, we aim to identify academic discussions and main topics on XR technology in consumer experience. For this purpose, we collected, selected, and analyzed 720 empirical studies. The results of examining these studies according to the publication year are presented in Fig. 2.

4.2. Term frequency (TF) and term frequency-inverse document frequency (TF-IDF) results

The values of TF and TF-IDF for the 46 keywords are presented in order as follows (see Table 3). In

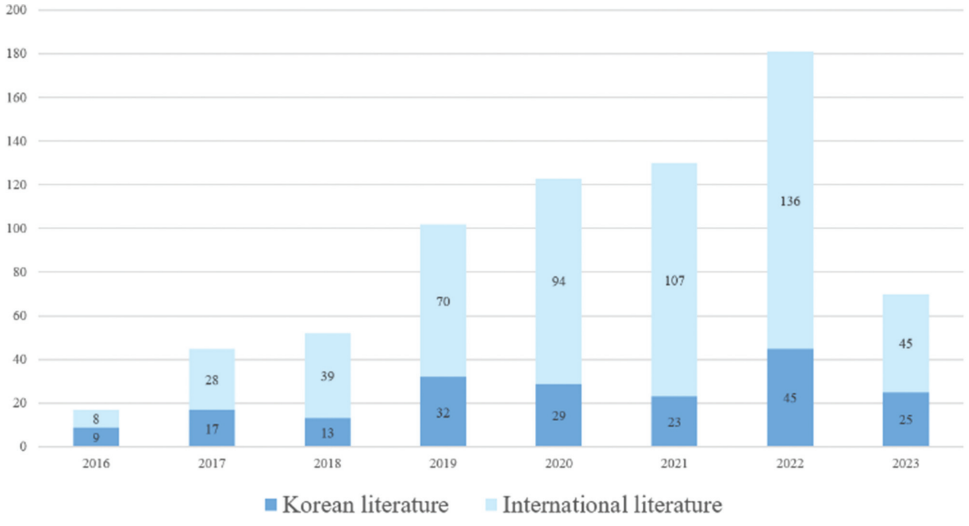

Fig. 2. Number of articles by publication year.

Table 3. TF and TF-IDF of top 46 keywords.

Ranking	Keywords	TF	Keywords	TF-IDF
1	VR	2,510	AR	1686.707
2	consumer	2,130	VR	1388.997
3	AR	2,088	game	1136.671
4	effect	1,483	brand	847.072
5	experience	1,285	tourism	830.417
6	technology	958	presence	815.524
7	application	608	product	786.797
8	game	532	application	707.196
9	presence	531	satisfaction	688.034
10	product	508	experience	662.374
11	environment	486	store	623.646
12	satisfaction	467	value	619.266
13	tourism	442	attitude	607.354
14	interactivity	420	environment	603.473
15	brand	403	content	590.744
16	attitude	379	interactivity	584.583
17	value	336	shopping	582.386
18	use	333	technology	575.150
19	intention	325	ads	569.189
20	shopping	319	sport	568.872
21	content	319	UX	561.927
22	UX	318	service	554.759
23	service	301	tourist	538.788
24	behavior	296	flow	537.659
25	usefulness	263	intention	525.332
26	perception	259	purchase intention	505.741
27	response	257	metaverse	503.727
28	store	256	system	479.971
29	marketing	254	usefulness	475.653
30	system	253	behavior	472.311
31	purchase intention	251	image	469.202
32	tourist	248	perception	464.066
33	flow	225	engagement	457.758
34	media	220	usage intention	456.094
35	enjoyment	213	use	443.632
36	image	205	media	436.509
37	immersion	200	enjoyment	435.937
38	engagement	200	marketing	432.830
39	ads	190	immersion	422.669
40	quality	187	effect	421.150
41	usage intention	186	response	420.865
42	sport	179	consumer	406.169
43	metaverse	165	quality	403.997
44	device	165	device	382.234
45	acceptance	160	video	375.167
46	video	157	acceptance	370.651

terms of TF, "VR," "consumer," "AR," "effect," "experience," "technology," "application," "game," "presence," and "product" were the most frequently occurring words. As a result of examination of TF-IDF, we found that "AR," "VR," "game," "brand," "tourism," "presence," "product," "application," "satisfaction," and "experience" appeared in order. This indicates that research on XR in consumer experience with uses in various fields such as games and tourism represents an important topic of discussion.

Furthermore, we derived the main attributes that consumers experience when using XR, such as "presence," "interactivity," "immersion," and "flow." In addition, we extracted words representing consumer response, such as "intention," "purchase intention," "behavior," "engagement," "usage intention," and "enjoyment." This suggests that these studies tend to focus mainly on the functional features of basic XR technology and consumer responses.

When comparing TF and TF-IDF, the top 46 words were the same. However, there were differences in the specific rankings. First, some words increased in relative importance in TF-IDF compared to those in TF. In terms of TF, "game," "tourism," "ads," "sport," and "metaverse" were ranked 8th, 13th, 39th, 42nd, and 43rd, respectively, but their relative importance

in TF-IDF increased to 3rd, 5th, 19th, 20th, and 27th, respectively. This suggests that XR technology in consumer experience is used in various domains, including games, tourism, and shopping.

In contrast, the relative importance of some keywords decreased. The words "use," "effect," and "consumer," which ranked 18th, 4th, and 2nd in the TF, ranked 35th, 40th, and 42nd, respectively, in the TF-IDF. This indicates that although the frequency of these words was high, the relative importance of these words decreased as they became more common across studies.

