



## Systematic Literature Review on Metaverse Education in Korea

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### Abstract

Recent advances in digital technology are bringing about significant changes in the concept of space. The amount of time spent in digital spaces continues to increase in people's daily lives, and rapid digital transformation has brought about various changes in our lives, culture, and economy as well as in other aspects of society. The metaverse, which blurs the boundary between physical and digital spaces, is expected to play a key role in driving the future digital ecosystem and has garnered considerable attention in the field of remote learning. As a leading country in this field, South Korea has seen a surge in metaverse education research. This study systematically examined trends in metaverse education research reported in South Korea since the outbreak of COVID-19 to identify the direction and implications of future metaverse-based education. The subjects comprised academic journal articles indexed in KCI candidate-level journals or above from 2020 to 2024 in the RISS database. Methods, subjects, educational content, and platforms were analyzed by year. The results of the analysis of a total of 337 collected documents are as follows. Research on metaverse education in South Korea began in earnest in 2022, focusing on literature and survey studies, with development and case studies gradually being conducted. Experimental and implementation studies have also continued until recently. Research has been most active in higher education, with a significant amount of research focusing on teachers, particularly pre-service teachers. The scope of research subjects and educational fields is expanding to include special education, education across generations, and vocational education. In addition, while early studies primarily utilized 3D-based platforms, recent studies have increasingly employed 2D-based platforms, suggesting that achieving educational objectives effectively is considered more important than adopting advanced technology in metaverse education. Based on these findings, this study discusses the current state and future prospects of metaverse education.

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## Introduction

Recent advances in digital technology have brought significant changes in the concept of space. The COVID-19 pandemic has further accelerated the global shift toward communicating and living in online digital spaces. The amount of time spent in digital spaces continues to increase, and digital transformation has brought about various changes in our lives, culture, and economy. The metaverse, which blurs the boundary between physical and digital spaces, is expected to play a key role in shaping the future digital ecosystem. At the core of the metaverse lies the vision of an immersive internet as an expansive, unified, persistent, and shared virtual realm (Lee et al., 2021).

The metaverse is a fusion of virtually enhanced physical reality and persistent virtual space (Smart, Cascio, & Paffendorf, 2007). It represents an interconnected web of ubiquitous virtual worlds that are integrated with and enhance the physical world. These virtual worlds allow users, represented by avatars, to connect and interact with each other while experiencing user-generated content. The environment is characterized by its immersive, scalable, synchronized, and continuous properties (Weinberger, 2022).

As a new social communication space, the metaverse holds significant potential. It offers a high degree of freedom for creation and sharing, providing users with a unique and immersive experience (Kye et al., 2021). The metaverse is gaining significant prominence, particularly in the field of remote learning. This is primarily due to its potential to address the inherent limitations of two-dimensional, web-based e-learning tools, especially in terms of realism and user motivation (Saritaş & Topraklıkoğlu, 2022).

In education, the metaverse can be viewed as an enriched learning environment through the integration of metaverse-related technologies with elements of both virtual and physical learning environments (Zhang et al., 2022). The metaverse-based learning environment differs in several respects from existing approaches that use real-time platforms. The metaverse enables “social connection” by providing a space that brings together students from diverse backgrounds to communicate and interact.

Real-time collaboration through integrated social technologies and communication tools can promote collaborative learning, deepen discussion, and foster cognitive interaction. In addition, the effective representation of spatial movement in the virtual world can enhance learners' immersion in the learning process. It also provides the additional advantage of improving classroom efficiency and student engagement (Chen, 2024).

An analysis of the literature on education utilizing the metaverse indicates that a substantial amount of design-based research has been conducted at the higher education level. The most frequently used keywords include metaverse, education, virtual reality, augmented reality, and artificial intelligence (Balat, Yavuz, & Kayalı, 2023; Saritaş & Topraklıkoğlu, 2022). Since the COVID-19 pandemic, research on metaverse education has increased rapidly, with Second Life identified as the most widely adopted platform (Battal & Taşdelen, 2023; Tas & Bolat, 2022). Virtual reality linked to metaverse platforms has been effective in sustaining educational outcomes,

improving learning adaptability, and fostering positive learning attitudes (Chen, Zhang, & Yu, 2023). However, the need for further discussions on the long-term impacts on education and ethical considerations has been suggested (Wider, et al., 2025).

In addition, the overreliance on literature reviews and theoretical discussions, with relatively few experimental studies, represents a limitation in metaverse education research (Tlili et al., 2022). China has been the most active in researching the use of the metaverse in education, while South Korea has also shown significant activity in this field, leading in terms of publications and citations (Balat, Yavuz, & Kayalı, 2023; Sarıtaş & Topraklıkoğlu, 2022; Wider et al., 2025). South Korea's prominence in this area is attributed to its high internet penetration and advanced technology sector (Ren, Tan, & Guo, 2025).

Most of these literature reviews, however, focused on international English-language journals and thus did not sufficiently examine the substantial amount of metaverse-based education being reported within South Korea. This study examined trends in metaverse education in Korea since the COVID-19 outbreak using a Korean academic database. Specifically, studies published between 2020 and 2024 were examined across four categories:

- (1) research methods,
- (2) research subjects,
- (3) educational fields, and
- (4) platforms utilized.

Furthermore, a co-word analysis of author keywords was conducted to identify core themes. Additionally, this research analyzed the effects of metaverse-based education according to educational content and research subject. Through this approach, the research aims to explore future directions and implications for the use of the metaverse in education.

## Method

This study employed a systematic literature review combined with bibliometric analysis. A systematic literature review is a structured method for summarizing and synthesizing findings from prior research on a specific topic or field, primarily focusing on targeted reviews and datasets of manageable size. Meanwhile, bibliometric analysis is a systematic study of large volumes of scientific literature aimed at identifying patterns, trends, and impacts within a particular field (Passas, 2024).

To identify research trends in metaverse education in Korea, this study first conducted a systematic literature review in accordance with the PRISMA 2020 checklist (Page et al., 2021), as shown in Figure 1. Second, a co-word analysis of author keywords was conducted. Co-word analysis is a bibliometric method that focuses on the co-occurrence of keywords within academic texts to reveal dominant themes and relationships across various research fields (Chen et al., 2023). Through this process, the relationships among research topics related to metaverse education were examined.

