【Articles】

A New Conceptual Model of Metaverse for Foreign-Language Education: Exploring Educational Infrastructures in the Age of Web 3.0

外国語教育に向けたメタバースの新たな概念モデル Web3.0 時代の教育インフラストラクチャーを模索する

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[Abstract]

This study explores a new decentralized and open form of foreign-language learning using metaverse in the age of Web 3.0. The contemporary world is characterized by economic and educational–cultural disparities among and within nations. A common digital platform for education is essential for language education to be accessible, autonomous, and open to all. A new language-learning metaverse based on connectivism theory would be a decentralized and open virtual campus for foreign-language learning across borders and institutions. A semi-immersive and simulation-based learning environment using real-time information from digital twins that can implement AI assistants capable of responding to multilingual voices would enable independent, assisted learning and personalized learning plans that can adjust learning speed and process completion.

[Article]

1. Introduction

This study explores a new decentralized and open form of foreign-language learning through the metaverse in the age of Web 3.0.[1] In recent years, various courses in informatics and languages at universities in the United States, South Korea, Japan, and other countries have frequently been using virtual spaces, or the metaverse (see Section 3.1). This study examines a conceptual model of a new metaverse for language learning based on the connectivism theory. Following an overview of Web 3.0 in the introduction, the background and objectives of the study are presented. Please note that this theoretical research paper is based on numerous recent practical educational studies as well as on diverse theoretical studies of technology in the era of Web 3.0. Therefore, it lacks practical considerations, such as specific lesson formats, their implementation, and the measurement of their learning effects. It is hoped that this abstract theory will somehow be concretized and implemented.

1.1. Overview of Web 3.0

The evolution of information technology and computing is moving our era to Web 3.0, called the "semantic web" or "spatial web"—a conceptual model that follows Web 1.0 and Web 2.0 (Fig. 1, Pileggi et al. 2012, 853).[2] Web 1.0, called the "syntax web," is a one-way information dissemination model that focuses on desktop applications and their use provided by browsers. Web 2.0, called the "social web," is represented by mobile application use and characterized by content sharing among users via social networks. This Web 2.0 is a central-

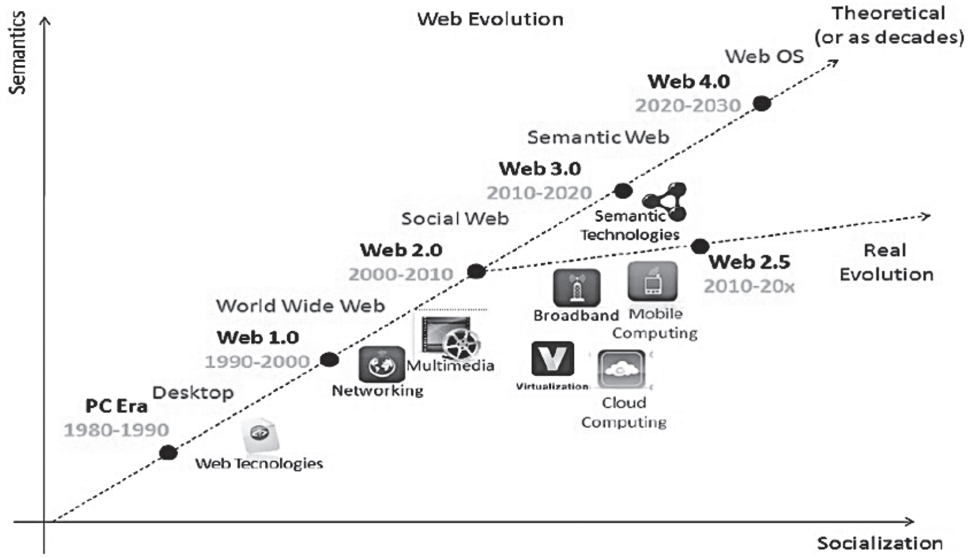

Fig. 1. "Theoretical vs. real Web evolution."
Graph from article on Pileggi et al. (2012) (DOI: 10.3390/fi4030852)

ized power system operated by mega-platforms such as GAFAM.[3] The next-generation model, Web 3.0, was previously called the "semantic web." It represents a system in which machines share and reuse information through ontologies, tagging each other with information, assigning meaning to content, and building relationships between content and its structure, as if they were humans (Evans 2021).

In recent years, Web 3.0 has taken over the concept of "semantic web" and encompassed digital twin technologies that digitize the physical world and reproduce it in a virtual space, which is called the "three-dimensional (3D) Web" or the "spatial Web." With the development of distributed ledger technology represented by blockchain, Web 3.0 is expected to expand the concept as a decentralized and open system of power with the application of advanced technology, increasingly eliminating the boundary between digital content and physical objects (Cook et al. 2020, 2).

The Web 3.0 era will be enabled by a number of technological innovations and their combined convergence including 5G networks, augmented reality (AR), virtual reality (VR), cutting-edge Internet of things technologies and devices, advanced AI and machine learning capable of understanding natural language, big data usage, advances in user interfaces, digital mapping, and so on. Instead of centralized services provided by mega-corporations, decentralized application (Dapps) services will be developed whereby any user can build and operate the system. In the Web 3.0 era, characterized by the "democratization of the Internet," users will be able to freely access data and services while ensuring their personal privacy and interests.

1.2. Background of the Study

Since the COVID-19 pandemic, the digital transformation (DX) of the education industry has been driven by the transformation of higher-education classes into interactive online classes using Web 2.0 technologies. Many digital platforms, such as Zoom, Google Meet, Webex, and other video conferencing systems; learning management systems such as Manabe and learning management cloud services such as Google Classroom; and video services such as YouTube, among others, have been introduced to the education field. Online and remote lessons beyond spatial and physical constraints are realized while maintaining social distancing between teachers and students.

Iio (2021, 19ff.) discusses such online classes and indicates that the advantages include the possibility of creating highly flexible content, providing a physically and temporally flexible viewing system and highly interactive learning effectiveness. However, he noted the following problems: time and effort is required to prepare for classes; on-demand classes tend to encourage a passive learning attitude in learners; participation off-video makes it difficult to recognize students; and communication is hindered.

