A systematic review of the application of metaverse in language education: Prominent themes, research methods, impacts, and future challenges

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Abstract

In the era of human-computer symbiosis, extensive research has examined the influence of educational technologies on education. The nascent field, metaverse, driven by advancements in 5G, VR, and AR, has emerged as a new frontier. Although some scholars have explored the application of the metaverse in education, there is a lack of research specifically focusing on its implications for language education. This systematic literature review aims to comprehensively examine empirical studies on the use of metaverse in language education, including, research topics, methodologies, common tools, impacts, and challenges. Through searching authoritative databases (i.e., Web of Science and Scopus) following the Preferred Reporting Items for Systematic Review and Meta-Analyses guidelines (i.e., PRISMA), 12 relevant articles were selected. Statistical analysis showed that South Korea and China are active contributors in this field, primarily investigating university students. Platforms like Ifland, Gather Town, and Metaverse Studio were commonly used for metaverse construction, along with tools such as VR. Quantitative and mixed-method approaches were favored, with research mostly focused on student and teacher perspectives and language proficiency outcomes. Overall, findings suggest positive attitudes towards metaverse implementation and its beneficial impact on learning outcomes, but caution against considering it a complete solution for language learning. Despite valuable insights, the existing literature on metaverse in language education remains limited compared to other technological domains. Further research is necessary to enrich the understanding of research directions, sample choice, experimental findings and so on.

Keywords language education; metaverse; systematic review

1. Introduction

Since internet giant Facebook changed its name to Meta in 2021, the concept of metaverse has dramatically re-emerged into the spotlight from all walks of life (Tlili et al., 2022). Its characteristics of high immersion, strong sociality, and decentralization have attracted all fields (i.e., finance, entertainment, education, etc.) to focus on this trade trend and try to find new development opportunities to step into. In education, metaverses transcend the constraints of conventional two-dimensional online learning, specifically the lack of interactivity (Hwuang, 2023). By leveraging three-dimensional environments and heightened immersion engagement the metaverse can stimulate student interest (Rojas et al., 2023), motivation, facilitate collaboration, and group activities, improve teacher-student interaction, (Irene et al., 2023) and even learning outcomes (Arita et al., 2022). Additionally, foreign language education has been criticized for decontextualization, but metaverse platforms may aptly compensate by situating lessons in virtual settings (Lee,

2023). Moreover, preliminary evidence suggests the metaverse enabled learning continuity during the pandemic (e.g., Onggirawan et al., 2023; Hyun, 2021) which magnets lots of researchers. Hence, myriads of empirical research on its educational applications (e.g., Han & Noh, 2021; Talan & Kalinkara, 2022; Wang & Shin, 2022) but studies focused on language education are scarce. Therefore, this study aims to systematically review existing literature on metaverse integration in education and its affordances for the language class, which encapsulates the current state of knowledge, analyzes critical themes emergent in this nascent field, and evaluates the promise and limitations of the metaverse for enhancing language teaching and learning thus far. Findings will inform future research and practice on balancing novel immersive modalities with sustained pedagogical principles to realize the potential of this emerging paradigm across diverse language education contexts.

2. Literature Review

2.1. What is Metaverse?

De facto, the metaverse is not a new word. The origin of the term metaverse was conceived in literature and film, with the earliest known usage in Neal Stephenson's 1992 sci-fi novel *Snow Crash* (Wang, 2022; Suh & Ahn, 2022). In this book, Stephenson (1992) depicted a surrealist digital space where people can escape the barriers of geographical space and live productively through their own Avatars. As society advances in technology, the concept of the metaverse is constantly being enriched. Gradually, some film and television productions have started to try to visualize the metaverse concept with special effects technology, such as Ready Player One and The Matrix (e.g., Buhalis et al. 2023; Wu, 2022; Yao & Yao, 2023). Propelled by these cultural forerunners, the video game market has been quick to grasp this industry windfall and has taken the lead in exploring the metaverse market for the first time. Examples like Second Life, Roblox, Fortnite, and VRChat are taken as the forerunners to the Metaverse (Dwivedi et al., 2022).

Such explorations in literature and film to entertainment games represent the culmination of longstanding aspirations to transcend geographic and physical barriers through technology. In addition, the key technologies of the metaverse: 5G, big data, AR, VR, blockchain, brain-machine interface, holography, etc. are developing very rapidly, which makes the metaverse concept full of infinite possibilities (Zhang et al., 2022; Park & Kim, 2022). Consequently, there has not been a clear definition of the metaverse so far (Dahan et al., 2022). Proposed definitions characterize the metaverse as a shift in human-technology interaction (Zhu, 2022), or an immersive, multi-sensory network integrating physical and virtual worlds (center for Journalism Studies of Tsinghua University, 2023). Researchers categorize academic metaverse conceptualizations into aspects like digital identity mapping, virtual-real integration, production transactions, and informational exchange (Zhao et al., 2022). Likewise, the metaverse represents human activities through interconnected 3D virtual spaces mirroring the real world (Kim & Lee, 2022). Academically, metaverse concepts encompass digital identity mapping, integrating physical and virtual worlds, enabling virtual transactions, and facilitating informational exchange (Zhao et al., 2022). In essence, the metaverse aims to simulate real-life activities and communities in immersive digital environments.

