

Re-envisioning Web Learning and Communication Experience With WebXR

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Abstract

As the digital era progresses, various information and communication technologies are adopted to enhance the language learning process and to facilitate effective communication. Over the past decades, learners have been exposed to a whole new world of knowledge learning, diffusion, and communication with augmented reality (AR) and virtual reality (VR) technology. Web-extended reality (webXR) is being used as a solution to bridge the real world and the virtual world in the realm of newly-designed, web-based learning and communication activities. The ability to adopt these kinds of technologies to diffuse disciplinary knowledge is necessary for our new generations. Aiming at re-envisioning the immersive web learning and communication experience with webXR, we initiated a project in 2022, with the intent to establish a webXR-based Virtual Chinese Language Learning Centre (VCLLC) to provide a well-structured virtual learning environment for students to deploy both the Chinese language communication skills and webXR technology ability to effectively write, display and diffuse their disciplinary knowledge in Chinese, in a manner which is best suited for modern communication. In this paper, we will discuss and share some experiences in establishing a transdisciplinary assignment mechanism that helps students learn and use Chinese language with the latest ICT technology to diffuse and communicate at new heights by promoting hands-on practices, which can help our students imagine, create, and deliver innovative XR experiences in the context of disciplinary Chinese learning.

Keywords: ICT, Language Learning, WebXR, Virtual Learning, Communication Intensive Course, RECTi Model

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Introduction

Over the past few decades, there has been an increasing emphasis on redirecting the educational focus from the acquisition of static knowledge to interactive communication. In addition to enhancing learners' comprehension of the subject matter, interactive communication stimulates critical thinking, creativity, and collaboration, which are essential skills in the 21st century (Teo 2019). As Constant Leung (2005) points out that it “signaled a shift from grammar-based pedagogy to Communicative Language Teaching,” implying the need “to reconnect with the social world if the concept of communicative competence is to mean anything more than a textbook simulacrum of Englishes in the world.” This approach acknowledges that learning is not restricted to rote memorization but also focus on developing students’ higher order thinking that encompasses active engagement with the subject matter through discussions, collaborations, presentations, and problem-solving (Vijayaratnam 2012).

Learners can be benefited through the adoption of interactive communication, including the cultivation of coveted skills such as communication, teamwork, and problem-solving, which are highly valued in modern job markets. By engaging in meaningful interactions with peers, learners can attain a deeper understanding of the subject matter and develop the competencies necessary for the practical application of their knowledge in authentic meaning-focused, task-based scenarios (Yildiz 2020).

At the same time, we have entered a realm of knowledge acquisition, dissemination, and communication through the utilization of various information and communication technologies (ICTs). Social media platforms (Siddig 2020), discussion forums (Stickler & Hampel 2015; Manegre & Gutiérrez-Colón, 2023), and other online tools (Salmons, 2023) facilitate learners' ability to connect with one another, engage in the exchange of ideas and experiences, and cultivate a more collaborative and supportive learning climate. Furthermore, by emphasizing collaboration and communication via the latest informational technology such as augmented reality (AR) and virtual reality (VR), we can create more engaging and effective learning experiences that better prepare learners for success in a rapidly changing world (Alenezi & Akour 2023).

A Shifting Focus from Static Knowledge Acquisition to Interactive Communication

Shifting the focus from static knowledge acquisition to interactive communication represents a significant shift in the way we approach education and learning.

At the University of Hong Kong (HKU), the emphasis on language learning has also shifted away from fostering native language proficiency as the prime goal. The overarching objective of language instruction is frequently viewed as the cultivation of interdisciplinary and communication-centered language skills. In 2019, HKU initiated a project that involved the implementation of a CI (Communication Intensive) badge.

Courses that have been awarded with this badge are characterized by curricula that intentionally incorporate components that foster the development of communication-related knowledge, skills, and attributes. Numerous language courses are meeting certain requirements such as providing explicit and precise documentation regarding communication-focused course learning outcomes, aligning communication-related outcomes with at least two of the four communication “literacies”/goals, and assigning a minimum of 40% of the course evaluation

to assessment tasks that are specifically related to communication-relation activities (HKU 2022).

In response to this change in learning emphasis, innovative strategies for teaching and learning that capitalize on technology and novel media to facilitate the distribution and acquisition of knowledge are being deployed. Such pioneering methods encompass online courses, virtual and augmented reality simulations, gamification, and interactive multimedia content. These techniques offer learners the opportunity to interact with the materials in more dynamic and immersive ways, resulting in more profound comprehension and increased retention (Blyth 2018).

