Harnessing immersive technologies for enhancing Japanese language acquisition: Methodological insights for prospective language educators

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Abstract

This article explores the methodological aspects of leveraging immersive technologies to facilitate Japanese language acquisition for prospective language educators. The study analyses the application of virtual and augmented reality in supporting and organising Japanese language learning for aspiring language teachers, and identifies the primary approaches to employing augmented reality in language education. The findings suggest that immersive technologies introduce a novel paradigm for educational materials, positively influencing the development of fundamental and professional competencies in future Japanese language educators. These technologies can be particularly effective when integrated into a blended learning model that combines distance, online, traditional, and self-directed learning of Oriental languages. The study highlights the need for further research to develop guidelines for utilising immersive technologies in teaching Oriental languages at various stages of language teacher training.

Keywords

immersive technologies, augmented reality, virtual reality, Japanese language acquisitionv prospective Japanese language educators, blended learning, oriental language learning, distance education

1. Introduction

The rapid advancement of information and communication technologies (ICTs) and their pervasive integration into various domains of human activity necessitate the adaptation of young individuals to novel modes of working, living, and interacting. Contemporary technologies, employed across diverse professional fields, hold immense significance for incorporation into the educational process, particularly within general education institutions, and are crucial for the competitiveness of youth in the global job market.

In this context, immersive technologies (ITs) are gaining increasing popularity in the education sector [1, 2, 3]. These technologies, which extend reality or create new realities by harnessing the 360° space, are exerting a profound influence on numerous facets of 21st-century life, including commerce, tourism, the interaction with and perception of digital information and media, science, and education [4, 5, 6, 7]. Makransky and Petersen [8] emphasise that the application of these technologies can enhance real-world visualisation through the incorporation of virtual objects, graphics, and object recognition technologies.

ITs encompass virtual reality (VR), augmented reality (AR), and mixed reality (MR), which are currently being employed in a wide array of fields, ranging from gaming and entertainment; theatre and live events; museums and cultural heritage; marketing, advertising, and tourism; architecture, product development, and design; to simulation and healthcare [9, 10, 11, 12, 13, 14].

While ITs are predominantly utilised in science education to cover topics such as human anatomy (Anatomy AR-VR, AR Human Anatomy, The Brain AR App, etc.), the universe (Planets AR, EARTH AR Poster, etc.), chemical reactions (MoleculAR, Chemistry Augmented Reality Education Arloon, etc.), and plant anatomy (Froggipeadia, Arloon Plants AR, etc.), this paper focuses on their role in

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foreign language education, specifically in the context of Japanese language learning. Given the limited availability of applications and IT content tailored for language education, we will explore all potential applications of ITs (VR and AR) in Japanese language acquisition and the experiences of students.

2. Theoretical backgrounds

The multifunctionality of ITs and the unfamiliarity of the concept of "virtual reality" have catalysed the actualisation of the term "virtual" and the rapid expansion of its scope, serving as an impetus for the conceptual design of the idea of virtual reality across various domains of human activity.

AR holds immense potential in the field of language education [15, 16], as it serves two primary functions: contextual visualisation (i.e., the presentation of virtual information within an extended context) and interactivity of learning (i.e., the embodiment of interaction with virtual content). VR, on the other hand, is a virtual 3D world that enables users to experience visual simulations and feel immersed in an environment free from temporal and spatial constraints.

The popularisation of the phrase "virtual reality" can be attributed to Jaron Lanier in the late 1980s [17].

At the current stage of ICT development, immersive technologies based on VR can be categorised as follows (figure 1):

- VR with full immersion, which provides a realistic simulation of the virtual world with a high degree of detail (e.g., the Virtual Shooter game zone);
- Partial immersion VR, consisting of VR and real-world attributes, is achieved by embodying computer graphics objects in a reality scene (e.g., a flight simulator) [18];
- VR without immersion, related to the virtual experience with a computer, where users can control individual characters or their actions in the software, while the environment does not directly interact with the user (e.g., World of WarCraft, ReHabgame);
- VR with group work, which represents a three-dimensional virtual world with elements of a social network (e.g., Minecraft already has a version of virtual reality supported by Oculus Rift and Gear VR helmets) [19];
- CAVE (Cave Automatic Virtual Environment), developed by students at the University of Illinois in 1995, is a three-dimensional stage with wall projections [18, 20].

The term "Augmented Reality" was coined by aircraft engineers Caudell and Mizell [21] in 1990. They developed head-mounted displays as equipment for electricians to be used during the assembly of complex wiring harnesses [22].