In tandem, COVID-19 has increased people's desire to break down the barriers of time and space (Kye et al., 2021; Zou et al., 2021). Under this milieu, the metaverse has shown a broad scenario and diverse forms of its future development on its practical application, which aids a plethora of fields, like e-commerce, education, digital games, tourism, social, and so on (e.g., Pesce, 2021; Monaco & Sacchi, 2023; Park & Kim, 2022). In entertainment, game platforms like Second Life and Roblox are popular. For tourism, South Korea's Incheon airport provides augmented reality navigation allowing visitors to virtually travel through history (e.g., Um et al). Regarding e-commerce, the metaverse helps unite online and offline experiences through digital twins. Luxury brand Prada launched a virtual spokesmodel (Sands et al., 2022), with other companies like KFC, Netflix, and the World Health Organization creating virtual celebrities (Baklanov, 2019).

This also provides a new opportunity for education. Specifically, on the theoretical level, Wang (2022) proposed the idea of collaborative classrooms at primary and secondary levels with the help of XR and the "three teachers". Additionally, with the aid of metaverse concepts, Jovanović et al. (2022) introduced a 3D virtual learning environment (3D-VLE). In terms of practical applications, Stanford University improved the course Virtual People (Kornfein, 2021). In the same vein, National Taiwan Ocean University (NTOU) cooperated with the XRSPACE company and promoted the world's first GOXR Metaverse University (XRSPACE, 2022).

Despite the differences in conceptual expression, the technical support at this stage is mainly reflected in two types of applications in the metaverse. The first one is to create virtual parallel worlds to strengthen the connection between the virtual world and the real world by constructing virtual identities for users. The second is to interact with users by creating a digital body, shaping the corporate image, and strengthening and shaping brand awareness while obtaining users' emotional identity. Overall, the metaverse application market is broad, diverse, and has infinite potential. Its high degree of immersion and interactivity can have a great impact on various industries in the post-epidemic era, providing good reference and thinking.

2.2. Metaverse and Education

Education, as the foundation of the country, its development is inseparably influenced by the pace of the times. By virtue of being resourceful, accessible, affordable, and flexible, online learning has become another form of supplementing traditional face-to-face learning (Zhang et al., 2022). However, the completion of online courses is not optimistic (Suresh & Mallikarjuna, 2019; Sinclair & Kalvala, 2016), mainly due to the limitations of current 2D learning platforms in terms of the users' interaction, which has led to a decline in learners' motivation and participation (e.g., Kang et al., 2020; Pursel, 2016).

However, this phenomenon can be eased by metaverse, which integrates the features of digital games, remote interaction, AR, VR, social sharing, etc. By combining these auditory, visual, and somatosensory devices, the metaverse can stimulate learners' senses, which can impel students to achieve active learning (Gürkan & Bayer, 2023) and relieve their demotivation (Park & Kim, 2022). Additionally, the metaverse implements the ability to link experiences to location-based triggers, which could help the learners interact with other speakers and virtual places (MacCallum & Parsons, 2019), thereby achieving social attributes and offering sustainable content. This is one of the hallmarks of Metaverse, which many other AR and VR tools have not been able to do previously (Park & Kim, 2022). This has attracted many scholars to discuss education in the era of the metaverse. The existing literature on the metaverse and education is centered around two main subjects of

learning, teachers, and students.

Extant research on teacher-metaverse dynamics predominantly examines educator perspectives (Aydin, 2023; Gürkan & Bayer, 2023; Han & Hong, 2023; Rachmadtullah et al., 2023). For example, Gürkan and Bayer (2023) surveyed 122 Turkish primary and secondary teachers, finding that 65% comprehended metaverse concepts and applications, but most only understood gaming applications (45%) vis-à-vis educational uses (11%). Just 30.3% recognized potential metaverse benefits for education. Similarly, Han and Hong (2022) quantitatively assessed South Korean elementary teachers' metaverse perceptions using a 5-point Likert scale. Results showed while over half express openness to integration, actual adoption remains scarce. Attitudes are mixed - teachers perceive that the metaverse enables personalized and interactive learning, yet worry about student concentration, misuse, and evading control. Findings concur that metaverse is better suited to upper primary grades, problem-solving, and hands-on activities.

Mirroring research on teacher perspectives, a myriad of researchers on metaverse and students have also focused on students' perceptions (e.g., Rojas et al., 2023; Hwang et al., 2023; Almarzouqi et al., 2022; Pyo, 2022; Yang et al, 2022). In addition to similar concerns about understanding, acceptance, and possible concerns that are prevalent in research on teachers, engagement, immersion, satisfaction, fun, and so on are often mentioned in the metaverse and student-related research. For instance, Rojas et al. (2023) implemented an educational metaverse platform for engineering students at four universities and quantitatively analyzed the students' perspectives, the conclusions of which showed that the students' perceptions of the platform's ease of use, satisfaction, fun, and immersion were positive, while in terms of learning experience and usefulness, the students' attitude was ambiguous. Also, students felt that the platform still fell short in terms of interactivity compared to face-to-face instructions.