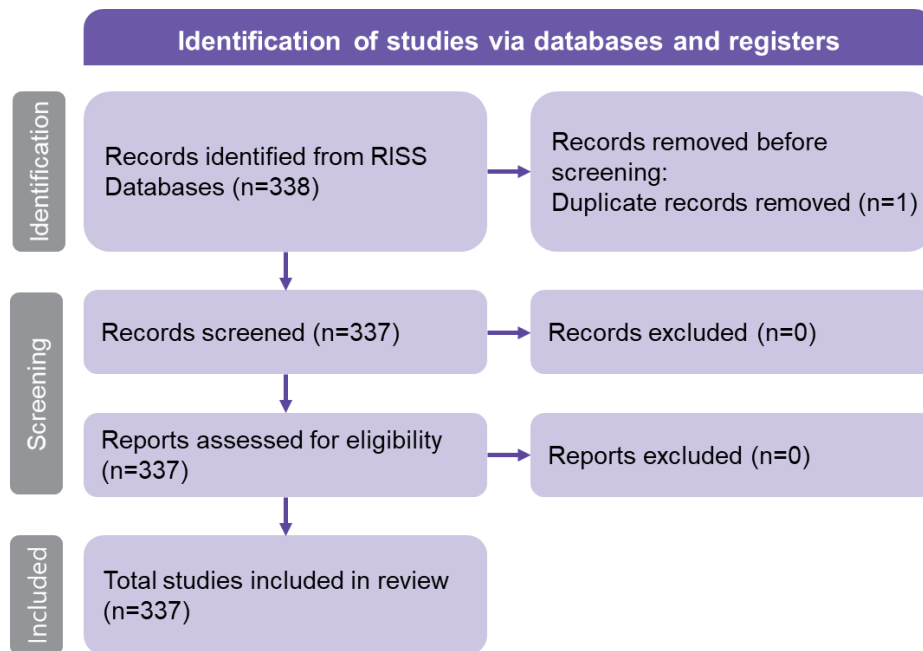


Figure 1. Research Flowchart based on PRISMA 2020

## Data Collection

In this study, literature was collected from the RISS database, targeting academic journals at the KCI-listed or candidate level from January 1, 2020, to December 31, 2024. RISS (Research Information Sharing Service) is a database operated by the Korea Education and Research Information Service (KERIS). It is an open public service that allows nationwide universities to jointly utilize academic resources they produce, hold, and subscribe to. The database provides access to a wide range of academic resources, including dissertations, domestic and international journal articles, and monographs. In addition, it is linked to the five major domestic journal databases—DBpia, KISS, Scholar, e-Article, and Koreascholar—making it possible to search most journals published in Korea. KCI (Korea Citation Index) is a specialized information service that selects listed and candidate journals to ensure the quality standards of domestic academic journals, while also providing citation information and statistical data. Papers published in journals at the candidate level or higher are considered reliable, as they have undergone academic peer review. To collect research literature on metaverse-based education, a detailed search was conducted using “metaverse” in the paper title and “education” or “class” as keywords. The term “metaverse” was included in the paper title to ensure that the main research objective and topic were directly related to the metaverse. Similarly, “education” or “class” was included in the keywords to identify literature on the use of the metaverse for educational purposes. A total of 338 bibliographic records were retrieved and collected using EndNote. After removing one duplicate record, 337 unique records remained. Following screening for eligibility criteria, all 337 records were deemed suitable for analysis.

## Data Analysis

Two researchers independently reviewed the abstracts and content of the collected literature. They classified and analyzed the research methods, subjects, and fields of educational application, and examined the most widely

used metaverse platforms. Each dataset was organized using Microsoft Excel according to the criteria below, and findings were obtained through iterative review and comparison between the researchers.

In studies analyzing metaverse education trends, research methods are commonly categorized as qualitative, quantitative, mixed-methods, and literature reviews (Thili et al., 2022). However, to provide a more detailed analysis of metaverse education research, this study categorized the methods into five types: development studies, literature reviews, case studies, experimental/action research, and survey studies, as shown in Table 1.

Table 1. Research Method Classification Framework

Research Method	Content
Development research	Research involving the development of virtual learning environments, educational models, content, and programs.
Literature review	Research that analyzes existing literature and relevant materials to explore utilization strategies.
Case study	Research analyzing specific educational cases and implementations.
Experimental/Action research	Research exploring the effects of metaverse-based educational interventions on learning outcomes through controlled implementations.
Survey research	Research investigating users' or learners' perceptions, experiences, and intentions regarding metaverse education.

The research subjects were also categorized into eleven groups after reviewing the abstracts and detailed content (see Table 2). The categories are as follows: 1) early childhood education for infants and toddlers; 2) elementary education for elementary school students only; 3) multi-level education spanning elementary through high school; 4) secondary education for middle and high school students only; 5) higher education for undergraduate and graduate students; 6) teacher education for pre-service teachers, in-service teachers, and educators; 7) generational education for a specific generation or multiple generations such as senior citizens or the MZ generation; 8) special education for gifted children or children with disabilities; 9) vocational education for specific professionals such as security personnel or military staff; 10) international education for international students and foreign language learners; and 11) other studies where the focus was not on specific learner groups but on prior studies, research methods, assessment systems, or educational frameworks.

The educational fields utilizing the metaverse were classified into 14 categories after detailed review: language education, mathematics education, social studies education, literature education, music education, art education, physical education, science and engineering education, environmental education, career education, religious education, nursing education, history education, and safety education. Beyond these specific educational fields, topics such as liberal arts or cultural education were classified as "Other." Studies that could not be categorized into specific educational fields, such as those focusing on the development of educational frameworks or general learning environments, were classified as "None."

Nine commonly used metaverse platforms—Zep, Gather Town, Zepeto, Roblox, Ifland, Minecraft, Mozilla

Hubs, Cospaces Edu, and Spatial—were identified by their official names. Proprietary VR platforms and other custom-developed platforms were classified as "Other." Studies that mentioned or utilized multiple platforms were recorded under each applicable platform. Studies that did not employ or specify any platforms, such as literature reviews or survey-based studies (n=141), were excluded from the platform analysis.

Table 2. Research Subject Classification Framework

Research Subject	Content
Early Childhood Education	infants and toddlers
Elementary education	elementary school students only
Multi-level education	elementary, middle, and high school students
Secondary education	middle and high school students only
Higher education	undergraduate and graduate students
Teacher education	pre-service teachers, in-service teachers, and educators
Generational education	specific generations or multiple generations (e.g., senior citizens, MZ generation)
Special education	gifted students, students with disabilities, and other special needs groups
Vocational education	specific occupational groups (e.g., security personnel, military staff)
International education	international students and foreign language learners
Other studies	prior research, research methods, learning assessments, educational systems, platforms, etc.

Co-occurrence analysis of author keywords was conducted using the VOSviewer software, based on English-translated keywords. To ensure consistency in terminology, the English translations of author keywords were further standardized as presented in Table 3 prior to the co-occurrence analysis. During this standardization process, lengthy terms such as Virtual Reality, Augmented Reality, Non-Player Character, Artificial Intelligence, and Problem-based Learning were abbreviated as VR, AR, NPC, AI, and PBL, respectively.