4.3. Centrality analysis results

We examined the centrality values of the top 46 words to understand the network structure (see Table 4). The subtechnologies of XR, "AR" and "VR," rank together as the highest in all centrality measures. This suggests that both subtechnologies of XR play an equally important role in the network structure. Considering all centrality, it can be understood that the technology words are the most connected to other words and closest to other words, and they are significant words in the network. This illustrates that

Table 4. Centrality analysis results.

No.	Degree centrality		Closeness centrality		Betweenness centrality		Eigenvector centrality	
1	AR	1.000	AR	1.000	AR	0.029	AR	0.213
2	VR	1.000	VR	1.000	VR	0.029	VR	0.213
3	effect	0.978	effect	0.978	effect	0.027	effect	0.210
4	consumer	0.956	consumer	0.957	consumer	0.025	experience	0.207
5	experience	0.956	experience	0.957	experience	0.025	consumer	0.206
6	presence	0.889	presence	0.900	presence	0.019	presence	0.197
7	application	0.822	application	0.849	application	0.016	technology	0.183
8	technology	0.822	technology	0.849	technology	0.016	application	0.183
9	perception	0.778	perception	0.818	perception	0.013	perception	0.175
10	attitude	0.756	attitude	0.804	attitude	0.012	attitude	0.171
11	brand	0.733	brand	0.789	satisfaction	0.011	brand	0.167
12	satisfaction	0.733	satisfaction	0.789	brand	0.011	satisfaction	0.166
13	intention	0.711	intention	0.776	interactivity	0.010	use	0.163
14	interactivity	0.711	interactivity	0.776	use	0.010	intention	0.163
15	use	0.711	use	0.776	intention	0.010	interactivity	0.162
16	game	0.689	game	0.763	marketing	0.009	game	0.157
17	content	0.644	content	0.738	game	0.009	product	0.150
18	marketing	0.644	marketing	0.738	content	0.008	content	0.147
19	product	0.644	product	0.738	media	0.008	immersion	0.146
20	UX	0.600	UX	0.714	product	0.007	marketing	0.144
21	enjoyment	0.600	enjoyment	0.714	enjoyment	0.007	engagement	0.142
22	immersion	0.600	immersion	0.714	service	0.007	UX	0.139
23	media	0.600	media	0.714	UX	0.006	enjoyment	0.138
24	engagement	0.578	engagement	0.703	system	0.005	media	0.136
25	flow	0.556	flow	0.692	flow	0.005	purchase intention	0.134
26	purchase intention	0.556	purchase intention	0.692	tourism	0.005	tourism	0.132
27	service	0.556	service	0.692	purchase intention	0.004	value	0.131
28	tourism	0.556	tourism	0.692	shopping	0.004	flow	0.131
29	shopping	0.533	shopping	0.682	immersion	0.004	shopping	0.128
30	value	0.533	value	0.682	tourist	0.004	service	0.125
31	tourist	0.511	tourist	0.672	engagement	0.004	usefulness	0.124
32	usefulness	0.511	usefulness	0.672	response	0.003	sport	0.121
33	environment	0.489	environment	0.662	value	0.003	tourist	0.121
34	sport	0.489	sport	0.662	environment	0.003	environment	0.118
35	system	0.489	system	0.662	usefulness	0.003	metaverse	0.116
36	metaverse	0.467	metaverse	0.652	image	0.003	quality	0.115
37	quality	0.467	quality	0.652	sport	0.003	usage intention	0.115
38	usage intention	0.467	usage intention	0.652	video	0.003	behavior	0.112
39	behavior	0.444	behavior	0.643	metaverse	0.003	system	0.111
40	response	0.444	response	0.643	quality	0.002	response	0.103
41	acceptance	0.422	acceptance	0.634	usage intention	0.002	acceptance	0.103
42	image	0.422	image	0.634	acceptance	0.002	ads	0.100
43	ads	0.400	ads	0.625	store	0.002	image	0.100
44	video	0.400	video	0.625	ads	0.001	video	0.094
45	store	0.378	store	0.616	behavior	0.001	store	0.092
46	device	0.333	device	0.600	device	0.001	device	0.085

technology plays a critical role in the research on XR technology in consumer experience.

Among the top keywords, “AR,” “VR,” “consumer,” “experience,” “satisfaction,” and “intention,” as well as the words “use,” “effect,” “presence,” “application,” “technology,” “perception,” “attitude,” and “brand” are in the top 15 among all centrality values. This indicates that words related to consumer experience and consumer response using XR technology are keywords that have a strong influence on the network.

Among the various areas where XR technology is used, the words “game,” “content,” and “marketing” are in the top 20. This means they are close to other words and appear to control information flow by mediating them, and they play a critical role in the network. It is clear that XR technology in consumer experience is discussed actively in various areas, such as “game,” “content,” and “marketing.”

4.4. *Semantic network analysis results*

The result of visualizing the semantic network of keywords is illustrated in Fig. 3. The size of each node reflects the frequency of the words, and the thickness of the lines indicates the number of co-occurrences of the words. The structure of the network is organized around the main technologies of AR and VR as well as around consumers and experience. In the graph, “consumer” is strongly connected to “experience,” “effect,” and consumer behavior or response variables such as “satisfaction,” “response,” “behavior,” and “engagement.” “AR” is strongly related to “effect,” “experience,” “application,” “technology,” and “game.” “VR” is strongly related to "effect," “experience,” “technology,” “tourism,” and “environment.” These results can be seen to reflect the academic discussion on the utilization and the consumer response to each technology.