Apart from perceptions, studies on metaverse and students had also foci on the learning outcomes. As proof, Arita et al. (2022) selected a sample of 75 fifth-grade primary school students for a before-and-after experiment on the use of metadata applications in science class, and the result of the t-test showed that the application of metaverse could positively impact the learning outcomes. Meanwhile, Hua and Fu (2022) built three interactive scenarios with the help of two metaverse platforms (i.e., Minecraft Studios and Roblox Studios), to verify their learning effects. The result showed that the avatars provided by the metaverse platform were conducive to the physiological representation of "high arousal-positive emotion", which could indicate that the metaverse had a facilitative effect on learning, by collecting electrocardiographic (ECG) data from the subjects. This consensus has been reached by some scholars (viz. López-Belmonte et al., 2022; Al Yakin et al., 2023). Paradoxically, Zhang (2023) failed to replicate the result. By using a mixed method to investigate the undergraduate students' use of Metaverse for learning. The data showed that students were highly engaged, motivated, and socially aware, but their academic performance was not improved, mainly due to the interference of device network problems and the novelty of the metaverse platform that attracted the students' attention (Zhang, 2023).

Additionally, ethical concerns and risks surrounding metaverse integration in education have spurred scholarly debate (Hu & Wang, 2022; Kaddoura & AI Husseiny, 2023; Yang & Zhu, 2022). For instance, Hu and Wang (2022) delineated four core ethical perils of educational metaverses: diminished interpersonal communicative rationality, problematic learner immersion and overindulgence, disjointed cognition and behavior across real-virtual divides, and human-technology tensions under AI inducement. Proposed mitigation strategies span bolstering intersubjective communication and perspective-taking, nurturing learner self-awareness and self-regulation, and synergizing physical and virtual spaces. Specifically, rational discourse and empathetic imagination could smooth social interactions. Learners should also strengthen self-discipline to avoid over-immersion in virtual environments. Further research and deliberation are imperative to unravel and address the array of ethical challenges introduced by educational metaverse integration.

In summary, metaverse has been well-researched in the field of education, and in general teachers and students have a positive attitude toward its development in this field, but they still have a rudimentary understanding of this nascent technology which triggers a raft of concerns and challenges, which means there is still a long way to go. In addition, the aforementioned research on the application of metaverse in education is mainly empirical, which suggests that there is an urgent need for an overview study of metaverse research in education. In addition, although previous authors (e.g., Samala et al., 2023; Tlili et al., 2022; Alfaisal et al., 2022; Chua & Yu, 2023) have provided reviews of the metaverse in the field of education, they have not been specific to a particular subject of education. Meanwhile, Wu et al. (2023) pointed out that most of the studies on metaverse in education are foci on disciplines like science, technology, engineering, and math (i.e., STEM), vis-à-vis language learning. Accordingly, this article aims to provide a systematic literature review of empirical articles on the use of metaverse techniques in language education. The issues to be addressed are as follows.

RQ1: Which countries have made outstanding contributions to language education in the metaverse?

RQ2: What participant samples were used in the study on metaverse-empowered language education?

RQ3: What kind of tools have been employed in metaverse-empowered language education?

RQ4: What are the research methods and the measurements of these empirical research?

RQ5: What are the main topics of the research on metaverse-empowered language education?

RQ6: How the application of metaverse will affect language teaching?

RQ7: What are the challenges of metaverse-empowered language education?

3. Methods

3.1. Research Design

This systematic review is strictly in accordance with the requirements of Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA), which is highly recommended by Page et al. (2021). The author selected Web of Sciences (WoS) and Scoups as the sources for articles for several reasons. Firstly, these two databases are considered to be the titans of bibliographic information (Pranckutė, 2021), which integrate myriad influential publications on educational technology (Mystakidis et al., 2022). Secondly, we referred to previous review studies in this area of computer-assisted language teaching and found that these two databases were commonly chosen (e.g. Zou, et al., 2020; Cramarenco, et al., 2023; Amores-Valencia et al., 2022, Darmawansah et al., 2023). And for the choice of literature type, the author chose "article". And in terms of the time limit, the author selected all articles up to 14 July 2023. In addition, using keywords searched in Soups as an example, the author (ALL (metaverse) AND ALL ("language education") OR ALL ("language learning") OR ALL ("language teaching")) AND (LIMIT-TO (DOCTYPE, "ar")) as search keywords, and unlike other authors who limited their search to titles and keywords, the authors chose to involve the full text in a finer and more comprehensive filter.

The primary results showed that there are 22 articles and 168 articles in WoS and Scopus respectively. Subsequently, the author screened the initial selection of articles according to the inclusion and exclusion criteria (see Table 1). The specific screening process is displayed in the PRISMA flow diagram (see Figure 1). Firstly, the author deleted nine duplicate articles. Secondly, six articles were deleted as they were not available. Thirdly, 40 articles that did not explicitly define the used technology as metaverse in the body of the text were excluded. Finally, researchers ruled out 90 articles that were not related to language education and 28 articles non-empirical articles. In the end, 12 articles were included in this review (see Appendix I).