Nelson [23] identifies augmented reality as an essential element of the "Bring Your Own Device" (BYOD) approach, which entails the use of mobile devices by teachers and students in the classroom for learning purposes.

Calo et al. [24] define Augmented Reality as "…a mobile or embedded technology that senses, processes, and outputs data in real-time, recognises and tracks real-world objects, and provides contextual information by supplementing or replacing human senses."

AR is a technology that incorporates digital information such as images, video, and audio into real-world spaces, enabling the blending of virtual environments with reality [25]. Users of this technology have the opportunity to learn in immersive, computer-generated environments through realistic sensory experiences.

Mobile AR applications can be grouped into three categories based on their purpose, place of use, and usability: marker-based, creation-based, and marker-less AR (figure 2).

It is worth noting that some applications in these categories may possess both creation-based and marker-less features. However, if an application is marker-based, it cannot have a marker-less AR feature, as it could only function with flashcards.

We can distinguish the following types of mobile AR [26]:

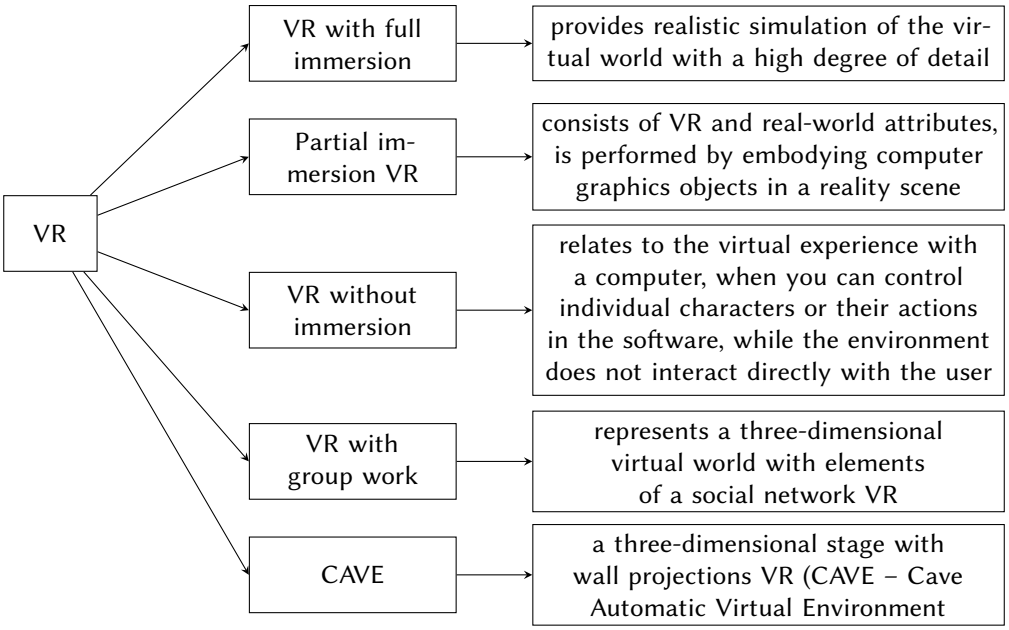

Figure 1: The five categories of VR.

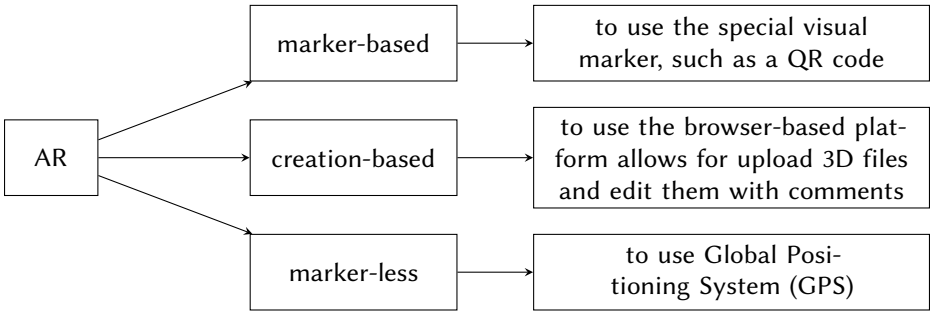

Figure 2: The three categories of mobile AR.

- marker-based, which uses a camera and a special visual marker, such as a QR code (quick response code);
- creation-based, which uses a browser-based platform allowing users to upload 3D files and edit them with comments, detailed instructions, and animations via a drag-and-drop interface;
- marker-less, which uses the Global Positioning System (GPS); the most common uses are to mark destinations, search for the correct location, such as a café or office, or in location-oriented applications.