Table 3. Author Keyword Standardization Examples

Author keyword	Standardized keyword
metaverse platform, platform	platform
distance learning, e-learning, remote learning, cyber education, non-face-to-face education	online education
metaverse-applied education, metaverse in education, metaverse education	metaverse education
university major classes, university education, university, higher education	higher education
Church education, Christian education	Christian education
virtual space, virtual world, virtual worlds	virtual world

The keyword co-occurrence analysis employed full counting, where each co-occurrence link was given equal weight. During the analysis, the minimum number of occurrences for a keyword was set to 4, and the minimum cluster size was set to 5.

## Results

A bibliometric analysis of Korean metaverse education research from 2020 to 2024 revealed distinctive publication patterns by year. No studies on this topic were published in 2020, followed by 12 articles in 2021. The field experienced rapid growth in 2022 with 110 publications, reaching a peak of 127 articles in 2023, before moderately declining to 88 articles in 2024. The following sections present the results of the analysis of these 337 collected documents, categorized by research methods, subjects, educational fields, and platforms, as well as the thematic trends identified through co-occurrence analysis of author keywords

### Research Methods in Metaverse Education Studies

As shown in Figure 2, research on metaverse education in Korea emerged in 2021 and expanded dramatically in 2022. In 2022, literature reviews were the most common, followed by survey and developmental research. In 2023, which marked the peak of research activity, studies were conducted across all research types, including experimental and action research. Even in 2024, when the overall number of studies declined, experimental and action research showed a slight increase compared to 2023. Across the study period (2021-2024), experimental and action research was the most prevalent with 77 studies, followed by literature reviews (76), development research (69), survey research (68), and case studies (47). This pattern suggests that following the introduction of metaverse technology into education after COVID-19, development research initially accompanied literature reviews and survey research, then gradually transitioned toward experimental and action research. While the necessity of online education during the pandemic led to increased interest in metaverse-based education, the return to in-person classes appears to have contributed to the decline in related research since 2024. Nevertheless, the continued growth in experimental and action research indicates the sustained implementation of metaverse-based education in actual educational settings.

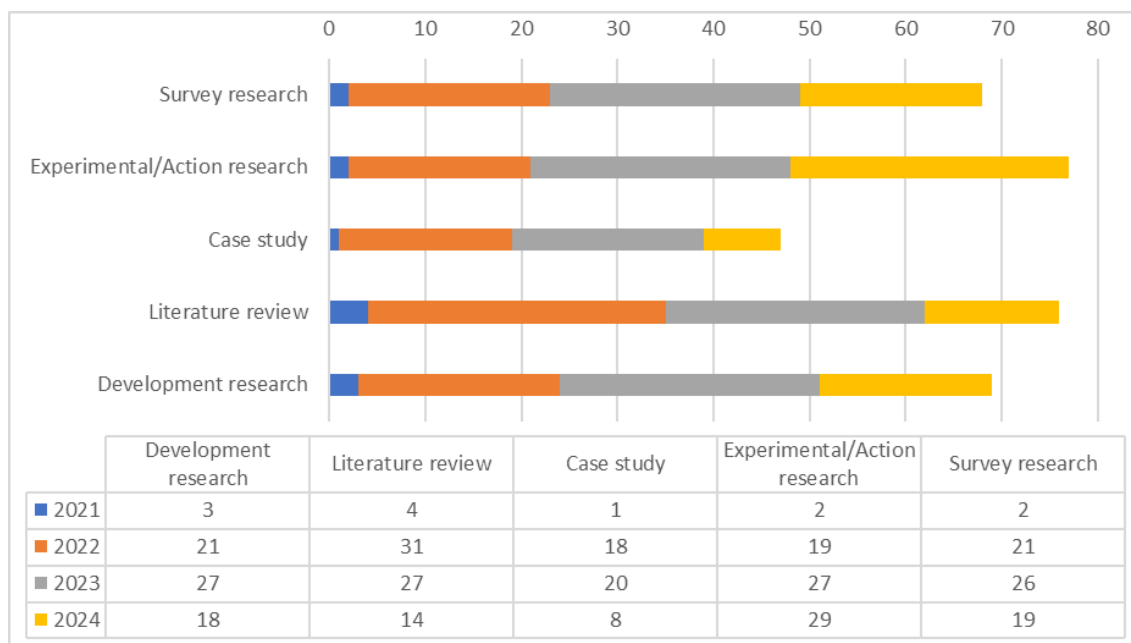


Figure 2. Research Methods for Metaverse Education by Year

## Research Subjects in Metaverse Education Studies

The "Other" category represented the largest group with 103 studies, primarily consisting of literature reviews and studies not focused on specific learner populations. Excluding this category, as shown in Figure 3, the largest proportion of studies focused on higher education targeting university students, followed by teacher education research involving pre-service and in-service teachers. Research on elementary and secondary education was also substantial. While studies targeting elementary students were more prevalent during the peak years of metaverse education research in 2022 and 2023, research on secondary education showed increased activity in 2024. Since 2023, the scope of research subjects has expanded to include early childhood education, special education, generational groups, and specific occupational populations.