Nihon University's College of Commerce began offering non-personal online classes in May 2020, and the author also conducted a simultaneous interactive language learning class and presented its educational results at Nihon University's campus-wide FD symposium in October 2020.[4)] A number of issues and problems for the future were identified in the process. One of them is the difficulty of establishing smooth communication in simultaneous interactive classes. When learners participated in the class by turning off the video for privacy reasons, they were unable to recognize each other's facial expressions, which hindered the performance of interactive tasks. Another problem of foreign-language learning through remote teaching is the difficulty in setting up a realistic simulation. In remote classes, it is necessary to set up a simulation environment with either text using two-dimensional (2D) images or video, which makes it difficult for students to have an immersive and realistic 3D experience.

In relation to the implementation of these online classes, education using VR and AR, which belong to Web 3.0 technologies, has been increasing since the 2000s. It has developed rapidly since the COVID-19 pandemic began. Liu et al. (2017) conducted a bibliometric analysis of relevant 975 articles published from 1995 to 2016 in the U.S., the United Kingdom, and Taiwan—leading countries for VR and AR education—and concluded that VR is the tool with the greatest potential and promise to promote learning outcomes. According to this comprehensive study, the two theoretical bases for applying VR to education are constructivism and autonomous learning. The aim is to achieve through VR education a learning environment in which learners construct and process their own knowledge and information, as well as an autonomous exploratory process of setting learning goals and selecting learning methods that guide them.

VR and AR are also being introduced in language learning in higher education, and Saito (2021) presented a comprehensive research trend on the use of VR and AR in English education. The following points are listed as learning benefits of this technology: (1) an immersive experience that allows for an optimal learning environment, (2) learning at any place and time, (3) training in a safe virtual space, (4) high learning effectiveness in language learning emphasizing engagement and memory, (5) promotion of internal motivation of learners, (6) enriching learning styles, (7) reduction of learning anxiety, and (8) promotion of intercultural understanding.

However, disadvantages are also noted regarding VR and AR use in the classroom. In fully immersive metaverse platforms, students often wear a “head-mounted display” (HMD) called “VR goggles.” HMD, however, often causes physical symptoms such as dizziness, nausea, and headaches, known as “cybersickness.”[5] Furthermore, according to Jensen et al. (2018), who addressed this issue, HMD-based classes can improve cognitive, psychomotor, and affective skills, but the strong immersive experience of using HDMs can have the opposite and detrimental effect of interfering with the performance of the learning task.[6]

The classroom examples presented above are practices using Web 2.0 digital platforms and some Web 3.0 VR technologies. All of these are advantageous in realizing a constructivist and autonomous learning process that puts the learner at the center while maintaining physical distancing, free lesson design, and interactive course formats. However, they leave many issues to be resolved.

Furthermore, by way of background to this study, the educational standards of many people today are affected by the economic and educational–cultural disparities both between and within nations and the “digital divide” between urban and peripheral areas in terms of information and communication technology (ICT) knowledge and skills (cf. Várallyai et al. 2015). As language acquisition is an important educational requirement for anyone seeking to acquire social engagement and autonomy, establishing a common platform for education that can overcome these various barriers and allow everyone to participate at any time is necessary.

1.3. Research Objectives and Main Points of Analysis

Based on the above discussion of language learning through the use of conventional digital platforms and applications, this study explores new methods of language learning in the post-COVID-19 age of semantic web/spatial web. For this purpose, we focus on the metaverse, an online virtual space that has been attracting attention as a new social platform in recent years, to examine its new conceptual model for language education. The metaverse is a persistent online 3D virtual space expected to be used as a digital platform for managing economic activities and communities, further described in Section 2.

Educational practices introducing the metaverse have been conducted, as shown in the review of previous studies in Section 3.1. However, some problems are common to those teaching practices. Moreover, as we will discuss in Section 5, Halimi et al. (2019) devised an "Intelligent Learning System" for Web 3.0 based on the connectivism theory proposed by Siemens (2005), a learning theory for the digital age. However, no studies have examined a foreign-language learning metaverse for the Web 3.0 era; thus, presenting a new conceptual model based on connectivism theory is important.

With reference to Web 3.0 technologies, this study examines a conceptual model of a new decentralized and open metaverse for language learning that will serve as an educational infrastructure and verifies the learning benefits expected from it. We proceed as follows: in Section 2, we discuss the definition of the metaverse; Section 3 provides examples of educational practices using the metaverse and a review of the existing literature. Section 4 examines characteristics of the metaverse applicable to the classroom. In Section 5, we analyze a conceptual model of a Web 3.0-type metaverse for language learning based on connectivism theory. Finally, the teaching methods and issues involved in introducing this model are discussed.

2. Definition of Metaverse and Expansion of Users' Market

Neal Stephenson proposed the concept of metaverse in his 1992 science fiction novel *Snow Crash*, a portmanteau of "meta," meaning transcendence, and "universe," meaning world or universe. Defined as a 3D virtual space, it is an economic and social platform that merges physical reality and virtual space,[7] allowing users to interoperate. Users control their own 3D avatars and are not only able to develop land, build cities, and conduct business transactions in VR but also play games and form communities with other avatars using voice conversation and chat functions.

The metaverse initially emerged as a platform for multiplayer online games: In Japan, online games such as "Fortnite" and "Animal Crossing" are well known, attracting many users. According to a recent eMarketer report (cf. Petrock 2021), the number of AR and VR users in the U.S. increased dramatically from 2019 to 2021, and this trend is expected to continue beyond 2022 (Fig. 2). The above market forecasts predict that the use of platforms and applications for building VR will continue to grow in the U.S. and that household penetration will also increase.