Researchers have identified several positive effects of AR on students' foreign language learning, including enhancing the effectiveness of their language skills in professional translation, increasing motivation to learn, and engaging students in collaboration with each other and with native speakers of the foreign language being studied [27, 28, 25, 29, 8, 30, 31, 19, 23, 32]. AR has immense potential in the field of language education due to its functions of contextual visualisation (i.e., the presentation of virtual information within an extended context) and interactivity of learning (i.e., the embodiment of interaction with virtual content).

A review of the literature by Viberg and Grönlund [33] indicates that Mobile Assisted Language Learning (MALL), as a mobile technology that can be adapted to support language learning, is applied in various ways but generally focuses on vocabulary acquisition, listening and speaking skills, and language acquisition, while grammar learning, pronunciation, and writing skills were underrepresented in the application of MALL.

Hein et al. [34] analysed 2,507 sources and selected 54 articles published between 2001 and 2020 that related to the role of immersive technology in students' foreign language learning.

They found that most of these studies focused on the comparative analysis of traditional blended learning methods, which included the use of VR and AR. The main characteristics of these technologies that support foreign language learning are the promotion of vocabulary learning, the development of speaking skills and intercultural competence, students' motivation for foreign language learning, and the ability to overcome anxiety and discomfort when communicating in a foreign language. The advantage of learning with AR over traditional teaching methods lies in the fact that students are given the opportunity to feel, rather than imagine, the subject, situation, or scenario, which cannot be demonstrated or described using traditional teaching methods.

The purpose of this article is to analyse the use of immersive technologies for supporting and organising Japanese language learning for prospective language teachers and to identify the main approaches to the use of immersive technologies in Japanese language learning.

3. Research methods

To achieve the purpose of our study and clarify the problem of utilising immersive technologies for prospective Japanese language teachers, we employed the following methods: systematic and comparative analysis of pedagogical, psychological, philosophical, sociological works, methodological and specialised literature; analysis of the pedagogical experience of using immersive technologies at the Institute of Philology of Taras Shevchenko National University of Kyiv in lectures and seminars on "Japanese characters"; synthesis and generalisation to formulate the main points of the study; interpretation of the research results through a student survey and comparative analysis of exam results in Japanese lexicology of students who studied the language using ICT and immersive technologies with exam results of students who studied the language using ICT but not immersive technologies. The research hypothesis is based on the assumption that the training of prospective Japanese language teachers will be effective if the following pedagogical conditions are implemented: activating the motivation of future foreign language teachers to carry out project activities using immersive technologies as didactic tools for learning Japanese; improving the content of training future foreign language teachers to form their knowledge about the use of information and communication technologies and immersive technologies for learning Japanese.

4. Results and discussion

Scientists attach special importance to the use of augmented reality in the study of Oriental languages by students, particularly prospective teachers of the Japanese language.

They note that the preparation of prospective teachers of Oriental languages (including languages with character-based writing, such as Japanese and Chinese) for professional activities is a complex process, as it differs significantly from the study and teaching of any other foreign language (for instance, English, French, German, Italian, Spanish, Turkish languages that are also included in the educational planning of the Institute of Philology of Taras Shevchenko National University of Kyiv).

Researchers recognise the use of ITs as a solution to the problems of fast, active, correct, and convenient Oriental language learning by students [27, 25, 29, 8, 30, 23]. They note that the use of these technologies can improve real-world visualisation with virtual objects, graphics, and object recognition technologies.

Frazier et al. [29] highlights the application of Google Earth VR and AR for foreign language learning, including Japanese, which allows users to visit different locations throughout the world, while simultaneously supporting their own learning of various subjects, such as history, political studies, international relations, etc.

Google Earth AR includes numerous instruments, like Mindshow, for the creation of new exciting places and their use in role-playing [23]. This tool is marker-less and uses GPS. Scientists focus their

Table 1
The results of students' survey on their understanding of ITs in Japanese language learning process (2020-2021).

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
I have a clear understanding of what ITs are and how they can be integrated into my own education process	8%	17%	32%	39%	4%
I have heard about ITs in foreign language learning	3%	16%	28%	49%	4%
I have discussed ITs for foreign language learning with my friends	18%	35%	14%	33%	0
I have experience with teachers using approaches with ITs for Japanese language learning	8%	43.6%	35.5%	12.7%	0
Total ($N = 31$)					

attention on the issue that these instruments are useful for distant language learning, although they should be supervised by a teacher.

We should pay attention to the possibility of foreign language learning, particularly Japanese, with the help of this service and others that focus on various fields of science in Japanese.