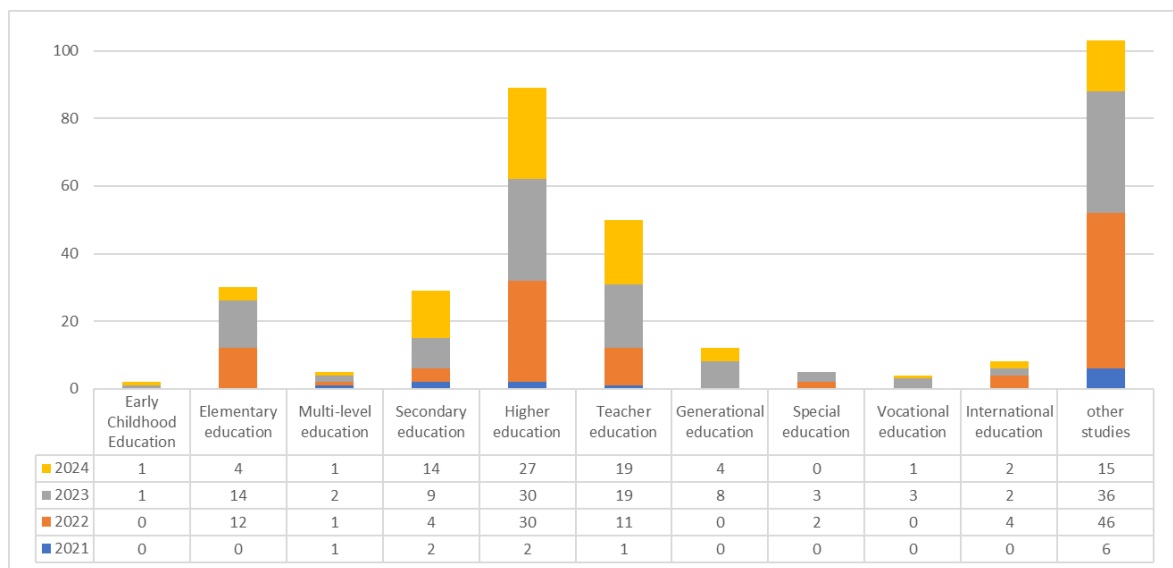


Figure 3. Research Subjects in Metaverse Education by Year

Numerous case studies and experimental/action research have demonstrated that metaverse education enhances not only overall class satisfaction but also satisfaction with technology utilization. Studies have shown effectiveness in strengthening cognitive, affective, and attitudinal aspects, as well as digital competencies (Choi & So, 2022; Han et al., 2024; Jeon, Jang, & Jung, 2022; Lee & Lee, 2023; Lim, 2022; Nam, 2022). For instance, university students participating in a phonetics course generated their own creative problems rather than simply following instructor guidance. They skillfully applied these problems and successfully completed collaborative projects (Lee, 2024). Using a metaverse connected to the real world was also effective in enhancing elementary students' conceptual understanding and improving memory through direct experience (Chang, Kim, & Kim, 2023).

The effectiveness of metaverse education has also been demonstrated across different age groups. Middle-aged adults, despite initial difficulties with platform use, gradually adapted and demonstrated creative problem-solving skills through technology, contributing to capacity building (Kang, Park, & Jung, 2024). Similarly, metaverse education proved effective for elderly learners, showing positive learning outcomes (Yoon et al., 2024). Notably, a metaverse-based vocational preparation program for adults with disabilities showed significant

results in increasing their employability (Lee, Park, & Lee, 2022).

Figure 4 illustrates the relationship between research methods and subjects. Despite the broadening scope of research subjects since 2023, literature reviews, development research, and survey research have remained the primary approaches overall. The most frequent subjects for experimental and action research were higher education, followed by elementary and secondary education. Research on teachers also shows a strong connection to school education, as much of this research focused on pre-service teachers. Further analysis reveals that studies targeting pre-service teachers predominantly employed experimental/action research or development research, while survey research and case studies were mostly conducted with in-service teachers. Research focusing on elementary and secondary school students most frequently used experimental and action research, followed by development research. In higher education, experimental/action research and case studies were most common, followed by development and survey research.

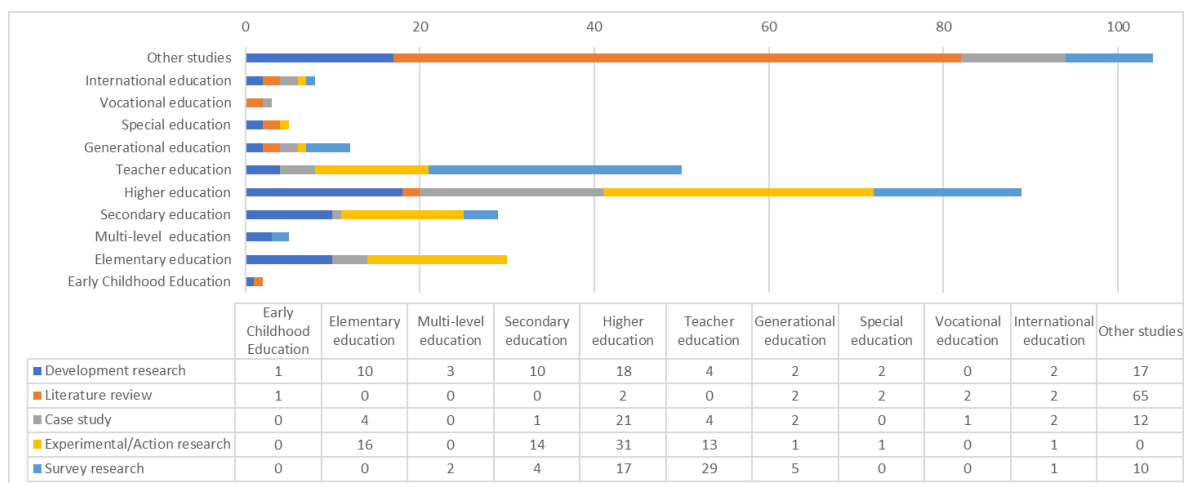


Figure 4. Research Subjects in Metaverse Education by Research Method

Undergraduate students reported high levels of satisfaction and positive learning outcomes from metaverse-based classes, with particularly high satisfaction with collaborative processes, demonstrating the potential of metaverse-based instruction (Lee & Han, 2022; Park & Han, 2023; Park & Hwang, 2024). Metaverse education was also effective in improving the digital literacy of pre-service teachers (Hong et al., 2023; Ju, 2023; Lee & Lee, 2024; Lee et al., 2023; Seo, 2024). Elementary school students were also able to take the lead in creating virtual spaces, which contributed to strengthening their digital competencies (Kim & Kim, 2023). Metaverse-based learning was particularly effective in enhancing learning presence and active learning, yielding positive learning outcomes in the domains of attitudes and behaviors rather than knowledge (Lim, Kim, & Ha, 2023).

### Research Fields in Metaverse Education Studies

After excluding 98 papers that did not focus on specific educational fields (e.g., research trend analyses, perception surveys, system analyses, and framework development), we identified the primary educational fields where metaverse-based research is conducted (see Figure 5). The 'Other' category accounted for the largest proportion with 57 studies, encompassing diverse educational fields including various university majors such as

education, tourism, liberal arts, and film studies. This category also included specialized topics such as unification education for the MZ generation, reflecting Korea's unique socio-cultural context (Shin & Cho, 2024). Language education, totaling 52 studies, primarily focused on Korean (targeted at both native speakers and foreigners) and English instruction, followed by Japanese and Chinese language studies. Art education showed consistent research activity with 19 studies distributed relatively evenly across years since 2021. Career education demonstrated recent growth with 19 studies, showing increased activity in 2024. Engineering education peaked in 2022 with 10 studies before declining in subsequent years. Emerging fields showed notable increases in recent years: music education (13 studies), safety education (6 studies), nursing education (6 studies), and history education (10 studies) all demonstrated growing research interest. Despite a slight decrease in total study volume in 2024 compared to peak years of 2022-2023, the expansion across diverse educational fields indicates the broadening application of metaverse technology in education.