4.5. *Topic modeling results*

The results of topic modeling are provided in Table 5 and Fig. 4. The keywords in Topic 1 are “VR,” “tourism,” “experience,” “effect,” “tourist,” “consumer,” “presence,” “technology,” “value,” and “satisfaction.” Studies on this topic have examined the effects of VR tourism on consumer value and satisfaction. For example, one study confirmed the effects of vividness and telepresence on consumer satisfaction with VR tourism (Zhu et al. 2023), and another study investigated the effects of VR tour videos on flow experience and flow experience on satisfaction (Liu and Huang 2023). As a result, virtual tourism is actively discussed as an alternative to the confusion in the tourism industry that COVID-19 caused. Therefore, Topic 1 is titled “Tourism.”

Topic 2 contains the keywords “AR,” “consumer,” “experience,” “effect,” “brand,” “product,” “shopping,” “technology,” “purchase intention,”

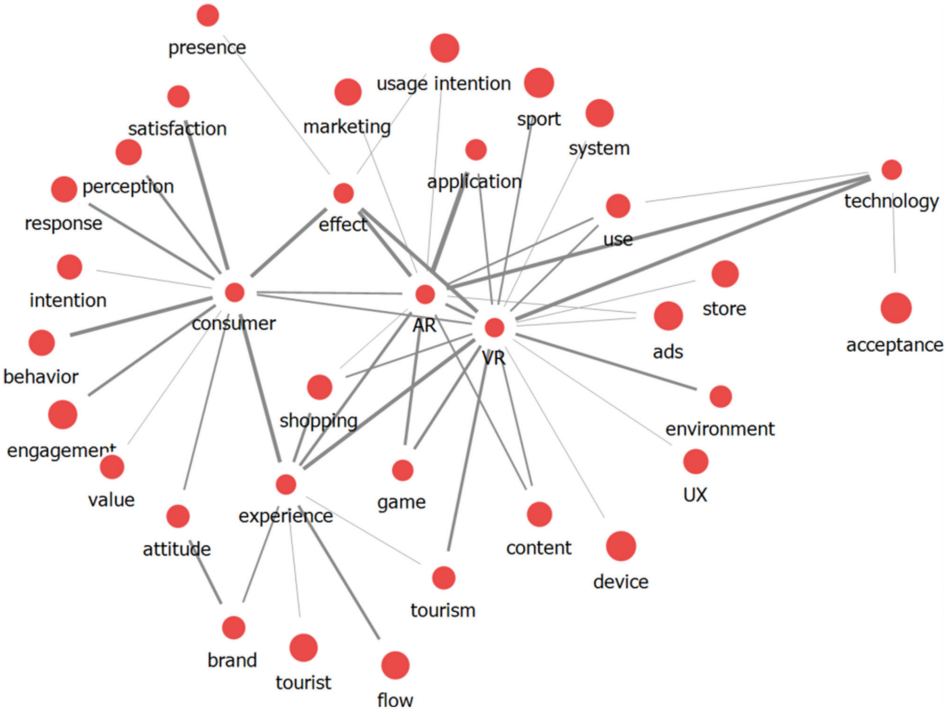

Fig. 3. Semantic network visualization.

Table 5. Topic modeling results.

Topic 1	Topic 2	Topic 3	Topic 4	Topic 5	Topic 6
18.19%	25.83%	15.14%	9.44%	10%	21.39%
Tourism	Buying behavior	XR technology acceptance	Virtual space	Game	XR environment
VR (0.123)	AR (0.103)	AR (0.109)	Consumer (0.051)	Game (0.111)	VR (0.122)
Tourism (0.058)	Consumer (0.093)	Technology (0.048)	VR (0.039)	Satisfaction (0.038)	Environment (0.026)
Experience (0.058)	Experience (0.047)	Application (0.047)	Metaverse (0.031)	Effect (0.034)	Presence (0.024)
Effect (0.044)	Effect (0.039)	Consumer (0.038)	Behavior (0.028)	Sport (0.031)	Experience (0.022)
Tourist (0.033)	Brand (0.038)	Effect (0.034)	Store (0.027)	Consumer (0.029)	Consumer (0.021)
Consumer (0.024)	Product (0.035)	Use (0.023)	Environment (0.027)	Flow (0.022)	UX (0.02)
Presence (0.019)	Shopping (0.027)	Usage intention (0.021)	Product (0.026)	AR (0.022)	Content (0.018)
Technology (0.017)	Technology (0.025)	Acceptance (0.02)	Effect (0.018)	Experience (0.02)	Effect (0.018)
Value (0.017)	Purchase intention (0.023)	Usefulness (0.018)	Food (0.016)	Player (0.018)	System (0.015)
Satisfaction (0.017)	Attitude (0.018)	TAM (0.015)	Platform (0.016)	Interactivity (0.017)	Immersion (0.015)

and "attitude." Studies on this topic have focused on consumption when shopping for products using AR technology. For example, AR shopping was compared to traditional online shopping to investigate purchase intentions (Lixăndroiu, Cazan, and Maican 2021). Another study investigated the effect of product experiences through AR applications on purchase intentions (Wang, Ko, and Wang 2022). Therefore, Topic 2 is called "Buying Behavior."

The keywords for Topic 3 are "AR," "technology," "application," "consumer," "effect," "use," "usage intention," "acceptance," "usefulness," and "TAM."