Table 1. Inclusion and exclusion criteria

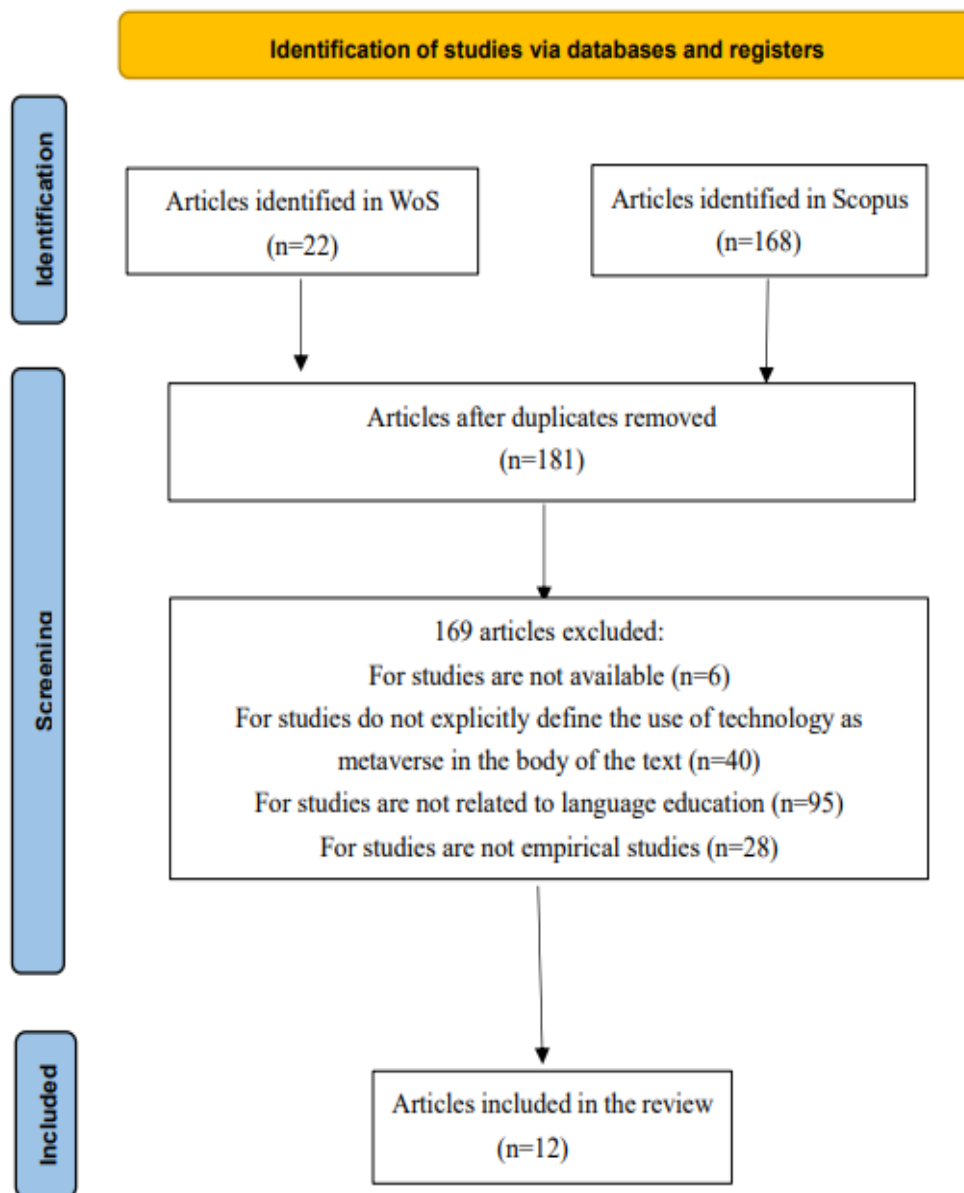| Inclusion criteria	Exclusion criteria
1) The use of technology is explicitly defined as metaverse in the body of the text.	1) The use of metaverse tools is not explicitly indicated in the article.
2) Articles must be empirical research.	2) Metaverse technologies were used in other fields.
3) Full text available.	3) Duplicate articles.
4) Articles on metaverse in the field of language education.	4) Non-empirical research.
	5) Articles that were not available.
	6) Reports, book chapters, thesis, conference proceedings, dissertations.

Identification

Articles identified in WoS
(n=22)

Articles identified in Scopus
(n=168)

Screening

Articles after duplicates removed
(n=181)

169 articles excluded:

For studies are not available (n=6)

For studies do not explicitly define the use of technology as
metaverse in the body of the text (n=40)

For studies are not related to language education (n=95)

For studies are not empirical studies (n=28)

Included

Articles included in the review
(n=12)

Figure 1. PRISMA flow diagram

4. Results and Discussion

RQ1: Which countries have made outstanding contributions to language education in the metaverse?

Twelve articles were left after close scrutiny had been conducted. Therefore, to address the first question, the country of affiliation of the first author of the article was taken into account in this question, and the author found that South Korea (n=5) and China (n=4) are the two countries that made the main contributions to the metaverse and language education, with South Korea contributing the most. Secondly, other countries such as Turkey, Spain, and Italy each contributed one relevant empirical study.

The predominance of research output from South Korea and China is unsurprising given these countries" reputation as global leaders in technological advancement and metaverse development. With strong financial investment, South Korea and China present fertile environments for piloting innovative educational metaverse platforms (Ning et al., 2023; Cheng, 2023). However, the lack of studies from Western contexts indicates a need to expand this research area globally to encompass more diverse student demographics, learning needs, and pedagogical models. Insights from countries where English is natively spoken can complement the pioneering work emerging from Asian contexts.