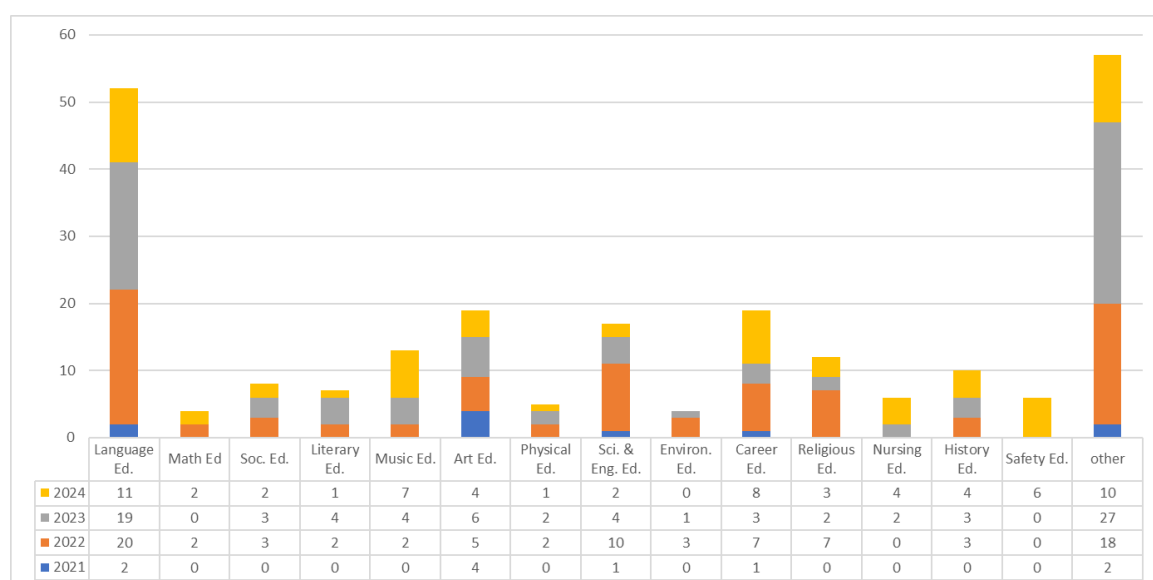


Figure 5. Educational Fields Utilizing the Metaverse by Year

Figure 6 presents the distribution of research methods employed across different educational fields in metaverse-based education research. In language education, which is the most active area of metaverse research, a significant amount of survey research (13 studies), developmental research (12 studies), and case studies (10 studies) have been conducted. Text-based communication in the metaverse was found to alleviate emotional burden, thereby enabling more accurate linguistic interaction and promoting active class participation as well as improved academic performance (Sim, Ryu, & Kim, 2023). For learners who struggle with reading classical novels, it has been demonstrated that drawing parallels between the fictional world and the metaverse virtual world enhances text comprehension (Park, 2022). This approach has also shown the potential for developing creative cultural content through new interpretations and storytelling of classics (Kim, 2022). Following language education, religious education showed the second-highest volume of literature reviews (7 studies) among specific educational fields. Although a limited number of experimental/action studies (1 study) and case studies (1 study) were conducted, most research in this field focused on literature-based examinations of metaverse applications. In arts education, case studies (6 studies) were predominant, supplemented by literature

reviews (5 studies) and experimental/action research (5 studies). In science and engineering education, development studies (8 studies) as well as experimental/action research (8 studies) were frequently employed. Environmental education was exclusively carried out through experimental/action research (4 studies), while music education and nursing education were also fields in which experimental/action studies were prevalent.

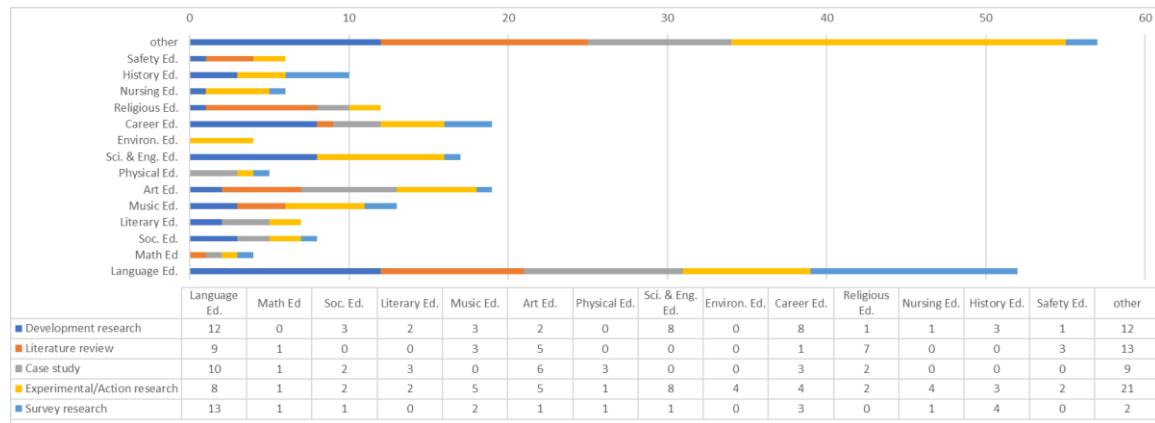


Figure 6. Educational Fields Utilizing the Metaverse by Research Method

These diverse methodological approaches across educational fields have yielded important findings about metaverse applications in education. Metaverse-based lectures have proven effective as alternatives to recorded video lectures or real-time classes delivered through video conferencing platforms (Park, 2024; Park & Lee, 2022). In particular, studies on environmental education have shown that metaverse programs are effective in changing students' environmental awareness, fostering a sense of responsibility for environmental action, and enhancing environmental literacy (Choi & So, 2022; Nam, 2022; Nam, Lee, & Lee, 2022). Meanwhile, research on elementary school students reported that although metaverse education positively influenced attitudes toward science learning, it had no significant effect on science achievement or digital literacy (Wang & Lim, 2023).