Furthermore, according to Diamandis et al. (2020), players worldwide collectively spend three billion hours a week playing video games, and digital media use aggregates to 11 hours a day in the U.S. Because of this external factor of increasing digital use, there should be a massive migration of people to the virtual world by 2030, according to them. This is not to say that this is an unrealistic vision: as we all know, Facebook has changed its name to "Meta" and has set a goal of connecting one billion people to VR in the future.[8] It is

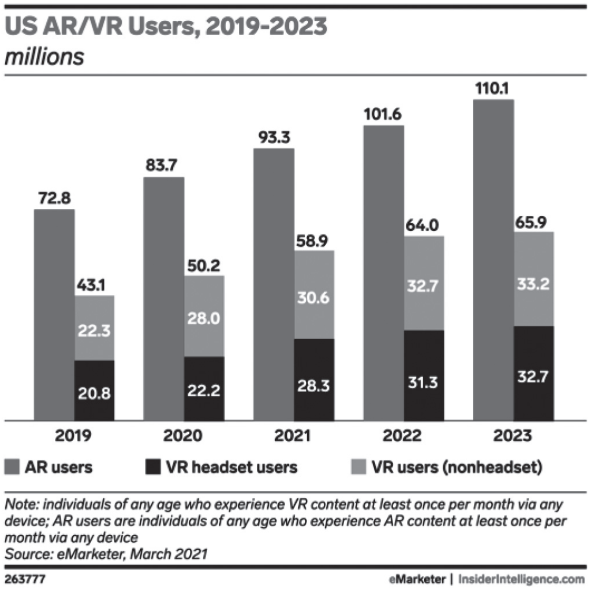

Fig. 2. “US virtual and augmented reality users 2021”
Graph from article on eMarketer (Petrock 2021)
(https://www.emarketer.com/content/us-virtual-augmented-reality-users-2021)

estimated that many people will move their economic activities, events, and entertainment from real space to virtual space.

In addition, an educational metaverse is currently being developed as a commercial enterprise. For instance, Roblox Education, a U.S. provider of an immersive learning metaverse, is expanding globally. More than 240 organizations in 75 countries already use the company’s “Roblox Studio,” a VR platform (cf. Goldman Sachs 2021, 19). As described, educational endeavors using the metaverse are expected to grow, not only because of the development of VR and AR technologies and the expansion of user applications but also because of the advantages of free class design, class formats that transcend geographical and temporal limitations, and multi-user participatory teaching methods. In the future, Japanese institutions of higher education will develop plans to use virtual space as a canvas.

3. Educational Applications of the Metaverse

This section reviews studies of classes that have introduced the metaverse and discusses their strengths and challenges.

3.1. Review of Previous Studies

Educational uses of the metaverse were already conceived of in 2008. Collins (2008) foresaw that the use of the metaverse in higher-education institutions would reduce costs and create an ideal working environment that met teachers' needs. The information education class proposed by Ogawa et al. (2009) serves as a practical example from the same period. In this class, the metaverse "Second Life" was introduced, and the students were asked to create their own avatars and given the task of making their own presentations and evaluating others' presentations.

In digitally advanced South Korea, DX is progressing in the field of education, and applications of the metaverse in the classroom have been reported in recent years. Jeon et al. (2021) provided several examples of classes using the "Gather.town" metaverse, wherein real schools, classrooms, and lounges are digitally copied to create mirror worlds with 8-bit designs. He also evaluated the use of metaverse in non-real-time offline classes outside regular classes, such as summer courses, where students can participate without time constraints. Moreover, metaverse enables peer tutoring, whereby learners teach each other, and flexible lesson design that combines live streaming, games, and whiteboards.

Meanwhile, Kye et al. (2021) examined the technical features of the metaverse and analyzed its advantages and limitations in educational applications. In that study, they described how a classroom map using "Zepto," a leading metaverse platform in Korea, was introduced to a distance learning class, achieving a strong learning outcomes during the COVID-19 pandemic.

Koyama (2010) conducted a study of the early application of "There," a metaverse, to teach English, conducted over a 5-year period from 2004 to 2008. Subject English-learners were computer technical college students. In and out of class, learners controlled their own avatars in the metaverse and attempted to communicate in English through text-based chat with foreign avatars whom they happened to meet. Subsequently, they engaged in a minimum of 30 conversation turns in English with other avatars. The turns included greeting, self-introduction, and self-presentation. According to Koyama (2010, 142f.), the students' dislike of English decreased, their English conversation skills improved, and their understanding of the necessity of learning English increased as a result of this experiment. A vocabulary test was conducted before and after the course to measure improvements in the conversational skills of the students. The results demonstrated a significant difference in average scores (ibid., 142).

3.2. Advantages and Disadvantages of Metaverse-Based Education

As mentioned above, several teaching practices in higher-education institutions have introduced metaverse. Among these studies, the following advantages are indicated: (1) more flexible class design, (2) more motivation for learners and better learning outcomes, (3) successful simulation with high immersion and rich virtual experience, (4) facilitated communication, (5) classroom implementation beyond physical distancing and time constraints, and (6) cost reduction. Here we see the advantages of free construction of knowledge by constructivist learners and ensuring an autonomous learning process, both of which are considered in VR and AR education. Both teachers and students are bound to fixed class times in conventional methods. However, class design is flexible in metaverse-based learning because tasks can be performed outside of study hours.

Moreover, Koyama's (2010) study of English-language learning using the metaverse, which was referenced in this study, can also be mentioned for its advantages, including the chance nature of conversations (then called "chats") between avatars who are not mutually acquainted and meet by chance in the metaverse. This chance or coincidence makes it possible for students to communicate with foreigners other than their classmates while they are in Japan, and thus to have an extraordinary experience that transcends physical distancing. The ability to interact with diverse students beyond the time and space of the virtual space reflects learning in the metaverse.

The disadvantages, however, are summarized by Kye et al. (2021, 10–11) as follows: (1) identity confusion due to unclear boundaries between the real and virtual worlds; (2) inability by administrators to grasp all their students' behaviors, which may lead to crimes; (3) risk of invasion of privacy as students can easily establish relationships with others. Furthermore, the issue of Koyama's (2010) practice can be cited. As previously mentioned, the element of chance governs conversations between avatars who meet in the metaverse. Therefore, if no other users are available when participants "dive" (enter) into metaverse, they will not be able to find a conversation partner and will spend their time aimlessly, in which case it will not work as a class. Even if a participant finds a conversation partner by chance, if there is a significant difference between the person's foreign-language ability and their level, they would not be a suitable conversation partner. If the foreign language spoken by the person is mixed with the local language (i.e., the person has an accent), it is difficult for a beginner foreign-language learner to understand the hybrid foreign language spoken by the other person.