It is important to emphasise the potential of augmented reality services that support the teaching of various disciplines. Special emphasis should be placed on training in the fields of STEM education, which involves integration between the disciplines of natural sciences, technological sciences, engineering, and mathematics [26, 35, 36]. For example, many augmented reality applications offer materials in Japanese (BioDigital Human 3D anatomy, 3D Anatomy Learning – Atlas, GeoGebraAR, Planets AR, etc.). It is clear that the vocabulary of these applications is designed for students who have language skills at the B1 level and above.

Geng and Yamada [30, 31] offer their experience of using AR generators to create markers based on Kanji characters as QR codes. They developed an AR compound verb learning system to support the learning of Japanese verbs. Under this system, students can scan a card with the Kanji characters of a particular verb and watch an animation that displays the corresponding action with the card through the smartphone screen in the application. "In this system, the meanings of verbs, including both single verbs and compound verbs, were represented by 3D animations created using Maya, according to the image schemas of the verbs. Maya is a 3D computer graphics software, and it is used to create interactive 3D animations and visual effects". The application was developed by scientists using Unity 3D and Vuforia. In addition, the combination function was proposed based on a combination of two cards with the corresponding Kanji characters (V1 + V2) to facilitate the effective study of complex verbs by students. Researchers have proven that the approach involving AR in Oriental language learning is the most effective for students compared to the traditional method.

Platte et al. [37] suggests using ARTranslate (https://github.com/benpla/ARTranslate) for foreign language learning using augmented reality. ARTranslate is software that recognises up to 1,000 objects in a user's environment using the Convolutional Neural Networks (CNN) method and names them accordingly. Objects are superimposed on 3D information in different languages using AR. The user can access the surrounding everyday objects in any language by switching languages in the ARTranslate application settings. The software runs on iOS version 12.

We surveyed students (31 students participated in this survey) about their attitudes towards the use of ITs to improve the quality of Japanese language learning. We proposed the following statements, which students should designate as "Strong disagree", "Disagree", "Neither agree", "Agree", or "Strongly agree": "I have a clear understanding of what ITs are and how I can integrate them into my own education process", "I have heard about ITs in foreign language learning", "I have discussed ITs for foreign language learning with my friends", "I have experience with teachers using approaches with ITs for Japanese language learning".

According to the questionnaire analysis of students' attitudes and understanding of ITs in the Japanese language learning process, it was found that students understand what augmented reality is but have not used these tools to learn Japanese: "I have a clear understanding of what ITs are and how they can be

integrated into my own education process": Strongly disagree – 8% students; Disagree – 17% students; Neither agree nor disagree – 32% students; Agree – 39% students; Strongly agree – 4% students; "I have heard about ITs in foreign language learning": Strongly disagree – 3%; Disagree – 16%; Neither agree nor disagree – 28%; Agree – 49%; Strongly agree – 4%.

We showed students the options for using such IM for different levels of Japanese language learning (Japanese language learning levels are available at https://www.jlpt.jp/) as:

- ITs for not language learning such, as BioDigital Human 3D anatomy, 3D Anatomy Learning – Atlas, GeoGebraAR, Planets AR, Google Earth AR and VR;
- ITs for language learning such, as Easy Japanese News, Triplens, ARTranslate;
- Platforms for creating web projects with AR elements such, as BlippAR and Google ARCore, and with VR such, as CoSpaces, for students to create their own examples of language learning.

These tools were proposed for use by 3rd year Bachelor's students in the study "Japanese Kanji characters", 4th year Bachelor's students in the study "Linguistic Tradition of Japan", 4th year Bachelor's students in the study "Japanese Language Etiquette", 2nd year Bachelor's students in the study "Japanese language: Practical Course for Translators", and 1st-2nd year Bachelor's students in the study "Oriental Language (Japanese language)" of the Department of Languages and Literatures of the Far East and Southeast Asia of the Institute of Philology of Taras Shevchenko National University of Kyiv.

After classes and self-study of students with the help of ITs, a survey was conducted as experts (27 students) on the choice of approaches to the study of Japanese characters. They were asked to use the Likert Scale method to rank approaches to language learning according to their importance – from ineffective (1 point) to very effective (5 points).

Approaches to the study of Japanese Kanji characters were determined according to traditional methods (direct method, grammar-translation method, audio-lingual method, cognitive method) and considering the use of information and communication technologies, in particular immersive technologies.