### Platform Usage in Metaverse Education Studies

Excluding 141 studies that did not utilize or mention metaverse platforms, the most frequently used platforms in Korea over the past five years were Gather Town (55 studies), ZEP (43 studies), and Zepeto (27 studies), in that order (see Figure 7). Gather Town enables natural interaction through its 2D graphics and location-based communication, and its easy spatial configuration makes it highly versatile for educational settings. ZEP, a metaverse platform launched by Korea's Naver Z in 2022, shares similarities with Gather Town. Although it is also based on 2D graphics, its avatars are more sophisticated, and its excellent mobile accessibility led to its rapid adoption in educational settings. Consequently, research using ZEP appears to have increased rapidly in Korea since 2023 (from 4 studies in 2022 to 18 studies in 2023 and 21 studies in 2024). Meanwhile, 3D graphics-based platforms such as Zepeto and Ifland, also developed in Korea, demonstrated moderate usage with 27 and 15 studies respectively. However, as these platforms are more suitable for seminars, events, and entertainment, they posed challenges in classroom space development and educational structuring, limiting their educational research applications compared to 2D platforms like Gather Town and ZEP. Additionally, research was conducted using VR-based platforms (17 studies), including both commercial solutions and in-house developed

VR systems. Educational platforms such as Cospaces Edu (11 studies), Roblox (9 studies), and Minecraft (4 studies) were also utilized, while Mozilla Hubs (3 studies) showed more limited usage.

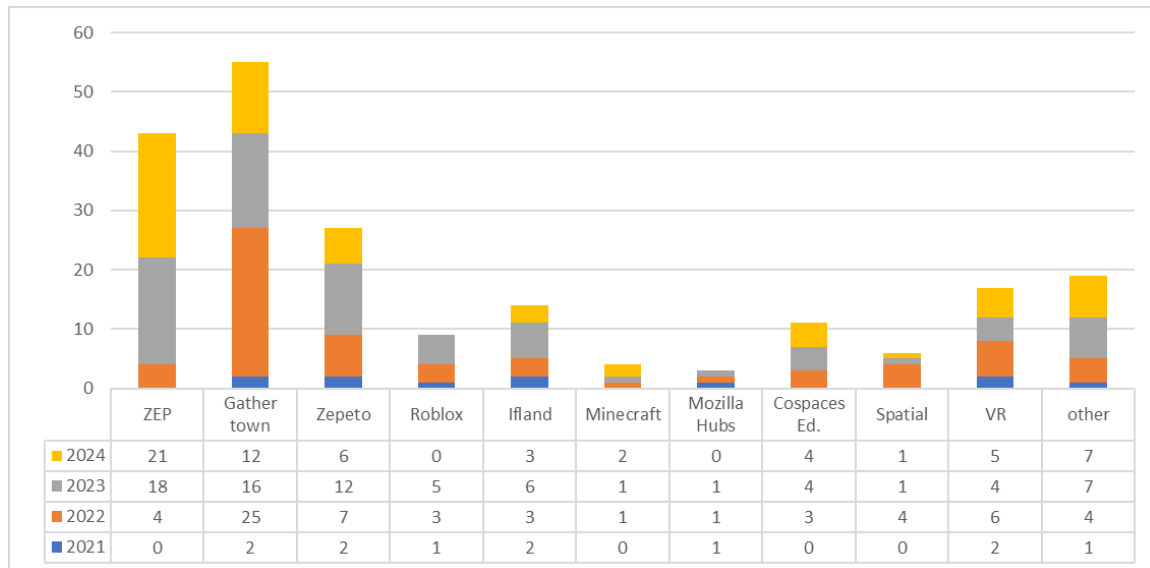


Figure 7. Metaverse Education Platforms by Year

### Keywords and Trend of Topics

In the co-occurrence analysis of keywords, when the minimum number of occurrences was set to 4, 41 out of 933 total keywords met the threshold (see Table 4).

Table 4. Top 15 Keywords Ranked by Occurrence Frequency in Co-occurrence Analysis

Rank	Keyword	Occurrences	Total link strength
1	Metaverse	275	294
2	VR	31	60
3	Platform	35	54
4	Online education	26	48
5	Virtual worlds	18	34
6	Higher education	19	30
7	Gathertown	14	29
8	Metaverse education	17	24
9	AR	10	23
10	Education	18	22
11	Korean language education	10	21
12	Edutech	11	18
13	Instructional design	8	16
14	Zep	9	14
15	AI	8	13

For each keyword, the total strength of co-occurrence links with other keywords was calculated. Based on occurrence frequency, the most frequently used keyword was "Metaverse" (275 occurrences), followed by "Platform" (35), "VR" (31), and "Online education" (26). However, when ranked by total link strength, "Metaverse" maintained the top position (294), followed by "VR" (60), "Platform" (54), and "Online education" (48). Keywords such as "Virtual worlds" (18 occurrences, 34 link strength) and "Higher education" (19 occurrences, 30 link strength) also showed notable co-occurrence patterns.