As discussed above, there are many advantages and disadvantages to using VR technology of the latest metaverse in the classroom. As a solution to these problems, this study presents a conceptual model of an open platform for language learning, which is an evolution of the centralized Web 2.0. As already mentioned, giant corporations control and offer numerous Web 2.0 platforms, which are centralized systems. Hence, personal information can easily be collected and potentially bought and sold (see Singhal et al. 2020, 23f.). Moreover, some metaverse fees are waived for personal use. Nevertheless, premium fees are set for game-providing metaverse, such as Roblox.[9] For example, oVice charges a monthly fee of 5,500 yen for corporate users of its metaverse.[10] In addition, it applies cluster charges of one million yen for event planning and usage for corporations hosting events in their metaverse.[11] Thus, metaverse use is not free.

4. Directional and Functional Development of the Metaverse

This section examines the technologies and functions that could be applied to language learning in the metaverse and provides guidelines for presenting a new conceptual model of the metaverse for educational use. The *Metaverse Roadmap* published by Smart et al. in 2007 estimates the possible technological developments, market expansion, social impact, and user trends of the metaverse over the subsequent decade (Fig. 3).

In this roadmap, "augmented reality," "virtual world," "lifelogging," and "mirror world" are listed as the four technological domains that make up the metaverse. "Virtual world" represents a space in which simulated social, economic, and political systems are intermingled using cybernetic technology, and it forms the foundation for the operation of the metaverse. "Lifelogging" uses augmented technology to record and distribute real-time information about objects and people. "Mirror world" is now being replaced by the concept of a digital twin or developed as a "mixed reality" technology that superimposes 3D holograms on real-world shapes.

The above four technological areas feature the "augmentation" and "simulation" technologies and two directional elements, namely, "intimate" and "external" (Fig. 3). Augmentation

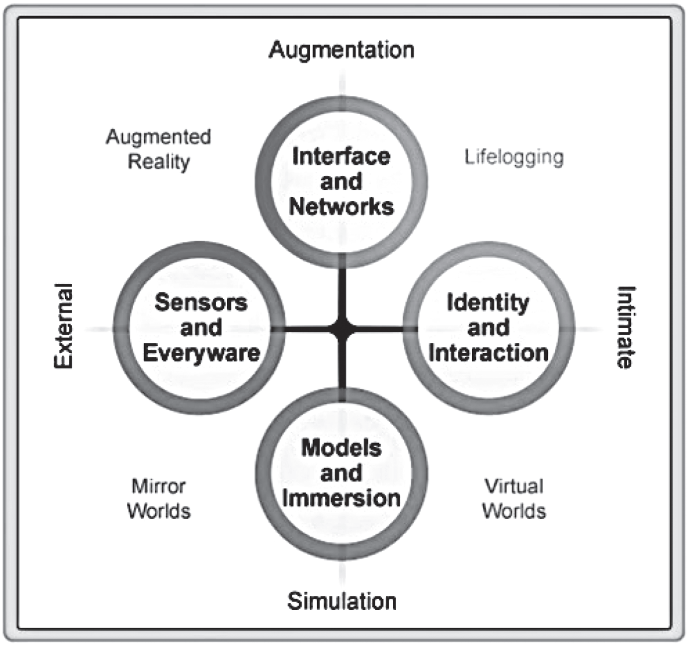

Fig. 3. "Metaverse Scenarios"
Graph from article on Smart et al. (2016, 17)
(https://www.w3.org/2008/WebVideo/Annotations/wiki/images/1/19/MetaverseRoadmapOverview.pdf)

denotes the ability to extend the metaverse to real-world systems. Simulation signifies the technique of constructing a virtual and interactive space that models reality. The term intimate relates to the construction of an identity that is represented by the alter ego avatar, which maintains subjectivity within the system and is created through interactions with other avatars. Externality concerns the storage and provision of information about the external world around the user as well as the ability of users to manage it themselves. Metaverse is expected to continue to strengthen and develop the above four technologies and directions.

The simulation functionality embedded in the structure of the metaverse has also been confirmed for its interactive effectiveness in language-teaching research, which is theoretically based on cognitive developmental science; according to García-Carbonel et al. (2014, 12), the application of games and simulation methodologies in language learning is intended to reproduce real-life language models through scenarios. Learners then use and discover informed behaviors and knowledge that can be applied to real-life situations through this training. This traditional learning method also facilitates communication between learners who role-play with each other, immersing them in the situation and allowing them to acquire professional knowledge and competencies.

Furthermore, VR and mirror-world simulation technologies are characterized by their reality modeling and immersive nature. In this regard, one can refer to Davis et al.'s (2020) study of the effects of practicing public speaking with VR from a clinical psychology perspective. Cognitive modifications to reduce public speaking anxiety and fear can be achieved with VR training in front of an audience in a virtual space. Such training in a virtual space for verbal communication can be applied to foreign-language learning, in which learners are immersed in an artificial situation to improve their language skills and develop problem-solving skills.

5. Designing the Metaverse as Public Sphere of Educational Culture on Virtual Space

Siemens (2005) postulated connectivism as an educational theory of the digital age. This conceptual construct is based on behaviorism, cognitivism, and constructivism, and similar to these prior theories, the learner is the subject that assembles knowledge. The connective principle extends the intellectual resources for learning in the dynamic and highly advanced information society and expands the scope of learning beyond teachers. Learning can occur both within and outside networks, and individuals can select from and opt for numerous up-to-date information sources to generate and build their knowledge. Individuals are connected in a network that decentralizes and commonizes their dynamic knowledge and simultaneously reverts it to the organization, which, in turn, reconstructs and feeds it back to society. The extension of personal networks allows learning communities to interconnect and amplify knowledge and understanding.

In this context, Shrivastava (2018) reported the outcomes of a joint experiment conducted in two different educational institutions in India and Austria using the theory of connectivism to create knowledge facilitating cross-cultural communication and understanding. The concept of connectivism is highlighted as a learning system that creates new knowledge across spaces by organizing individual learning and team processes of knowledge acquisition with complex and sophisticated open sources as nodes in the current digital age of daily updates.