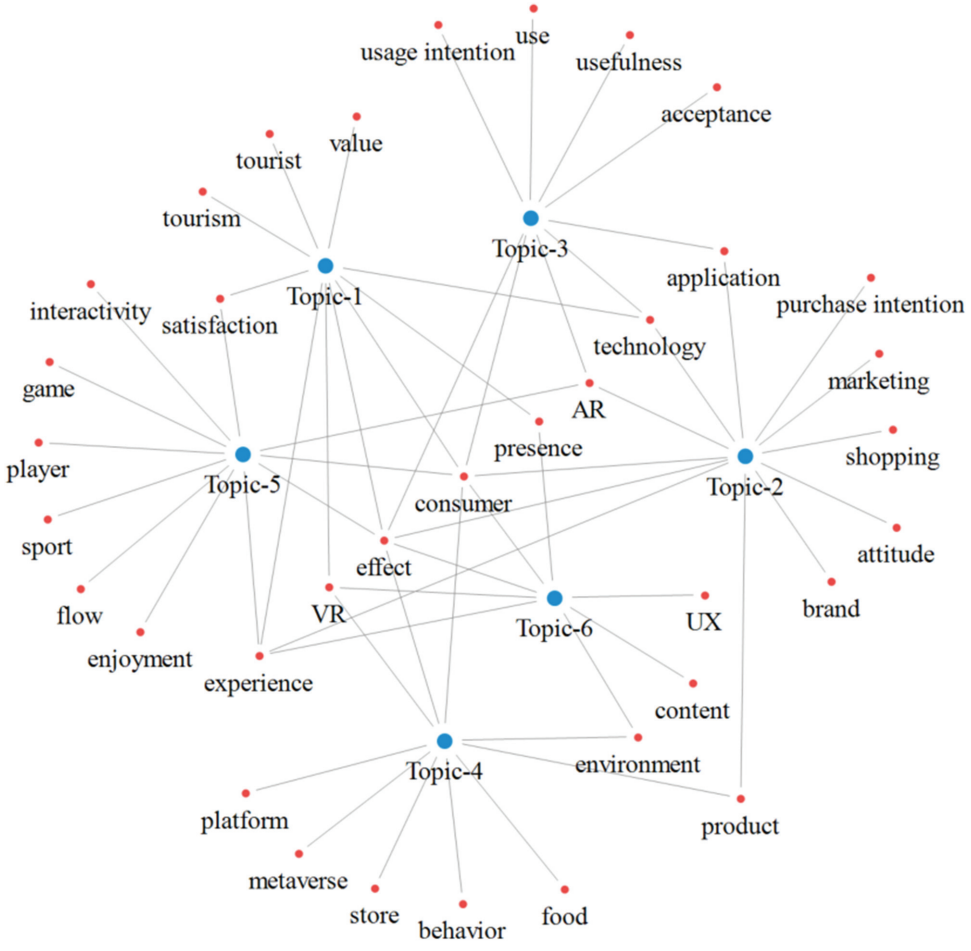

Fig. 4. Topic modeling results.

Studies on this topic have examined issues related to technology acceptance. For example, there is research on the effect of technology acceptance theory on the intention to use AR mobile applications (Oyman, Bal, and Ozer 2022). There is another study on the intention to participate in VR and AR sports experiences using experience economy theory and the extended technology acceptance model (Lee and Oh 2022). Therefore, Topic 3 is called "XR Technology Acceptance."

The keywords in Topic 4 are "consumer," "VR," "metaverse," "behavior," "store," "environment," "product," "effect," "food," and "platform." This topic deals with virtual spaces such as VR and the metaverse. For example, one study demonstrated a positive relationship between immersive experiences in virtual shops and consumer behavior (Park, Im, and Kim 2018), whereas another study evaluated the usability and telepresence of immersive VR in a simulation virtual grocery store (Schnack, Wright, and Holdershaw 2019). In addition, the impact of virtual avatar-fitting services on consumer behavior has been explored on the metaverse platform, an advanced form of AR and VR technology (Jhee, Han, and Jung 2022). In other words, consumer behavior has been examined through experiences in virtual stores. Therefore, Topic 4 is called "Virtual Space."

The keywords for Topic 5 are "game," "satisfaction," "effect," "sport," "consumer," "flow," "AR," "experience," "player," and "interactivity." This topic contains words related to game and entertainment experiences. A study on AR-based Pokémon Go games (Hamari et al. 2019; Kosa and Uysal 2021) and another on the usage behavior of VR sports games (Seong and Hong 2023) are examples. Therefore, Topic 5 is called "Game."

Topic 6 includes "VR," "environment," "presence," "experience," "consumer," "UX," "content," "effect," "system," and "immersion." Studies on this topic are related to consumer experience in the XR environment. For example, a study investigating the effects of hand gestures on the consumer experience in a VR environment (Mitre-Ortiz, Muñoz-Arteaga, and Cardona-Reyes 2023) and a study comparing the effects of desktop VR with a VR head-mounted display device on presence (Shu et al. 2019) are included in this topic. Thus, Topic 6 is called "XR Environment."

5. Discussion and implications

5.1. General discussion

In this study, we aimed to identify the current research issues and derive major topics from the academic literature related to XR technology in consumer experience by conducting a literature review through semantic network analysis and topic modeling analysis. For this purpose, we selected and analyzed 720 studies published from January 2016 to April 2023.