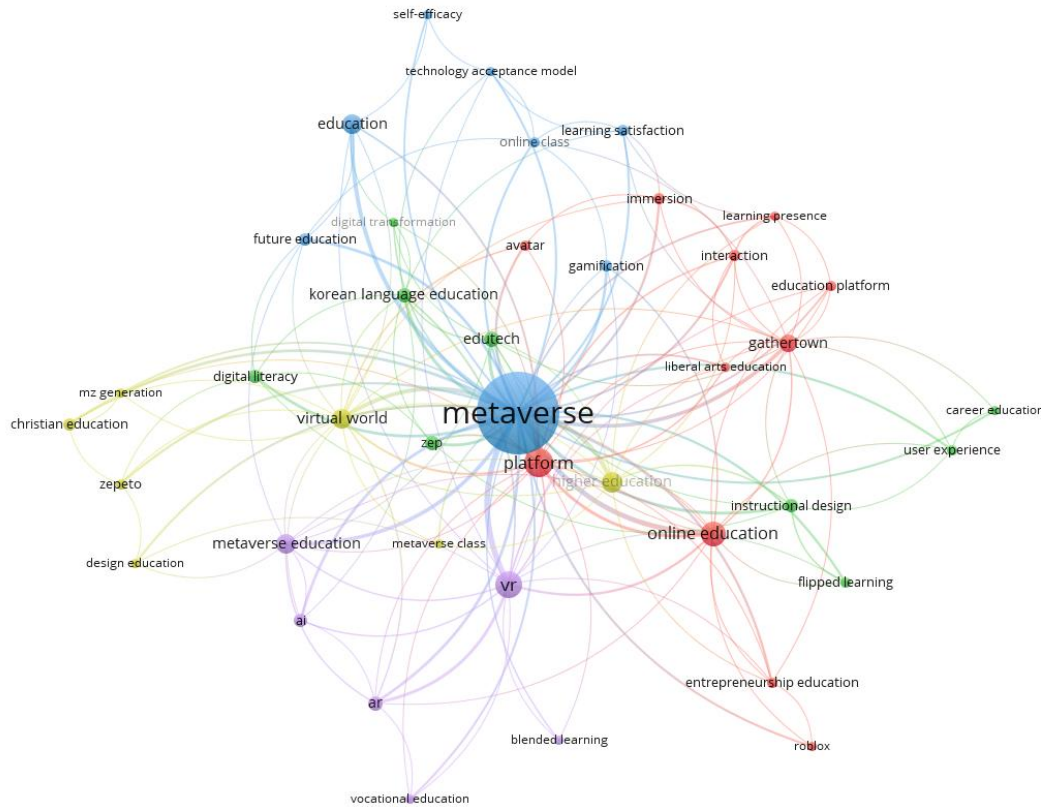


Figure 8. Network Visualization of the Most Frequent Keyword

Figure 8 visualizes the network structure of the 41 high-frequency keywords, classified into five distinct thematic clusters (see Table 5). Node size represents keyword frequency, while edges indicate co-occurrence relationships between keywords. The first cluster (red, 11 keywords) centers on “immersive virtual learning environments”, encompassing metaverse-based platforms such as Gather Town and Roblox where learners engage through avatar-mediated interactions. This cluster emphasizes core experiential elements including immersion, presence, and interactivity, with particular relevance to creativity-focused disciplines such as entrepreneurship and humanities education. The second cluster (green, 9 keywords) focuses on “learner-centered instructional design”, highlighting the integration of edutech solutions to support dynamic, personalized learning experiences. This theme encompasses career education and language learning applications designed for future-ready skill development. The third cluster (blue, 8 keywords) represents “gamified educational technologies”, emphasizing the integration of game elements and metaverse environments into online learning systems. This approach particularly influences learner outcomes in terms of self-efficacy, satisfaction, and technology acceptance. The fourth cluster (yellow, 7 keywords) focuses on “specialized educational contexts”. This cluster encompasses

applications in higher education and generation-specific approaches (MZ generation), as well as domain-specific implementations in Christian education and design education, primarily delivered through platforms like Zepeto and virtual world environments. The final cluster (purple, 6 keywords) focuses on “extended reality (XR)-based blended learning”. This refers to metaverse education that combines augmented reality and virtual reality supported by artificial intelligence. By encompassing technologies and experiences that connect the real and virtual worlds, it appears particularly effective for vocational education and training.

These five clusters collectively demonstrate the multifaceted nature of metaverse education research, spanning from technological infrastructure (Clusters 1, 5) to pedagogical approaches (Clusters 2, 3) and contextual applications (Cluster 4). The network analysis reveals that metaverse education research integrates technological affordances with learner-centered design principles across diverse educational contexts.

Table 5. Keyword Co-occurrence Analysis Clusters in Metaverse Education Research

Cluster No(color)	Cluster label	Number of keywords	Representative keywords
1 (Red)	Immersive virtual learning environments	11	avatar, education platform, entrepreneurship education, Gathertown, immersion, interaction, learning presence, liberal arts education, online education, platform, Roblox
2 (Green)	Learner-centered instructional design	9	career education, digital literacy, digital transformation, edutech, flipped learning, instructional design, Korean language education, user experience, Zep
3 (Blue)	Gamified educational technologies	8	education, future education, gamification, learning satisfaction, metaverse, online class, self-efficacy, technology acceptance
4 (Yellow)	Specialized educational contexts	7	Christian education, design education, higher education, metaverse class, mz generation, virtual world, Zepeto
5 (Purple)	XR-based blended learning	6	AI, AR, blended learning, metaverse education, vocational education, VR

Figure 9 provides an overlay visualization of high-frequency keywords over time. Many keywords appear in teal and green, indicating that research on metaverse education was most active in 2022 and 2023. Keywords from 2021, which appear in purple or deep blue, are rare due to the limited number of studies. However, keywords like "avatar" can be found, centered around core terms like "metaverse," "VR," and "online education." This period represents the early stages of metaverse education, where its potential as an alternative to online learning during the pandemic was first explored. The teal-colored keywords from 2022, a year that saw a rapid increase in research papers, include "self-efficacy," "user experience," "technology acceptance model," "edtech," "gamification," "immersion," "future education," "blended learning," "flipped learning," and "learning



## Discussion

As a result of a systematic review of metaverse education research in Korea from 2020 to 2024, it was found that such research began in earnest in 2022. This finding aligns with Hwang and Han's (2022) analysis of Korean metaverse research trends from 2007 to 2021, which noted that while research had been active in the arts and social sciences, educational applications remained limited. However, interest in educational applications of the metaverse emerged after 2021, coinciding with the pandemic. Korean metaverse education research initially began with literature reviews and survey studies in 2022, gradually progressing to developmental and case studies, with experimental and action research continuing to present. The keyword co-occurrence analysis demonstrates that Korean metaverse education research has evolved from conceptual introduction and technical exploration toward pedagogical applications, emphasizing enhanced learning experiences. Recent studies focus on developing concrete metaverse education models using actual platforms, applying them across diverse educational fields to achieve practical learning outcomes and competency-based educational goals.

According to literature analyzing overseas research trends, metaverse education research has primarily focused on higher education, with limited attention to early childhood, elementary, and secondary education. Research targeting students with disabilities has been particularly insufficient (Avic & Akgul, 2024; Tlili et al., 2022). In contrast, Korean metaverse education research, while most active in higher education, has demonstrated broader scope and inclusivity. Studies have extended to elementary and secondary education levels, with substantial research focusing on pre-service teachers. Moreover, the scope has expanded to include early childhood education, special education, generational education, and vocational training. This comprehensive approach has yielded educational benefits across diverse populations, from young children to elderly learners, including meaningful outcomes in vocational preparation programs for people with disabilities. These diverse applications align with research indicating that metaverse education fosters creativity and reduces learning risks by promoting interaction, enhancing motivation and learner engagement, and providing previously impossible experiences (Tlili et al., 2022). The Korean research landscape suggests that when metaverse environments provide effective virtual spaces tailored to learner characteristics, meaningful educational outcomes can be achieved across all age groups and abilities in safe, controlled environments.

In South Korea, metaverse education has been most actively utilized in language education, with substantial applications in arts and career education, and growing extensions to science and engineering, music, and religious education. This contrasts with global trends identified by Tlili et al. (2022), where metaverse education studies have predominantly focused on natural sciences, mathematics, and engineering, followed by general education and arts and humanities. These differences may reflect Korea's unique educational properties and the rapid adoption of metaverse platforms during the pandemic period. Regarding research methodologies by educational field, development research and experimental/action research have been predominant in science and engineering education, while literature reviews, survey research, development research, and case studies have been more prevalent in humanities and arts fields. This methodological distinction suggests that science and engineering education has emphasized practical implementation and empirical validation of metaverse applications, whereas humanities and arts education has focused more on theoretical exploration and strategic

development for future adoption.