Furthermore, Halimi et al.'s (2019) theoretical study of the intelligent learning systems represents a comprehensive study of the Web 3.0-related learning model based on connectivism, and their model is further designed on the basis of such connectivism, combined with semantic web representation and the use of learning analytics techniques. The system enables learners to connect and share information distributed across the network with others anytime and anywhere. It also shapes learning by creating knowledge through data mining, monitoring learning activities, conducting semantic analysis of voluminous learning data, and developing approaches to improving learning.

Halimi et al.'s learning system based on connectivism is solely grounded in the technical concepts of the semantic web and it does not include the newer, decentralized, and open Web 3.0 concepts of spatial web/3D web. Therefore, if Halimi et al.'s learning model is further augmented with elements of VR 3D space and simulation elements of a public metaverse with a digital twin, we can create a decentralized and open language learning model based on connectivism that is more universal and appropriate for the digital age.

What would a metaverse for language learning based on this intelligent learning model for the Web 3.0 era look like? Here is a brief overview (Figs 4 and 5).

(1) A common open platform for education that transcends the limitations of nations and higher-education institutions and becomes the main campus for foreign-language learning worldwide.
(2) A semi-immersive and simulation-enabled learning environment using real-time information from digital twins.
(3) System implementation of a large number of AI assistants capable of responding to multilingual voice support to enable self-directed learning.
(4) A highly personalized learning plan that can freely adjust learning speed and process completion.

In the next section, we examine in detail the conceptual model of the metaverse specific to language learning, following the abovementioned points.

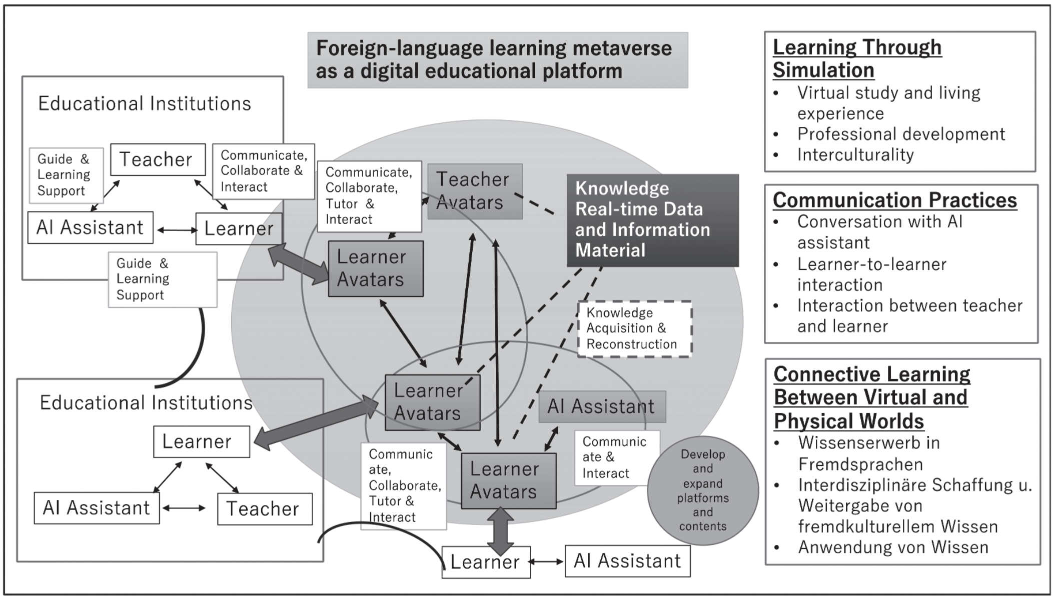

Fig. 4. Foreign-language learning metaverse as a digital educational platform

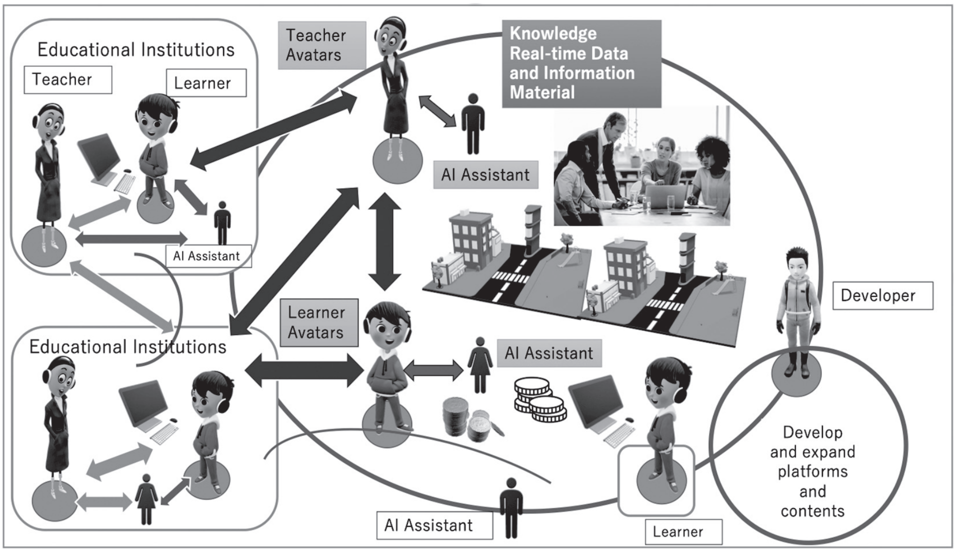

Fig. 5 Images of the educational metaverse

5.1. Establishment of an Educational Public Sphere: A Decentralized Open Platform

As mentioned in Section 1.2, the current situation is one of widening economic and educational disparities between and within nations, with many people losing access to educational and information resources, failing to achieve educational equality. Therefore, the author would like to propose the concept of an educational metaverse in the age of Web 3.0, which would be a supra-regional and universal infrastructure for society and culture that can be applied to language learning. It should exist as an educational and cultural public sphere in a virtual space, a common platform that is freely accessible to all, through decentralized governance based on the cooperation of each state and each institution of higher education.