The emergence of innovative approaches for disseminating, acquiring, and communicating knowledge like social media, chatbots, online forums etc. represents a unprecedented frontier in the realm of education and learning. Embracing these novel methods has the potential to create more engaging, inclusive, and efficacious learning experiences that enhance learners' preparedness for success in a swiftly evolving world.

Synopsis of Our Project

Our project aims to innovate the immersive web-based learning and communication experience by leveraging WebXR technology. In 2022, we successfully applied a TDLEG project with the objective of establishing a Virtual Chinese Language Learning Centre (VCLLC) that utilizes cutting-edge WebXR technology to offer students a well-structured virtual learning environment with innovative and immersive learning experience. The establishment of a WebXR learning center is particularly relevant in the post-pandemic context, where the COVID-19 pandemic has forced many educational institutions to resort to online learning (Zhang 2020).

The VCLLC is intended to enable students to not only enhance their proficiency in the Chinese language but also develop their technology skills of ICT and apply them to effectively write, display, and disseminate their disciplinary knowledge in Chinese over a WebXR environment, which is best suited for modern communication practices in the cyber world.

The WebXR learning center offers a virtual environment that enables students to access a wide range of educational materials, including courses, simulations, and interactive multimedia resources. Students could then explore more complex concepts and scenarios, thereby facilitating the development of a deeper comprehension of the subject matter. We also attempt to create a transdisciplinary assignment mechanism that facilitates students' acquisition of the Chinese language by the latest ICT technology. This mechanism aims to promote hands-on practices that will enable students to imagine, create, and deliver innovative XR experiences that are contextualized within their disciplinary fields. This represents an exciting prospect to harness cutting-edge technologies to augment the learning experience and prepare students for triumph in a fast-changing world.

By developing these skills, students will be better equipped to diffuse and communicate their disciplinary knowledge at a new level, thereby enhancing their language learning and communication abilities.

Virtual Learning in Brief

Over the past decade, there has been a surge in the application of virtual reality (VR) and augmented reality (AR) models driven by advancements in technology and the expansion of communication networks and infrastructure (Bolter & Engberg 2021). Virtual learning has emerged as an effective learning tool, particularly in language acquisition, through the use of various AR and VR technologies such as Virtual Reality Language Immersion (Dhimolea, Kaplan-Rakowski, & Lin, 2022), Augmented Reality Vocabulary Flashcard (Nursabra, Syamsinar, Nurchalis, & Nuralima, 2023), Virtual Language Exchanges (Lin, & Lan, 2015), and Gamification (Al-Dosakee, & Ozdamli, 2021) with AR and VR technologies. These technologies have the potential to create more captivating and enjoyable immersive learning experiences. For example, Wedyan, Falah, Elshaweesh, Alfalah, & Alazab (2022) suggested that augmented reality can improve reading comprehension, academic achievement, vocabulary items, students' motivation, engagement, collaboration, and creativity.

Virtual learning can take various forms, ranging from online courses to virtual classrooms. Online courses are typically self-paced and can be accessed from anywhere with internet connection. Virtual classrooms, on the other hand, simulate a traditional classroom setting, with real-time interaction between students and instructors. As Kuhail, ElSayary, Farooq, & Alghamdi (2022) pointed out, immersive technologies such as AR, VR or XR have become prevalent in various domains and proven to improve learning significantly.

(i) Augmented Reality

Augmented Reality (AR) is an innovative technology that supplements a real-world environment with computer-generated sensory inputs (G. Dini, M. Dalle Mura, 2015). It aims to enhance the user's perception and understanding of the real world, rather than replacing it entirely by adding digital elements to the real world. In 1992, Thomas Preston Caudell, a researcher at Boeing, first coined the term "augmented reality" (AR) when he created an AR application for industrial purposes that allowed for the viewing of assembly diagrams (Arena, Collotta, Pau, & Termine, 2022). In the preceding decade, many AR experiences relied on a trigger barcode-like image to impose an object or video on top of objects in a real-time environment that could be viewed on a mobile device. The latest AR technology also employs surface tracking to enable the placement of virtual objects within the user's physical surroundings, eliminating the need for a trigger image.

AR can be particularly effective in communication-centered learning activities, as it enables learners to practise communication skills in realistic scenarios (Parmaxi & Demetriou 2020). For example, AR can be used to simulate a workplace environment, allowing learners to practise communication and collaboration skills with virtual colleagues. In fact, AR technology has positively impact users' learning process and experience significantly (Ghobadi, Shirowzhan, Ghiai, Ebrahimzadeh, & Tahmasebinia, 2022).