Overall, this breakdown of authors' country affiliations reveals a research landscape still in its infancy but held by a handful of leading nations. To mature into a robust field, metaverse language education scholarship requires a greater contribution from academics across the world to assess the generalized promise and pitfalls of these technologies. International research collaborations may help disseminate expertise while enabling locally tailored implementations that avoid one-size-fits-all assumptions. With the prudent global expansion of this research domain, the full potential of metaverse language education can be revealed.
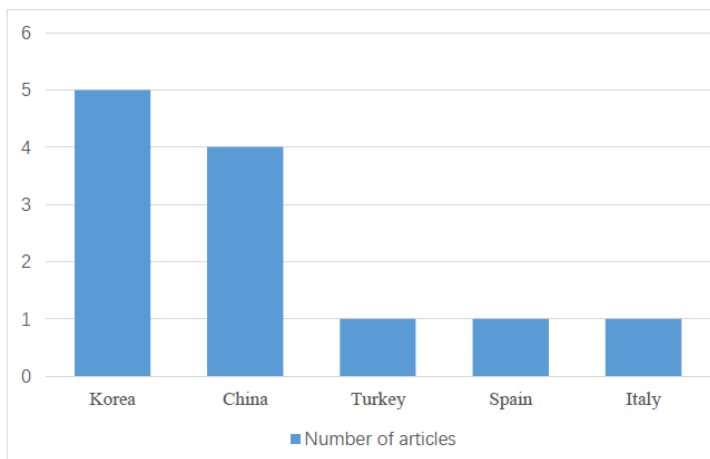
Figure 2. Number of articles from countries

RQ2: Selection of samples

In metaverse language education scholarship, students represent the predominant research subjects, reflecting their vanguard role as digital natives. Quantitatively, students featured as participants in nine of the twelve examined studies, constituting three-quarters of the sample (Figure 3). Within student populations, university learners predominated, serving as subjects in seven articles and underscoring their avant-garde status. Elementary and high school students represented the focus in one study each (Lee, 2023; Çelik & Ersanlı, 2022 respectively), though Lee (2023) enriched perspectives through supplementary teacher interviews. Beyond student-centric foci, instructors received explicit attention as subjects in two studies (Manna, 2023; Lee & Huwang, 2022), with Manna (2023) examining pre-service teachers specifically. Uniquely, Wei (2023) targeted users aged 25-30 years old.

This disproportionate emphasis on students, especially undergraduates, mirrors their vanguard exploration of nascent metaverse platforms and pedagogies. The few teacher-focused studies acknowledge educators' equally integral role in manifesting education's metaverse future. Ultimately, the prevalence of student-oriented research underscores their generational primacy as pioneers of virtual learning. Meanwhile, the rare teacher-centered investigations highlight the infrastructural and professional development requirements for successful metaverse integration in schools.
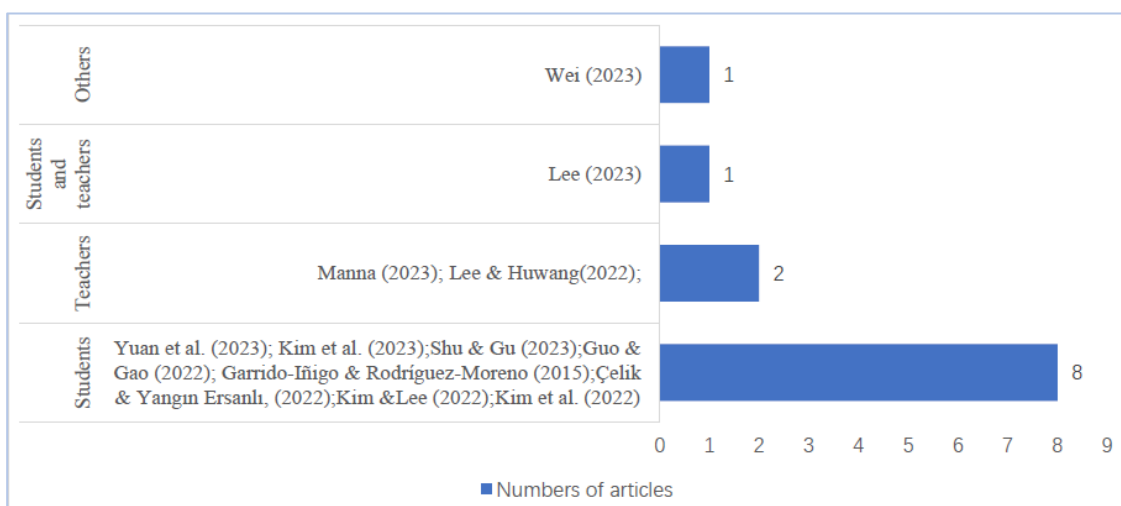

Figure 3. Selection of research object

RQ3: Choice of the tools

In general, the instrumentation for metaverse-based research bifurcates into the direct deployment of extant platforms and the creation of customized metaverse environments. Namely, the direct use of popular software such as gather town, ZEPETO, ifland, and so on. Or with the help of other software, VR, AR, or other tools that provide a metaverse environment for their research subjects. The results are shown in the Rising Sun chart (Figure 4). As evidence, eight scholars chose existing metaverse platforms, of which ifland (Kim et al., 2022; H. Kim et al, 2023), gather town (Lee, 2023; Kim & Lee, 2022) and metaverse studio (Çelik & Ersanlı, 2022; Manna, 2023) are frequently used. Other readymade platforms like Opensim (Garrido-Iñigo & Rodríguez-Moreno, 2015) and Frame VR (Lee & Huwang, 2022) afforded additional out-of-the-box facilities. Complementarily, bespoke metaverse environments enabled through virtual reality (VR) tools represent a second instrumental approach (Wei, 2023; Guo & Gao, 2022; Yuan et al., 2023). Expanding beyond VR, Shu and Gu (2023) incorporated artificial intelligence components to enrich their customized metaverse setting. As depicted in the radial chart (Figure 4), this bifurcation between leveraging extant metaverse platforms and constructing custom virtual environments underscores the diversity of instrumentation underpinning contemporary metaverse research. The creative synthesis of prefabricated solutions and purpose-built tools suggests a way in flux, poised to evolve apace with technological advances that promise an ever more immersive and multi-modal metaverse experience.