To investigate this concept of metaverse as an educational infrastructure, we refer to the ideal concept of a blockchain-based "Decentralized Autonomous Organization" (DAO), critically examined by Nabben (2021). According to Nabben, DAOs should not be centralized and oppressive digital platforms in which only an elite group gains control of the virtual space. Its organization would be a "public interest" organization within a public blockchain community, with harmonious human and algorithmic co-constitution, and autonomous self-determination and governance of individuals and groups.[12)]

However, as Singhal et al. (2020) noted, blockchain allows for a decentralized system structure, but because of the commonly agreed-upon state and the global computer-like behavior of the system, it is a logically centralized system in certain respects. Nevertheless, according to Singhal et al., this technology will enable leadership through the "Wisdom of Crowds," which incorporates the opinions of many diverse people and the consequent development of various fields. James Surowiecki's (2004) book, The *Wisdom of Crowds*, alluded to the term, hypothesizing that the aggregation of many insights can render an accurate prediction. People and things are networked in our times, and collective knowledge forms public learning. For instance, *Wikipedia* signifies that the Wisdom of Crowds is already considered a decentralized system. These new technologies could provide each user with a self-governing identity, allowing them to participate in learning characterized by openness and decentralized control.

As for the organization of decentralized governance as sociocultural infrastructure, the government-approved platforms that have already been realized ahead of their time can serve as a reference. In Japan, for example, since 2020, a virtual space called "Virtual Shibuya," a mirror world, has been operating, and public events such as coming-of-age ceremonies were held here during the COVID-19 pandemic.[13)] Such a public administration-driven metaverse is expanding while also promoting digital infrastructure. In that virtual space, everyone is free to receive public services and support without restrictions, and it is intended to function as a multilayered and decentralized community place that transcends traditional administrative divisions. Using these public platforms as a model, the creation of a platform for language learning as an international infrastructure for educational culture could serve as a digital learning space freely accessible to everyone.

According to connectivism, this theory defines learning as a process by which learners themselves become actors; find and connect to various intellectual resources such as people, organizations, and data nodes in a network; and then build their own multilayered knowledge. Therefore, metaverse itself should be a public platform for the promotion of common learning, where learners can dive in, find various nodes, and develop a learning network with other people and machines.

In this way, the open platform for language learning should become the main campus for worldwide foreign-language learning through multilingual support. In connectivism, learners themselves are not passive but active learning subjects in the construction and deployment of networked knowledge. In such decentralized, open, autonomous learning, learners can shape the content of the platform. In this regard, Roblox Education, the current educational metaverse, requires a developer to customize it for each institution's users, which is costly. Therefore, the educational metaverse in the age of Web 3.0 will be easier to use if users are free to enlarge the space, and if the program is easy to configure to create spaces for language learning and discussion. Learner involvement will be high if users are free to build systems that respond to the ideas of the participants, such as communities, virtual canvases, vocational schools, and time-slip experience tours to the past.

5.2. Real-time and Semi-immersive Learning Environment in Digital Twin

The Web 3.0 technologies will advance the construction of the digital twin. For example, the "Tokyo Digital Twin Project" and the "PLATEAU" project aim to use real-time information in physical space and conduct interactive integration in digital space to provide administrative services.[14] Those are encouraging autonomous and decentralized uses of 3D city model data using geospatial information and releasing it as open data. Everyone can freely use real-time urban space data for simulation purposes in business and create new experiences and values in culture and art. In the U.S. and Europe, where 3D urban data utilization is advancing, such data are recognized as public property that should be returned to citizens (Saito et al. 2022). These data are released into the public domain in the U.S.

The prospect of public and private use of the open data of the digital twin supports the realization of the concept of a decentralized, connectivism theory–based educational platform discussed in the previous Section 5.1. According to connectivism, information is constantly being updated, and learners develop the decision-making capacity to connect to and acquire such new knowledge, while also discarding it. The use of urban data transmitted in real time allows learners to acquire more knowledge, share it with users in the network, and derive creative answers to solve problems or feed the reconstructed information back to the larger organization.

Furthermore, this real-time urban data can also be used as an open metaverse for foreign-language learning in the future. The platform would provide learners with a simulated cultural experience as a place of interaction. Thus, the city as a platform could be reconfigured as a realistic compact city, where learners could learn about foreign customs, different cultures, and history while using real-time local information, and understand the local experience and culture using a more up-to-date simulation.

If the local higher-education institutions can be digitally twinned, a virtual study-abroad experience can be conducted, serving as risk-avoidance preparation before studying abroad. In our world, many people have limited freedom of movement; hence, providing people with a realistic, interactable virtual learning space in a multi-user mode can have the same educational effect as face-to-face interactive classes that transcend national borders. In addition, real-time city information could be used in metaverse to simulate city-building as if it were a game, and to learn about the use of and connections to transportation modes such as planes, buses, and trains that are operating in real time. Furthermore, it would be possible to study global business, such as local monetary values and business practices through virtual transactions, such as shopping, and virtual experiences while learning the language of local agriculture and factories.

Regarding this experiential learning using virtual technology, the class practice by Yonemoto (2021), which is based on gamification methodology using foreign language learning AR to simulate disaster situations, is instructive. It is a process of learning information on disaster preparedness, evacuation routes and survival methods in a foreign language. This kind of learning in the metaverse will be more effective not only as a preparation for disaster preparedness in a foreign country, but also as a simulation of learning a foreign language necessary for actually living there.

Finally, this study proposes a semi-immersive educational process for language learning in metaverse. As already mentioned, while classes with VR goggles (HMDs) are effective in learning various simulations, the physical symptoms of cybersickness and the learner identity confusion that occurs in VR classes were noted. Furthermore, from the author's perspective, wearing HMDs is unsafe, as they cannot recognize if a fire or crime occurs in their surroundings. For this reason, a sustained learning experience on a PC is recommended without wearing VR goggles, which are conducive to virtual experiences. There are many advantages to setting up a semi-immersive learning environment with a sense of being in reality, rather than being fully immersed in a virtual world to accomplish learning tasks.

5.3. Autonomous Learning Through the Introduction of Interactive, Voice-enabled AI Avatars

In January 2022, Meta announced a new supercomputer, the "AI Research SuperCluster," with visions of a system that would enable real-time translation capabilities for multiple people and in multiple languages (cf. Lee et al. 2022). Thus, in the Web 3.0 world, automatic speech recognition technology is expected to evolve further. Implementing such an oral language-enabled virtual AI assistant in the metaverse system will support the user's independent work and interactive learning environment. Two uses for this voice-enabled assistant can be thereby identified: 1) guidance and tutoring for the learner and 2) support for the learner's language learning partner and performance.