Our students were offered the following approaches to Japanese Kanji (漢字) learning for the assessment:

- use of electronic dictionaries;
- search and use of Internet resources;
- usage of online educational literature;
- creation and application of their own associations (offline);
- handwriting Kanji characters (offline);
- use of AR and VR applications;
- creation of their own educational materials on the basis of ITs.

The results of this questionnaire are presented in table 2 "Results of students' questionnaires on their opinion on the choice of approaches to the Japanese Kanji characters learning".

Thus, the results of students' questionnaires about their opinion on the choice of methods for studying Japanese Kanji characters showed that the most necessary approach for them was based on the creation of students' own learning materials using augmented reality (5). According to interviews with students who wished to comment on their answers, this was motivated by the creation of augmented reality Kanji characters that would be of interest to other students and reflect the most difficult cases in Oriental language translation practice. The use of electronic dictionaries (4.8) is also important, as most AR applications are focused on the assimilation of foreign language vocabulary by users (for example, Triplens, ARTranslate, etc.).

To achieve our goal, we created, organised and implemented educational content (training course) "Information Support of Philological Research in Japanese Studies" for philology bachelor's students of Oriental languages, based on the use of immersive technologies. It consists of the following modules: Module 1 "Theoretical foundations of the use of ICT in the study of foreign languages", covering topics such as "Basic concepts", "Methods of using ICT in the study of foreign languages", etc.; Module 2

Table 2
Results of students' questionnaires on their opinion on the choice of approaches to the Japanese Kanji characters learning.

The approaches to Japanese Kanji (漢字) learning	Mean values
use of electronic dictionaries	4.8
search and use of Internet resources	4.4
usage of online educational literature	3.2
creation and application of their own associations (offline)	2.9
handwriting Kanji characters (offline)	4.7
use of AR applications	3.8
use of VR applications	3.7
creation of their own educational materials on the basis of augmented reality	5

"Electronic educational resources for learning a foreign language (Japanese)", which covers topics such as "Electronic dictionaries and their practical use in translation and teaching", "Online tests in foreign languages: the use of international test systems and the creation of personal tests using web services"; Module 3 "Immersive technologies of learning a foreign language (Japanese)", which covers such topics as "Model of learning a foreign language using virtual reality", "Model of learning a foreign language using augmented reality"; Module 4 "Research activities on the establishment of Electronic Educational Resources for the translation and teaching of Japanese".

Students were divided into groups according to their desire to learn language using ICT, including immersive technologies, which are present in separate modules of the course "Information Support of Philological Research in Japanese Studies", which is part of a series of linguistic disciplines that form the philological basis of the bachelor's program at the Institute of Philology of Taras Shevchenko National University of Kyiv in different lectures and seminars.

In response to the question "Do you want to learn a language using immersive technologies?", 21 students answered, while 8 students did not take an active part in the survey and training due to extreme conditions (military action in Ukraine). As a result of the survey, two groups were created: 11 students who will study language using ICT and immersive technologies, and 10 students who will study language using ICT but not immersive technologies. The group of students studying the "Japanese language and literature" course using ICT and immersive technologies passed the exam with an average of 95 points, while the group of students that studied language using ICT but did not use immersive technology passed the exam with an average of 85 points.

5. Conclusions and prospects for further research

In conclusion, immersive technologies provide a new paradigm for the presentation of educational materials, positively impacting the formation of fundamental and professional competencies in prospective Japanese language teachers. We can identify the following benefits of using ITs to train future teachers of the Japanese language:

- the use of ITs makes the learning process more visual and mobile;
- the use of ITs increases students' interest and motivation to learn the language;
- ITs improve the learning process by incorporating innovative forms of student engagement;
- ITs create conditions for the formation and development of students' creative abilities;
- these technologies and approaches contribute to the support of the linguistic and cultural aspect of student learning.

The following approaches to the use of ITs for the study of Japanese by students should be distinguished: 1) the use of specialised applications for language learning; 2) the use of applications for studying other disciplines (anatomy, biology, computer science, astronomy, etc.) while simultaneously

learning a foreign language; 3) the creation of personal examples by students for learning a foreign language with the help of special web platforms.

ITs can be effective when used in blended learning that combines distance, online, traditional, and self-directed learning of Oriental languages.

The author plans to continue the longitudinal research, analysing the statistical data of students' academic performance and expanding the research to several other subjects (taught at Taras Shevchenko National University of Kyiv) during the academic year 2022-2023.

Prospects for further research include the creation of guidelines and manuals on the use of immersive technologies for the study of prefabricated languages at different levels of training for prospective teachers of the Japanese language.

Declaration on Generative AI: The authors have not employed any Generative AI tools.

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