The main results can be summarized as follows. As a result of the topic modeling, we extracted six major topics. Looking at the proportion of topics, Topic 2, "Buying behavior (25.83%)" held the highest proportion, indicating that many studies have focused on consumers' buying behavior, which encompasses a series of behaviors such as product and brand discovery to purchase in a market. This indicates that consumer experiences based on XR technology are being discussed and studied with a focus on consumers' purchasing behavior, rather than any other consumer issues. Following this, we derived the topics of "XR Environment (21.39%)," "Tourism (18.19%)," "XR Technology Acceptance (15.14%)," "Game (10%)," and "Virtual Space (9.44%)." The research topics can largely be categorized into three parts: the characteristics and environment of XR technology; utilizations of XR technology in various ways; and XR technology acceptance.

Second, because the keywords "marketing," "ads," "store," "game," "sport," and "tourism" appeared, it is clear that XR technology is being actively used in various ways and discussed across several fields to enhance the consumer experience. This implies that XR technology has been used to enhance the consumer experience and actively studied across various industries. In particular, we derived "tourism" and "game" as key domains. This is likely because digital tourism is emerging as an industrial alternative following COVID-19 in the tourism field (Akhtar et al. 2021). Moreover, the utilization of XR technology in game industry is due to its potential of providing a breakthrough for game service companies, attracting a broad consumer audience in a game market dominated by a few game services (Park and Ko 2022).

In addition, this study revealed that the literature has emphasized the importance of entertainment experience through words such as "sport," "enjoyment," and "game." This is in line with Pine and Gilmore (1998), who emphasized the "entertainment realm" as a major dimension of experience. It also supports the results of recent studies arguing that hedonic value and enjoyment affect the intention to use AR technology (Kumar, Gupta, and Chauhan 2023; Vieira, Rafael, and Agnihotri 2022). This indicates that entertainment experiences are still important for consumer behavior and satisfaction in the future development of XR technology because consumers pursue entertainment experiences in the expanded

virtual space that they have not experienced in reality.

Next, the finding that XR technology is being studied in relation to "Virtual Space" implies that scholars are highly interested in how XR technology can contribute to perceptions of consumer spatiality, which is necessary for constructing the consumer experience (Khamis and El Harairy 2023). To illustrate, XR technology has been made to provide consumers differentiated experiences in virtual reality, such as exploring tourist attractions or trying on clothes in virtual reality instead of in person. Specifically, a growing number of studies have indicated that spatial presence and its environmental attributes are formed by a subjective sense to facilitate positive XR-based experiences. Specifically, when the boundaries between the real world and a virtual place are blurred and effectively interlinked, spatial sense can work (Khamis and El Harairy 2023). It seems that in the fields of game and tourism, space-making is key to attracting consumers. The findings also imply that the academic discourse highlights the notable progress and evolution of XR technology. For example, the emergence of the metaverse, which integrates AR and VR as its main subtypes, as a main topic in the literature confirms that spatiality has evolved from fragmentary and simple levels to sophisticated and advanced levels. This is considering that the metaverse is perceived as a virtual world and another vast society where virtual avatars represent the human real world, interact with each other, and socialize consumers (Lee and Jeon 2022; Lee and Kim 2022). The research stream indicates how the XR technology-based consumer experience will evolve, expand, and interact with the real world in the future.

Finally, the keywords "application" (0.047), "use" (0.023), "usage intention" (0.021), "acceptance" (0.02), and "TAM" (0.015) highlight that the XR literature has mainly discussed how consumers are accepting and are likely to accept it. Technology acceptance is a major theme in the consumer studies field. XR is a newly emerged technology and has become pervasive; thus, consumers' intention to select and use it as part of their daily lifestyle represents an important issue.

In this study, we clearly illustrate that the XR technology literature discourse in consumer experience is overwhelmed by consumers' acceptance and facilitation to lead to buying and relevant domains. However, it is overlooked how consumers can be ethically, legally, and emotionally ready for new but electronic world where all the information is translated into electronic signs and then delivered, interacted with, and exposed to many anonymous people or corporations. Considering that XR technology has the potential to affect various consumer lifestyles and consumer welfare in the future, there is a need for research on how consumers can enjoy and experience this new and innovative technology in a safe, informed way. In this sense, it is necessary to look at consumer perceptions, emotions, and concerns that influence consumer lifestyles and decisions. Therefore, future studies should go beyond the current emphasis on the technical and production perspectives to investigate consumer-oriented perspectives.

5.2. *Theoretical implications*

The findings of this study provide significant implications for the fields of XR and consumer experience. First, this study is one of the first literature reviews on XR technology to integrate AR and VR technology in consumer experience. This comprehensive approach differs from previous studies that have focused on specific fields separately, such as tourism (Akhtar et al. 2021) or subtechnologies of XR (Heller et al. 2023). Alternatively, our study provides holistic and comprehensive insight by examining XR, an umbrella concept of hyper-realistic technologies.

Second, this study attempted to overcome the limitations of traditional content analysis research methods by using semantic network analysis and topic modeling. Traditional content analysis methods typically depend on the researcher's subjective classification of text data, which can lead to a loss of information during the classification process or may enable the researcher's subjective bias (Danowski 1993). To overcome these limitations, this study quantitatively analyzed qualitative data using semantic network analysis and LDA algorithm and revealed the roles and positions of keywords in the network. Through this methodological innovation, it was possible to grasp hidden structures and topics that could be overlooked by the existing approach. That is, we structured and visualized the network based on the centrality values of keywords. The insight gained from this analysis is that it visually provided structural information about the current academic discussion on XR in consumer experience.