Metaverse education is primarily applied to situational learning, cooperative learning, problem-based learning, and game-based learning (Feng et al., 2024), and students generally exhibit positive attitudes toward it. Additionally, learners perceive metaverse education as offering greater interaction with teachers and peers, a more enjoyable learning environment and content, and flexibility in time and space (Talan & Kalinkara, 2022). While some empirical studies note that research findings thus far remain at the level of broad, general suggestions (Heo, Shin, & Sol, 2023), the accumulated research demonstrates that metaverse education is a sufficiently appealing method. It serves as a learner-centered, engaging tool for collaborative learning.

While metaverse education has positive effects on interest and immersion, issues with device utilization skills and systematic learning challenges are identified as barriers (Cheong & Lee, 2022; Park, 2023; Shin & Han, 2023). From a technical perspective, issues such as network traffic and smartphone interface design have been noted, and limited class sizes have also been identified as problematic, as they can reduce communication quality. Platforms like Gather Town and Zep, which are primarily used in Korean educational settings and feature 2D pixel graphics, provide a game-like learning experience. While they show significantly higher satisfaction levels compared to online classes using platforms like Zoom, they have the drawback of lacking realism (Lee, 2021). In contrast, 3D-based platforms like VR require significant time and cost for classroom implementation, and learners also need considerable time to adapt to them (Jung & Seo, 2022). Therefore, 2D-based metaverse platforms still appear to be more suitable for school settings. As Tlili et al. (2022) suggested, it's necessary to study how teachers can adapt in a future where AR technology becomes more widespread. Furthermore, as the internet evolves toward Web 4.0 through technologies like blockchain and NFTs, metaverse education research will need to consider these changes to stay relevant. What is clear for now is that user-friendly metaverse technologies remain most important in practice. These should enable teachers to design educational content that stimulates learners' interest and motivation, thereby fostering immersion.

Korean metaverse education research topics, identified through keyword network visualization, include immersive interactive virtual learning environments, learner-centered instructional design, gamified educational technologies, Specialized educational contexts, and XR-based blended learning. These themes are similar to the five clusters identified by Wider et al. (2025): advanced educational technology, technology adoption and acceptance, immersive learning, challenges and opportunities in educational technology, and extended reality in education. However Korean research distinctively expands learner categories due to strong interest in generational education. Furthermore, timeline analysis reveals that keywords such as "metaverse," "VR," and "avatar" emerged in 2021. In 2022, keywords such as "self-efficacy," "user experience," "edutech," "gamification," and "immersion" became prominent. In 2023 and 2024, significant attention was given to keywords like "AI," "learning satisfaction," and "digital literacy." This pattern aligns with Ren, Tan, & Guo's (2025) findings that metaverse-related terms like "virtual worlds," "Second Life," and "avatars" emerged in 2021, keywords like "augmented reality" and "gamification" became prominent in 2022, and the metaverse was frequently associated with education, learning, and technology in 2023.

Recent Korean research, however, focuses more on instructional design aligned with specific learning objectives like digital literacy and learning satisfaction, while demonstrating strong interest in AI integration. The convergence of generative AI and metaverse education has the potential to create more inclusive and engaging educational environments (Qian, Wang, & Cai, 2023). The potential of AI in the metaverse could enable intelligent NPC tutors, which can be used to analyze students' behavioral and interaction patterns, assess performance levels, and create new roles (Tlili et al., 2022). Han (2024), in a comparative analysis of Intelligent Tutoring Systems (ITS) and metaverse-based learning systems, proposed a hybrid tutoring model that combines the strengths of ITS—effective in improving learning outcomes—with those of the metaverse—effective in enhancing learning motivation and engagement. The design of metaverse-based learning activities may differ from traditional pedagogy, presenting both challenges and opportunities for teachers' instructional design capabilities (Feng et al., 2024). For effective educational implementation of technologies like the metaverse and generative AI, enhancing instructors' technical skills is essential. This requires targeted teacher education and professional development programs focused on creating and utilizing educational content within virtual environments.

## Conclusion

This study systematically examined the state of metaverse education research in Korea from 2020 to 2024, focusing on research methods, subjects, educational fields, and platforms. Through co-occurrence analysis of author keywords, it identified core themes and explored the directions and implications of metaverse education. The conclusions are as follows.

First, metaverse education functions as a learner-centered and engaging tool for collaborative learning. It is applicable across diverse domains—including language and humanities, science and engineering, music and arts, vocational education, and religious education—and effectively serves learners of all ages, including those in special education. Korean metaverse education research initially began with conceptual introductions and technical exploration through literature reviews and surveys. It has since expanded to include development studies, case studies, and experimental/action research across various fields and learner groups. These studies have demonstrated positive educational outcomes, including improved learner experiences, increased satisfaction, and enhanced competencies.

Second, metaverse education is effective when it ensures easy access and interaction for both learners and teachers, and incorporates gamification-based learning formats that stimulate interest and motivation. Rather than prioritizing technical sophistication—whether through 3D/XR platforms with advanced graphics or 2D systems—it is more beneficial to consider hybrid or flipped learning models that strategically integrate online and offline elements. Metaverse technologies and tools provide substantial technical support for education, enhancing learner immersion and motivation. However, it should be noted that if challenges arise in student management and instructional design, or if the suitability of the technology for learners is not carefully examined, it may instead impose cognitive load or hinder learning efficiency.

Finally, future metaverse education research should focus on introducing generative AI tutors and developing XR-based educational content across diverse fields. Continued attention must also be given to strengthening the digital competencies and literacy of both educators and learners. The metaverse isn't a new technology; it has been "reincarnated" multiple times over the past two decades. The failed Google Glass, for example, has reemerged as XR Glass in 2025. These advancing technologies are expected to soon transform educational environments into settings where XR and AI tutors naturally integrate into the learning experience. Therefore, beyond equipping teachers and students to use these technologies effectively, greater emphasis must be placed on literacy education addressing social and ethical challenges in virtual environments.

By 2024, South Korea achieved 100% nationwide distribution of digital devices for classroom use, creating an environment ready for metaverse technology implementation. The government aims to prioritize the introduction of AI digital textbooks in English, mathematics, and information technology courses by 2025. However, the current situation where AI digital textbooks are only usable as supplementary educational materials is generating significant controversy. Given these technological advances and ongoing challenges in educational innovation, metaverse education is expected to gain attention as a method for maximizing learner-centered educational effectiveness. During this transitional period of educational change driven by advanced technologies, metaverse education can act as a bridge—connecting online and offline education, integrating the real and virtual worlds, and linking traditional education with future-oriented learning.

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