Figure 4. Selection of the tools

RQ4: Research methods and the measurements

Table 2 illustrates the authors' statistical results for the experimental methods and measurement tools of these studies. It displayed that the research methods used by the researchers were diverse, with quantitative methods being the most commonly used by the researchers, with about 6 articles, namely, 50% of the studies employing quantitative methods. This was followed by 5 mixed method studies and 1 qualitative study, in which the authors also used a wealth of measurement methods to testify their findings, with questionnaires being the most commonly used measurement tool, with 9 studies choosing questionnaires as the experimental tool, and interviews and tests being frequently used as measure tools, with 5 studies each using these means respectively. To make the conclusions more convincing, Lee (2023) used student journals, reflective journals, and discussions. Notably, Guo and Gao (2022) leveraged EEG in their experiments to fulfill the specific objectives of their study.

In summary, metaverse language education research to date has favored quantitative, questionnaire-based methods to objectively gauge impacts on student performance, motivation, and perceptions. However, the meaningful incorporation of qualitative tools by over half the studies recognizes the value of subjective insights to fully understand learners' virtual experience. As the field evolves, studies leveraging mixed methods and neuroscientific technologies can further unpack the nuances of language pedagogy in immersive digital environments. Rich multidimensional perspectives will be crucial to guiding evidence-based best practices in this rapidly emerging domain.

Table 2. Research methods and measurements

Methods	Authors	Measurement
Mixed methods	Yuan et al. (2023)	questionnaire
		interview
		test
	Shu and Gu (2023)	pre-test and post-test
		interview
		questionnaire
	Lee (2023)	pre-test and post-test
		questionnaire (post-survey)
		interviews with the teachers
		screen recordings
		students' journal
	Garrido-Iñigo & Rodríguez-Moreno (2015)	test
		survey (discussion)
	Kim et al (2023)	pre-test and post-test
		interview
		questionnaire
Quantitative methods	Çelik & Ersanlı (2022)	questionnaire
	Guo & Gao (2022)	EEG
	Kim & Lee (2022)	questionnaire
	Lee & Huwang (2022)	reflection papers (text mining, sentiment analysis)
		questionnaire
	Kim et al. (2022)	questionnaire
	Wei (2023)	questionnaire
Qualitative methods	Manna (2023)	semi-structured pre- and post-interviews

RQ 5: Main topics of these research

The author categorized the themes of the twelve articles into the following three categories students' perceptions, teachers' perceptions, and learning outcomes. However, it is worth noting, that there are several authors who focus on multiple aspects (see Figure 5). Overall, 6

articles (50%) encapsulated 2 topics in their articles and mainly focused on students' perceptions and learning outcomes.

Besides, in articles that focus on only one topic, students' perceptions are the major topic that has been discussed a lot, which took up to a quarter of the select studies and the variables focused in these studies were very diverse. For example, Wei (2023) investigated users' satisfaction with the efficiency of interactions and the feeling of immersion. Kim (2022) investigated the students' knowledge of the metaverse, whether they were interested in the metaverse's application to the teaching of the Korean language, and which specific language skills (e.g. listening, reading, speaking, and writing) they would like to see the metaverse applied to. Another example is that Guo and Gao (2022) explored the students' interactivity, immersion, and cognition by employing EEG.

Also, in terms of the number of studies, teachers' perceptions got scant attention within the field of metaverse language education, with only 2 articles (i.e., Lee & Huwang, 2023; Manna, 2023) that include teachers as subjects of research.

Finally, learning outcomes as an isolated theme appeared in one study examining academic performance (Shu & Gu, 2023), which displayed that the metaverse is a boon to language learning (i.e., English speaking, vocabulary and grammar, reading, writing, and translation).

All in all, existing research exhibits a student-centered nexus exploring virtual learning experiences and measurable gains. This reflects students' avant-garde position as pioneers of emerging metaverse platforms. However, the paucity of teacher-focused and multi-perspective investigations represents a considerable knowledge gap. A comprehensive understanding demands increased research attention on instructor readiness, pedagogical requirements, and potential challenges alongside student outcomes. Though still in its infancy, metaverse education research has unveiled promising learning potential through learners' eyes, while illuminating avenues for fuller elucidation.