Third, this literature review has revealed that studies dealing with technology acceptance have been actively discussed and indicates that future research should reflect the consumer welfare perspective. Most prior research has actively focused on the use in specific fields, such as games and tourism, or has focused on the environment and characteristics of XR and technology acceptance. Meanwhile, this study has highlighted a lack of detailed discussion on how

consumer rights and responsibilities can be maintained while employing XR technology. In particular, there has been a lack of discussion on barriers to consumer welfare such as privacy and ethical issues. This provides the insight that research from a consumer welfare perspective is necessary along with the utilization of XR technology in various fields in the future.

5.3. Practical implications

The results of this study offer practical implications. First, the findings of this study confirm that clear potential for XR technology to be considered as an effective business strategy tool to form and enhance the consumer experience in various industries. Our findings indicate that XR is already actively used to enhance the consumer experience in the fields of tourism, games, and shopping. We can also expect more advanced forms of XR technology to emerge in the future, such as the metaverse, which has been actively discussed. Therefore, the use of XR technology in various industries to provide differentiated experiences for consumers will be a key strategy for companies to gain a competitive advantage.

Second, when developing XR services and content, companies must consider the aspect of consumer welfare issues in the long term. According to the research results, existing studies have focused on discussing consumer acceptance of XR technology, but there is a lack of discussion on the damage or concerns that consumers may experience when using XR. This suggests that as XR technology evolves and becomes more sophisticated, there will inevitably be more issues related to it. Therefore, it is important to consider and develop strategies in advance for minimizing consumer harm, such as privacy and ethical issues, to protect consumers during their XR experience.

5.4. Limitations

This study has several limitations. First, data collection was limited to articles published after 2016, when the popularity of XR technology increased. For this reason, academic discussions related to XR technology before 2016 may have been overlooked. Therefore, it is necessary to review academic discussions over a wider period in future studies. Second, in this study, we integrated Korean and international literature and drew significant implications and insights from both as a whole, but we did not explore the two literature bodies separately. In future studies, researchers should divide the literature body by country and analyze the trends and characteristics according to each country.

Despite these limitations, we collected, selected, and analyzed XR literature that is rapidly developing and being conducted in the field of consumer experience. The derived keywords, network structure, and main topics contribute to a more holistic understanding of XR technology in consumer experience.

Conflict of interest

There is no conflict of interest.

References

Akhtar, Nadeem, Nohman Khan, Muhammad Mahroof Khan, Shagufta Ashraf, Muhammad Saim Hashmi, Muhammad Muddassar Khan, and Sanil S. Hishan (2021), "Post-COVID 19 Tourism: Will Digital Tourism Replace Mass Tourism?," *Sustainability*, 13 (10), 5352.

Azuma, Ronald T. (1997), "A Survey of Augmented Reality," *Presence: Teleoperators & Virtual Environments*, 6 (4), 355–385.

Bekele, Mafkereseb Kassahun, Roberto Pierdicca, Emanuele Frontoni, Eva Savina Malinverni, and James Gain (2018), "A Survey of Augmented, Virtual, and Mixed Reality for Cultural Heritage," *Journal on Computing and Cultural Heritage (JOCCH)*, 11 (2), 1–36.

Blei, David M. (2012), "Probabilistic Topic Models," *Communications of the ACM*, 55 (4), 77–84.

Blei, David M., Andrew Y. Ng, and Michael I. Jordan (2003), "Latent Dirichlet Allocation," *Journal of Machine Learning Research*, 3, 993–1022.

Bonacich, Phillip (1987), "Power and Centrality: A Family of Measures," *American Journal of Sociology*, 92 (5), 1170–1182.

Bonacich, Phillip (2007), "Some Unique Properties of Eigenvector Centrality," *Social Networks*, 29 (4), 555–564.

Chiang, Feng-Kuang, Xiaojing Shang, and Lu Qiao (2022), "Augmented Reality in Vocational Training: A Systematic Review of Research and Applications," *Computers in Human Behavior*, 129, 107125.

Cho, Minjung, Hyesu Yun, and Eunju Ko (2023), "Contactless Marketing Management of Fashion Brands in the Digital Age," *European Management Journal*, 41 (4), 512–520.

Chuah, Stephanie Hui-Wen (2018), "Why and Who Will Adopt Extended Reality Technology? Literature Review, Synthesis, and Future Research Agenda," *Literature Review, Synthesis, and Future Research Agenda* (December 13, 2018).

Danowski, James A. (1993), "Network Analysis of Message Content," *Progress in Communication Sciences*, 12, 198–221.

Data Science Plus (2018), "Evaluation of Topic Modeling: Topic Coherence," (May 3), https://datascienceplus.com/evaluation-of-topic-modeling-topic-coherence/.

Doerfel, Marya. L. (1998), "What Constitutes Semantic Network Analysis? A Comparison of Research and Methodologies," *Connections*, 21 (2), 16–26.

Fast-Berglund, Åsa, Liang Gong, and Dan Li (2018), "Testing and Validating Extended Reality (xR) Technologies in Manufacturing," *Procedia Manufacturing*, 25, 31–38.

Forbes (2021), "Augmented and Virtual Reality after Covid-19," (September 14), https://www.forbes.com/sites/forbestechcouncil/2021/09/14/augmented-and-virtual-reality-after-covid-19/?sh=7d2c2a62d97c.

Freeman, Linton C. (1979), "Centrality in Social Networks: Conceptual Clarification," *Social Networks*, 1, 215–239.