An example of (1) is the practice proposed by Laeeq et al. (2021), whereby an intelligent multi-agent-based voice-enabled virtual assistant is implemented to accelerate user tasks and improve learner performance and motivation through natural voice commands. If these learners do not need to use a mouse or keyboard to perform tasks, achieve progress, or complete the next assignment, they will be more efficient at all stages of learning. Moreover, as the educational resource disparities widen, learners who lack educational resources often face a digital divide problem, such as a lack of IT skills and other ICT, and discomfort with machines. An easier-to-understand virtual assistant can take the operational burden off their shoulders and mitigate these educational and informational divides. Therefore, learners can be verbally guided through the operation of the metaverse and the execution of their studies. Furthermore, MacCallum et al. (2019, 27) concluded that teachers with low VR manipulation skills are less likely to benefit from learning in the AR metaverse. Some AI guidance would be useful to support faculty with this information gap.

Regarding (2), Saito (2021) provides a helpful discussion on speech assistants that improve learners' conversational skills. According to her, technologies for automatic speech recognition and automatic pronunciation evaluation have already been introduced in the field of language education, facilitating learning pronunciation and speech production. Moreover, Desai et al. (2021) used a virtual assistant in teaching English conversation and found it effective for learning. This system includes the SynQG model for question generation, the RoBERTa model for grammar error correction, and the Parselmouth–Praat model for speech analysis. This automatic speech recognition technology has the potential to evolve further and is expected to be used in many learning platforms in the future, including metaverse.

In connectivism, the learner does not solely rely on the teacher to assimilate knowledge, but connects to and builds knowledge from the sources in the network, both alone and with colleagues. The teacher provides information on each node to the learner, monitors them, and works with them to come up with solutions to problems that cannot be solved by AI. In such an intelligent learning system for the Web 3.0 era, if VR avatars capable of natural language understanding that respond to users' conversations are implemented in a metaverse city, foreign-language learners can proceed with their learning independently. It is better to develop not only scripted conversation patterns based on collective knowledge but also individually responsive deep-learning conversations for each learner.

With this methodology, learners would not rely on chance to converse with foreigners they happen to meet in the metaverse, as we have seen in Section 3.2, referring to Koyama's (2010) study of English learning using the metaverse. The learner will be able to simulate a face-to-face conversation with an AI assistant at any time, even alone, within the virtual space. Autonomous learning in which the learner chooses his or her own learning goals and process is possible. Of course, the multi-user mode in class units can continue to practice conversations with each other, attempting to improve the effectiveness of group learning while gaining a sense of intimacy.

In the current metaverse, for example, in the game Fortnite, users cannot communicate verbally with an algorithmically controlled non-player character when playing in solo mode. The user's ability to have voice conversations is limited to other human avatar users when the user switches to multi-user mode. To solve these problems of the current metaverse, a new autonomous learning platform for language learning in the Web 3.0 era would be better for implementing a VR-AI assistant to guide and converse with each user. This would support the user's personalized learning process.

5.4. Personalized, Decentralized, and Open Learning Plans

The connectivism learning theory builds on previous learning theories, such as constructivism, behaviorism, and cognitivism and integrates self-organized learning processes within a network. This theory is learner-centered and manages the learning process and proficiency level by itself. The large amount of data generated by the learner also allows analysis of student behavior through learning analytics approaches and social semantic techniques (Halimi et al. 2019, 1374). For learning systems practice in the "semantic" Web 3.0 based on the theory of connectivism, a survey by Saito (2021) of the trends of various AIED (AI in Education) deployments in U.S. universities is instructive. According to the survey, the systems that have been adopted since 2008 include (1) intelligent tutoring systems, (2) dialog-based tutoring systems, (3) exploratory learning environments, and (4) automatic feedback and scoring essays. These not only allow learners to learn individually and autonomously but also reduce the cost of university education.

It would be ideal to incorporate such a system that uses advanced artificial intelligence to support independent learning within metaverse in the Web 3.0 generation. There, each learner's data, whether individual or in a group, will be organized and managed through mechanical contextualization, hierarchization, and structuring. The analysis is then used to make inferential and automatic content recommendations for more appropriate learning support. Such an integrated, personalized, and intelligent learning system makes the learner's own learning behavior visible and enables a flexible and engaged learning environment.

Metaverse learners take the free learning process discussed in Section 5.3. and manage the setting and performance of their own assignments, selecting appropriate tasks. The learning speed and the completion of the process may be freely adapted to the learner's level of learning proficiency, which may allow the learner to complete the course earlier. It would also be desirable to allow students to choose to study either on an individual basis or in units per class. In terms of class units, either at each university or, ideally, internationally and across institutions, learners could be organized by field of specialization, interest, or proficiency level, and classes could be updated from time to time as learners' academic skills improve. In this way, learners can constantly communicate and collaborate with other learners from different countries, allowing mutual cultural exchange through foreign-language learning. It will be possible to achieve the ideal of connectivism, open collaborative learning anytime, anywhere, with anyone, and with a diverse group of people.

This will create a new common learning space for group work and other activities that transcend geographical and physical distance, regardless of university or status, with greater range and intensity than ever before. In addition, as already mentioned in the digital twin concept, free use of vast amounts of big data is expected in the era of Web 3.0, and the accumulation of such vast data will enable learners to create their own optimal simulations for language learning through AI applications. Furthermore, it is normally necessary to prepare various teaching materials such as textbooks and supplementary materials required for language learning, and teachers need to spend a lot of time creating such materials. However, by applying people's vast collective knowledge, teachers and learners can collaborate to automatically create personalized learning content tailored to their own learning processes, teaching styles, and interests. Decentralized and open content creation can lower the cost of education.

The metaverse is expected to replace the traditional classroom space as a tool for independent learning once universities are eventually integrated. Foreign language learning should denote social and educational and cultural infrastructure for everyone, regardless of time or place. Moreover, people with physical disabilities can use the learning metaverse to create easily accessible foreign language learning environments without traveling from home.