RQ6: Pros and cons of metaverse platforms for language learning

From the conclusions of various scholars, in general teachers' and students' attitudes towards the application of the metaverse to language education are positive, as far as the students are concerned, they express their interest in the metaverse, their level of satisfaction, and their opinion that it is helpful for learning (Wei, 2022; Garrido-Iñigo & Rodríguez-Moreno, 2015, Kim & Lee, 2022), Lee's (2023) study also noted the metaverse's democratizing potential, as students would have more equal opportunities for some less confident students to actively participate in the classroom. Teachers also believe that it is effective for language education when applied appropriately (Manna, 2023; Lee & Huwang, 2022) Also from the results of some experiments, the metaverse is favorable for improving students' language learning performance (Yuan et al., 2023; Shu & Gu, 2023; Çelik & Ersanlı, 2022) In addition, Guo & Gao (2022) verified that when learners learn English in a metaverse environment, the student's learning state basically belongs to the medium-high cognitive

engagement state using EEG device tests. It shows that metaverse-empowered English teaching can improve students' learning outcomes.

However, teachers have also voiced apprehensions regarding the adoption of Metaverse in education. Specifically, they express concerns that students' attention may be diverted toward these technological tools, potentially undermining their focus on language learning itself (e.g., Manna, 2023). Additionally, students participating in Kim et al.'s (2023) study conveyed dissatisfaction with the Metaverse platform, highlighting its intricate usability and the disproportionate amount of time spent on system operation rather than language acquisition.

Thus, while predominately applauding the metaverse's motivational and pedagogical potential, stakeholders aired caveats about appropriately scaffolding environments and activities to maintain target language centrality. These nascent quantitatively demonstrated benefits coupled with emergent best practices could inform institutional integration policies and teacher training to maximize the metaverse's advantages while mitigating risks.
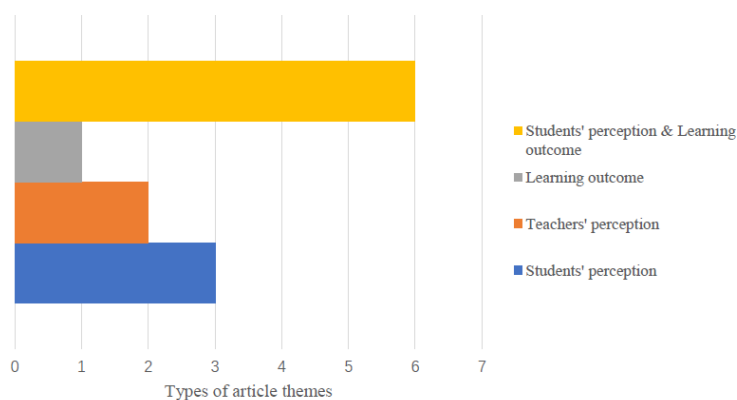

Figure 5. Topics in Metaverse and Language Education

RQ7: What are the challenges of metaverse-empowered language education?

Researchers have identified two primary categories of challenges associated with the utilization of Metaverse in education technology. On the one hand, there are user-related challenges stemming from the unfamiliarity of many teachers and students with this emerging concept. This lack of familiarity hinders their ability to effectively utilize Metaverse, thereby indirectly impacting their language learning experience in a negative manner (Lee, 2023; Yuan et al). In addition, Kim et al. (2022) noted that although the metaverse facilitated language learning, students felt it could not fully replace traditional face-to-face classrooms, as they craved teacher assistance. Despite differing samples, Garrido-Iñigo and Rodríguez-Moreno (2015) reached comparable conclusions, with students expressing a desire for teacher presence to support their learning and provide a sense of authenticity. This highlights the importance of balancing technological innovation with sustained teacher guidance and interactive pedagogy. While leveraging the experiential benefits of immersive virtual environments, the metaverse

cannot supplant fundamental human elements of teaching and social learning which remain pivotal to quality educational experiences, student development and outcomes. Moreover, the use of metaverse is perceived differently by students with different levels of foreign language proficiency and is particularly counterproductive for beginners due to language limitations and unfamiliarity with new technologies. Thirdly, teachers in Lee's studies (2023) claimed that not every teacher can construct the metaverse and it will take a lot of time and energy, which was in alignment with Manna's conclusion, namely, teachers considered this work to be complex and not easy to carry out.

On the other hand, many authors have expressed that the software used has many technical or design flaws, such as noise, power drain, difficulty in connecting to the platform, limited changes in avatars that are difficult to recognize, overlapping speech bubbles, and other user experience degradation, all of which are expected to be improved in future research (i.e., Kim, 2023; Çelik & Ersanlı, 2022, Lee, 2023; H. Kim et al, 2023). It is worth adding that Manna (2023) also expressed apprehension that the infrastructural and economic constraints of different social contexts must be taken into account before such technologies are used on a large scale in order to avoid widening the digital chasm.

Consequently, realizing the vaunted disruptive potential of metaverse language learning relies on addressing engrained human hesitancies and suboptimal technical infrastructure in tandem. Success requires research insights to guide best practices responsively tailored to diverse users' needs and skill levels. Beyond isolated technological fixes, a holistic approach is imperative encompassing pedagogical, ethical, and access considerations to ensure metaverse environments enhance rather than compromise learning.

5. Implications for future research

The findings indicate that overall, students and teachers have a positive attitude towards the metaverse, which provides high immersion and interactivity. This not only stimulates students' interest in language learning but also improves acquisition to some extent. However, concerns were raised including students' lack of concentration in class and increased workload for teachers. Nevertheless, research on the metaverse as a novel technology in language education remains scarce, concentrated primarily in Korea and China. Given differences across countries in educational philosophy, learning styles, and even metaverse adoption, these contexts may not represent diverse language environments, pedagogical systems, and learning preferences. Studies from other countries are needed to enrich the field.