Hamari, Juho, Aqdas Malik, Johannes Koski, and Aditya Johri (2019), "Uses and Gratifications of Pokémon Go: Why Do People Play Mobile Location-Based Augmented Reality Games?," *International Journal of Human–Computer Interaction*, 35 (9), 804–819.

Heller, Jonas, Dominik Mahr, Ko de Ruyter, Eric Schaap, Tim Hilken, Debbie I. Keeling, Mathew Chylinski, Carlos Flavián, Timothy Jung, and Philipp A. Rauschnabel (2023), "An Interdisciplinary Co-Authorship Networking Perspective on AR and Human Behavior: Taking Stock and Moving Ahead," *Computers in Human Behavior*, 143, 107697.

Hoffmann, Stefan and Robert Mai (2022), "Consumer Behavior in Augmented Shopping Reality. A Review, Synthesis, and Research Agenda," *Frontiers in Virtual Reality*, 3, 961236.

Jhee, Seon-Young, Sang-Lin Han, and Hyo-Young Jung (2022), "Effect of Avatar Virtual Fitting Service on Customer Experience and Reuse Intention in Metaverse," *Journal of Marketing Management Research*, 27 (4), 59–82.

Jiang, Hanchen, Maoshan Qiang, and Peng Lin (2016), "A Topic Modeling Based Bibliometric Exploration of Hydropower Research," *Renewable and Sustainable Energy Reviews*, 57, 226–237.

Jung, Timothy, Sujin Bae, Natasha Moorhouse, and Ohbyung Kwon (2023), "The Effects of Experience-Technology Fit (ETF) on Consumption Behavior: Extended Reality (XR) Visitor Experience," *Information Technology & People*, https://doi.org/10.1108/ITP-01-2023-0100.

Khamis, Noha Essam and Yosra El Harairy (2023), "Employing Extended Reality (XR) to Expanding Narratives of Place-Making, Spatial Presence and Immersive Experience," *ASCAAD 2023*, 963–974.

Kim, Sang-Woon and Joon-Min Gil (2019), "Research Paper Classification Systems Based on TF-IDF and LDA Schemes," *Human-centric Computing and Information Sciences*, 9, 1–21.

Korea Citation Index (n.d.), "Introduction to KCI", (accessed November 10, 2023), https://www.kci.go.kr/kciportal/aboutKci.kci.

Kosa, Mehmet and Ahmet Uysal (2021), "The Role of Need Satisfaction in Explaining Intentions to Purchase and Play in Pokémon Go and The Moderating Role of Prior Experience," *Psychology of Popular Media*, 10 (2), 187–200.

Kumar, Harish, Parul Gupta, and Sumedha Chauhan (2023), "Meta-Analysis of Augmented Reality Marketing," *Marketing Intelligence & Planning*, 41 (1), 110–123.

Le, Tran-Thien-Y, Ja-Shen Chen, and Ngoc B. Nguyen (2024), "The Effects of Attributes of Non-Immersive Virtual Reality on Customers' Experience of Video Tours Under Social Distancing for COVID-19," *International Journal of Human–Computer Interaction*, 40 (3), 885–902.

Lee, Eun-Jung and Jihye Jeon (2022), "Effect of Experience of Fashion Brand Metaverse Virtual Reality Store on Perceived Avatar Identification, Perceived Fun, and Consumer-Brand Self-Congruity," *The Journal of the Convergence on Culture Technology (JCCT)*, 8 (4), 387–395.

Lee, JeaWoog, YoungBin Kim, and Doug Hyun Han (2022), "LDA-Based Topic Modeling for COVID-19-Related Sports Research Trends," *Frontiers in Psychology*, 13, 1033872.

Lee, Kyongmin and Seungwook Oh (2022), "The Users' Intention to Participate in a VR/AR Sports Experience by Applying the Extended Technology Acceptance Model (ETAM)," *Healthcare*, 10 (6), 1117.

Lee, Un-Kon and Hyekyung Kim (2022), "UTAUT in Metaverse: An "Ifland" Case," *Journal of Theoretical and Applied Electronic Commerce Research*, 17 (2), 613–635.

Liu, Chun and Xiaoting Huang (2023), "Does the Selection of Virtual Reality Video Matter? A Laboratory Experimental Study of The Influences of Arousal," *Journal of Hospitality and Tourism Management*, 54, 152–165.

Lixăndroiu, Radu, Ana-Maria Cazan, and Cătălin Ioan Maican (2021), "An Analysis of The Impact of Personality Traits Towards Augmented Reality in Online Shopping," *Symmetry*, 13 (3), 416.

Margetis, George, Konstantinos C. Apostolakis, Stavroula Ntoa, George Papagiannakis, and Constantine Stephanidis (2021), "X-Reality Museums: Unifying the Virtual and Real World Towards Realistic Virtual Museums," *Applied Sciences*, 11 (1), 338.

Milgram, Paul and Fumio Kishino (1994), "A Taxonomy of Mixed Reality Visual Displays," *IEICE Transactions on Information and Systems*, 77 (12), 1321–1329.

Mitre-Ortiz, Andres, Jaime Muñoz-Arteaga, and Héctor Cardona-Reyes (2023), "Developing a Model to Evaluate and Improve User Experience with Hand Motions in Virtual Reality Environments," *Universal Access in the Information Society*, 22 (3), 825–839.

Naili, Marwa, Anja Habacha Chaibi, and Henda Ben Ghézala (2017), "Arabic Topic Identification Based on Empirical Studies of Topic Models," *Revue Africaine de Recherche en Informatique et Mathématiques Appliquées*, 27 (Special issue CARI 2016).