The organization and operation of such a common educational metaverse across nations and universities requires common grading standards. For learners of European languages, the introduction of the standardized "Common European Framework of Reference for Languages" (CEFR) will help them understand their proficiency levels and identify their future achievement goals. Using these standards as a guide, it will be possible to design the language learning process as a credit system based on proficiency level, not tied to time or course hours. If a language course requires students to absorb specialized knowledge and vocabulary at the same time, or to include specialized or cultural experiences as part of the course requirements, other evaluation criteria should be used (CEFR encompasses evaluation criteria for only six levels from A1 to C2; hence, other criteria must be established if these levels are insufficient).

As for the protection and security of personal information, blockchain technology allows for stricter protection of personal information and grade management. According to Kobayashi (2021), decentralized, open, community-based organizational management in the age of Web 3.0 will allow people to manage their own information themselves. When learners learn in a common metaverse, identity is guaranteed by facial recognition, preventing avatars from impersonating themselves or acting on their own behalf when performing tasks. It then becomes desirable to manage personal information through a self-sovereign ID using block-chain. If the learner is affiliated with a university, the organization will manage his/her grades, but the personal information will be managed jointly with the learner himself/her-self, while learners who are not affiliated with an institution will control their information individually.

6. Conclusion

The universal educational metaverse discussed in this study assumes that all target students have the same level of digital information skills and free access to ICTs. However, as discussed in Section 1.2, the existing uneven digital gap cannot be eliminated due to socioeconomic inequalities and educational disparities. For these problems of the digital divide, as emphasized by Cruz-Jesusa et al. (2016, 72f.), it is necessary to first find the gaps in digital education and then eliminate the educational inequalities. The realization and operation of metaverse considered in this study will be difficult without simultaneously resolving these information disparities. Moreover, as already mentioned in Section 5.3, differences in teachers' ICT experience and skills must be considered in the teaching of VR use (cf. MacCallum et al. 2019, 31).

Moreover, the development, customization, implementation, and maintenance of a metaverse educational system would probably mandate the expense of enormous cost, time, and effort. Such immense requirements of national investments indicate that the construction of an open metaverse learning space and its accessibility to the general public remains a distant likelihood. However, the plan could someday become a reality if nations mutually invest a percentage of their GDPs in its actualization.

Nevertheless, a decentralized and open digital platform for education that is operated jointly by the state and educational institutions is expected to not only have advantages beyond advancing the DX of education but also solve the cost issues surrounding contemporary university education.[15] In the trend toward cost-cutting at universities, the practice of digital classes connecting students at different universities online will become increasingly standardized. In the context of this trend in the education industry, the development and operation of a common metaverse in virtual space for education can be considered to represent a possible direction for the education industry of the future.

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Notes

1) This article reflects a comprehensive revision of the author's proceeding manuscript (Yamazaki 2022) to which significant additions and corrections were effected. This amended version of the original paper also incorporates and develops the comments and suggestions offered by reviewers. This study is based on Asuka Yamazaki's conference presentation entitled "Ein neues konzeptionelles Modell des Metaversum für den Fremdsprachenunterricht: Erforschung von Unterrichtspraktiken im Zeitalter des Web 3.0," (Koreanischen Gesellschaft für Deutsch als Fremdsprache (KGDaF)), (April 23, 2022, Korea University, Korea)

2) Regarding the different designations of Web 3.0, a number of articles have been published: Pileggi et al. (2012, 853) define Web 3.0 as a "semantic web," and Cook et al. (2020) define it as a "spatial web."

3) Web 2.5 is the theoretical and practical web model in the middle stage between Web 2.0 and Web 3.0. Some researchers have argued that certain computing technologies are currently located in this stage (Pileggi et al. 2012, 853).

4) Cf. Asuka Yamazaki (2020, Oct. 17) "A Successful Model of Language Teaching Using Zoom. From the Introduction of Active Learning to the Examination of Issues in the First Semester," *The 3rd Symposium on Online Teaching at Nihon University*.

5) The BBC (2020) also reported on this "cybersickness" problem, in which software developers wore VR headsets for many hours a day, resulting in weakening eyesight.

6) There is also concern about negative psychological effects regarding VR (see Bailenson 2018).

7) The definition of the metaverse has been developed from several works: cf. Collins (2008), Smart (2016), Kobayashi (2021) and Okashima (2022) etc.

8) Davies, Pascale (2021, Oct.12) "Meta takes its first step in making the metaverse real with Horizon Worlds app," *Euronews*, https://www.euronews.com/next/2021/12/10/meta-takes-its-first-step-in-making-the-metaverse-real-with-horizon-worlds-app (accessed March 6, 2022)

9) For more information on "Roblox," see https://www.roblox.com/premium/membership (accessed May 9, 2022).

10) The Web site of "oVice," see https://ovice.in/ja/pricing/ (accessed May 9, 2022).

11）About “cluster,” see the Website: https://www.biz.cluster.mu (accessed May 9, 2022).

12）For DAO, see also Fukunaga (2021).

13）For more information on “Virtual Shibuya,” see https://vcity.au5g.jp/shibuya (accessed Jan. 15, 2022).

14）Cf. Tokyo Digital Twin Project, https://info.tokyo-digitaltwin.metro.tokyo.lg.jp (accessed Feb. 17, 2022). About “PLATEAU,” see the Website: https://www.mlit.go.jp/plateau/ (accessed Feb. 17, 2022).

15）In the context of the declining birthrate in Japan, Japanese universities are in a difficult financial situation, and foreign-language courses are being consolidated and outsourced as online classes (cf. Ueno 2022).

要旨

本稿はWeb3.0時代におけるメタバースを利用した新しい分散型でオープンな外国語学習の形を模索する。現代は各国家間や国内での経済的また教育文化的な格差が生じている。誰にもアクセス可能で自律的でオープンな言語教育のために、教育用の共通デジタルプラットフォームが必要である。コネクティビズム理論に基づいた新しい語学学習用のメタバースは、国境や教育機関を超えた外国語学習の分散型でオープンな仮想キャンパスとなる。またそのプラットフォームは、デジタルツィンのリアルタイム情報を利用した半没入的でシミュレーション可能な学習環境となるだろう。そして、自立型の支援学習を可能にする多言語音声に対応できるAIアシスタントの実装と、学習速度や課程の修了を調節できるパーソナライズされた学習計画を可能にする。