Moreover, compared to research on other educational technologies, current metaverse topics in language education center on student and teacher perspectives alongside learning performance. Also, in the field of educational technology, D. Zou's (2020) literature review on the flipped language classroom revealed additional themes like influences of external factors, influences of learner factors, etc. The limited research scope in language education is likely attributable to the nascent state of metaverse-related research. Hence, a broader diversity of themes is hoped for as the field matures. Additionally, most studies sampled university students, with less representation of other groups. Expanding research to varied populations is recommended.

In terms of methodology, current research relies heavily on quantitative surveys with minimal qualitative investigations. Future efforts would benefit from enriched methodological plurality encompassing quantitative, qualitative, and mixed-methods designs to fully elucidate the complex phenomena surrounding metaverse-based language pedagogy. Also, current studies tend to employ short-term experiments. Longitudinal tracking is necessary to assess the metaverse's lasting influences on language acquisition.

6. Conclusion

Through a systematic literature review, this paper charts the contours of the metaverse in language education. It elucidates which countries have made the greatest contributions in this nascent field, the predominant focus on university student samples, the range of technologies employed, the scope of research topics, diverse research methods and instruments utilized, and the benefits as well as challenges of metaverse integration in language pedagogy. Key findings indicate an overall positive attitude among both instructors and learners, with the immersive quality of metaverse environments stimulating student interest and improving language acquisition to a certain degree. However, concerns persist regarding diminished student focus during lessons, increased teacher workloads, and how to navigate the relationship between technology integration and sustained teacher direction. Additionally, hardware problems and design issues still need to be ameliorated.

Moreover, this systematic review has several limitations that should be acknowledged. First, the small number of studies included (n=12) indicates the nascent state of research on the metaverse in language education, constraining analyses, and conclusions drawn from the evidence. Second, the predominant focus on university student samples restricts generalizability to other populations. Further studies among younger learners and non-academic contexts are required. Third, the narrow geographic spread of the reviewed literature concentrated in China and Korea may limit applicability to other cultural settings. The international diversity of samples would enrich understanding. Finally, the scope of technologies, languages, learning scenarios, and outcome measures was constrained. Expanded research across contexts would strengthen the knowledge base regarding optimal applications of the metaverse for language learning enhancement. In conclusion, this review represents an early step in elucidating the role of the metaverse in language education, but inherent limitations highlight the necessity of more expansive, diverse, and sophisticated inquiries to advance the field.

In conclusion, though research remains limited in this burgeoning area, the metaverse shows early promise as an emerging technology in language education. As the field matures, more expansive research is called for by focusing on various topics, and broadening the diversity of populations examined will also strengthen the generalizability and utility of findings. This review represents an inaugural step toward consolidating knowledge and mapping trajectories for future inquiry. The metaverse is poised to grow as a paradigm-shifting force in educational innovation. Continued research across diverse linguistic and cultural contexts will further unravel its potential.

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Data availability

The data analyzed for this systematic review consist of information extracted from the studies retrieved from the selected databases (i.e., WoS and Scopus), using the search strategy detailed in the Method section. References were managed using Excel software.

The extracted data support the findings and conclusions presented in this review. The data and materials are available upon request to the corresponding author. Interested researchers may contact the corresponding author for details on the selection process and overall literature search and data extraction methodology.

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Conflict of Interest

The authors received no funding and declared that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Appendix I

Authors	Title	Publication
Wei (2023)	Metaverse-based online English teaching scheme in multi-source and cross-domain environments	Fractals
Yuan et al. (2023)	Educational metaverse: an exploration and practice of VR wisdom teaching model in Chinese Open University English course	Interactive Technology and Smart Education
Kim et al. (2022)	A Study on foreign students' perception of Metaverse-Based Korean Language Course as general education	The Korean Association of General Education
Shu & Gu (2023)	An empirical study of a smart education model enabled by the Edu-Metaverse to enhance better learning outcomes for students	Systems
Lee (2023)	Second language learning through an emergent narrative in a narrative-rich customizable metaverse platform	IEEE Transactions on Learning Technologies
Çelik & Ersanh (2022)	The use of augmented reality in a gamified CLIL lesson and students' achievements and attitudes: a quasi-experiment study	Smart Learning Environments
Kim et al. (2023)	Exploring the potential of Metaverse as a future learning platform for enhancing EFL learners' English proficiency	Korean Journal of English Language and Linguistics
Manna (2023)	Teachers as augmented reality designers: A Study on Italian as a foreign language teacher perceptions	International Journal of Mobile and Blended Learning
Lee & Huwang (2022)	Technology-Enhanced Education through VR-Making and Metaverse-Linking to foster teacher readiness and sustainable learning	Sustainability
Garrido-Iñigo & Rodríguez-Moreno (2015)	The reality of virtual worlds: pros and cons of their application to foreign language teaching	Interactive Learning Environments
Kim & Lee (2022)	Analysis of Chinese Education cases and learner experiences using metaverse: focusing on Chinese-Korean tandem classes	중국학 [Chinese Studies]
Guo & Gao (2022)	Metaverse-powered experiential situational English-teaching design: an emotion-based analysis method	Frontiers in Psychology

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