Oyman, Mine, Dondu Bal, and Serhat Ozer (2022), "Extending the Technology Acceptance Model to Explain How Perceived Augmented Reality Affects Consumers' Perceptions," *Computers in Human Behavior*, 128, 107127.

Park, Jihye and Dongwoo Ko (2022), "Catch Me If You Can: Effects of AR-Enhanced Presence on the Mobile Game Experience," *Internet Research*, 32 (4), 1235–1263.

Park, Minjung, Hyunjoo Im, and Do Yuon Kim (2018), "Feasibility and User Experience of Virtual Reality Fashion Stores," *Fashion and Textiles*, 5 (1), 1–17.

Pine, B. Joseph and James H. Gilmore (1998), "Welcome to the Experience Economy," *Harvard Business Review Press*, 76 (4), 97–105.

Qamar, Sara, Zahid Anwar, and Mehreen Afzal (2023), "A Systematic Threat Analysis and Defense Strategies for the Metaverse and Extended Reality Systems," *Computers & Security*, 128, 103127.

Riar, Marc, Nannan Xi, Jakob J. Korbel, Ruediger Zarnekow, and Juho Hamari (2022), "Using Augmented Reality for Shopping: A Framework for AR Induced Consumer Behavior, Literature Review and Future Agenda," *Internet Research*, 33 (1), 242–279.

Ruhnau, Britta (2000), "Eigenvector-Centrality—A Node-Centrality?," *Social Networks*, 22 (4), 357–365.

Samsung Newsroom (2020), "Samsung Electronics Declares "Age of Experience" at CES 2020," (January 7), https://news.samsung.com/global/samsung-electronics-declares-age-of-experience-at-ces-2020

Schmitt, Bernd H. (2010), *Customer Experience Management: A Revolutionary Approach to Connecting with Your Customers*. John Wiley & Sons.

Schnack, Alexander, Malcolm J. Wright, and Judith L. Holdershaw (2019), "Immersive Virtual Reality Technology in a Three-Dimensional Virtual Simulated Store: Investigating Telepresence and Usability," *Food Research International*, 117, 40–49.

Seong, Bo-Hyun and Chang-Yu Hong (2023), "Decision-Making in Virtual Reality Sports Games Explained via the Lens of Extended Planned Behavior Theory," *International Journal of Environmental Research and Public Health*, 20 (1), 592.

Shu, Yu, Yen-Zhang Huang, Shu-Hsuan Chang, and Mu-Yen Chen (2019), "Do Virtual Reality Head-Mounted Displays Make a Difference? A Comparison of Presence and Self-Efficacy Between Head-Mounted Displays and Desktop Computer-Facilitated Virtual Environments," *Virtual Reality*, 23 (4), 437–446.

Statista (2023), "AR&VR (South Korea)," (accessed January 5, 2024), https://www.statista.com/outlook/amo/ar-vr/south-korea.

Steuer, Jonathan (1992), "Defining Virtual Reality: Dimensions Determining Telepresence," *Journal of Communication*, 42 (4), 73–93.

Sun, Qinglan, Debora Shaw, and Charles H. Davis (1999), "A Model for Estimating the Occurrence of Same-Frequency Words and the Boundary Between High-And Low-Frequency Words in Texts," *Journal of the American Society for Information Science*, 50 (3), 280–286.

Sung, Yun-A (2022), "A Suggestion and an Analysis on Changes on Trend of the 'Virtual Tourism' Before and After the Covid 19 Crisis Using Textmining Method," *Journal of the Korea Convergence Society*, 13 (4), 155–161.

Tang, Ailie K.Y. (2017), "Key Factors in the Triumph of Pokémon GO," *Business Horizons*, 60 (5), 725–728.

The New York Times (2016), "Oculus Rift Review: A Clunky Portal to a Promising Virtual Reality," (March 28), https://www.nytimes.com/2016/03/31/technology/personaltech/oculus-rift-virtual-reality-review.html.

Vieira, Valter Afonso, Diego Nogueira Rafael, and Raj Agnihotri (2022), "Augmented Reality Generalizations: A Meta-Analytical Review on Consumer-Related Outcomes and the Mediating Role of Hedonic and Utilitarian Values," *Journal of Business Research*, 151, 170–184.

Walsh, Kenneth R. and Suzanne D. Pawlowski (2002), "Virtual Reality: A Technology in Need of IS Research," *Communications of the Association for Information Systems*, 8, 297–313.

Wang, Yining, Eunju Ko, and Huanzhang Wang (2022), "Augmented Reality (AR) App Use in the Beauty Product Industry and Consumer Purchase Intention," *Asia Pacific Journal of Marketing and Logistics*, 34 (1), 110–131.

Wasserman, Stanley and Katherine Faust (1994), *Social Network Analysis: Methods and Applications*. Cambridge University Press.

Zhao, Weizhong, James Chen, and Wen Zou (2015), "Best Practices in Building Topic Models with LDA for Mining Regulatory Textual Documents," *CDER 9th November*.

Zhu, Chris, Don Chi Wai Wu, Colin Michael Hall, Lawrence Hoc Nang Fong, Sara Naderi Koupaei, and Feifei Lin (2023), "Exploring Non-Immersive Virtual Reality Experiences in Tourism: Empirical Evidence from a World Heritage Site," *International Journal of Tourism Research*, 25 (3), 372–383.