(ii) Virtual Reality (VR)

In contrast to augmented reality, which can be integrated into the user's surrounding environment, virtual reality is an emerging technology that presents a unique opportunity for teaching and learning with intensive communication activities. It aims at creating a completely artificial experience that can substitute the real world, rather than enhance it, which offers a unique and powerful learning experience to polish communication skills and prepare learners

for real-world scenarios. VR is particularly effective in situations where real-world environments are difficult or impossible to replicate, such as medical procedures or hazardous environments. In communication-centered learning activities, VR can be used to simulate high-pressure communication scenarios, such as negotiations or conflict resolution.

Comparing with other technologies, VR offers a more sophisticated and immersive learning experience. The development of virtual reality (VR) applications is a complex process that requires specialized expertise, in which meant a significantly higher developing cost that involved technical personnel.

(iii) WebXR

When choosing the appropriate technology for communication-centered learning activities, it is crucial to consider the limitations of both AR and VR. AR necessitates a real-world environment, which may not be feasible or suitable for all cases. On the other hand, VR can be costly to implement and may require specialized equipment. To strike a balance between AR and VR, an emerging technology known as eXtended reality (XR) has gained attention in recent years (Meccawy, 2022).

WebXR is a developing technology that amalgamates virtual and augmented reality with HTML, CSS and Javascripts coding like WebGL, Three.js, and A-Frame (Baruah, 2021). It enables learners to engage with educational content in a more dynamic and interactive manner that can be accessed via web browsers. Instead of introducing a new display type to the XR continuum, WebXR enables the deployment of virtual worlds within a web environment (Rzeszewski & Orylski, 2021). It provides a consistent interface for accessing VR/AR hardware across different devices, making it easier for developers to create and deploy immersive experiences on the web.

WebXR provides flexible ways to make use of a virtual environment (Bao, Tran, Nguyen, Pham, Lee, & Park, 2022), and is transforming the landscape of learning activities by providing an innovative and immersive learning experience to users to engage in learning activities, provides greater flexibility, accessibility, and interactivity no matter a physical VR device is available or not. It also facilitates a more realistic and immersive interaction with educational content, enabling more profound comprehension of intricate concepts and scenarios. WebXR allows learners to navigate virtual environments, manipulate 3D objects, and partake in interactive simulations, all within the confinements of their web browser, without the need to install any native applications (Pilat, Arapi, Pappas, Omieljanowicz, Prokopiuk, & Tamre, 2022).

Furthermore, WebXR technology enhances the learning experience by providing a more interactive and collaborative environment. WEBXR has gained prominence among educators and researchers as a tool for enhancing learning activities. For example, AL-Hafidz, Sukaridhoto, Al-Rasyid, Budiarti, Mardhotillah, Amalia & Satrio (2021) have successfully developed an immersive platform that enables doctors, lecturers, and students to collaborate in a virtual environment, facilitating real-time medical simulations with WebXR technology. Other application examples include Rodríguez, Dal Peraro, & Abriata (2021), Teshima, Sakaguchi, Mitsue, Uehara & Sugimoto (2022), Wong, Bayoumy, Freke & Cabo (2022), Luigini, Fanini, Basso, & Basso (2020), and Mogra & Guo (2023).

Details of the Project

The project aims to provide an exemplary model for the teaching and learning of Chinese language. Through task-based practice, students will engage with the language in a practical and immersive manner, resulting in the development of their language skills and knowledge through hands-on experience.

It also seeks to adopt an innovative approach to interdisciplinary collaborative learning, which will establish a dynamic learning environment that encourages students to collaborate across different fields of study.

(i) Project Timeline

It will be run in two stages:

Phase One	Establish a Virtual Chinese Language Learning Center that will utilize WebXR technology, with the goal of providing students with a methodically designed virtual platform to improve their language and communication skills, as well as to develop proficiency in WebXR coding techniques.
Phase Two	Set up a transdisciplinary assignment mechanism which will enable students to acquire and apply the Chinese language using cutting-edge information and communication technology (ICT), with the goal of enhancing the diffusion and communication of the Chinese language through practical experience.

Throughout the assignment period, students from each specialization will:

- Engage in idea exchange and appreciation to jointly develop effective solutions for producing works that adhere to correct formatting requirements;
- Select appropriate quantities and qualities of information, and;
- Determine optimal methods for display.

(ii) Design of Pedagogy and Activities

The pedagogy of the curriculum design for the virtual learning environment is underpinned by the RECTi model developed by Dr. Chi Ming Chan. A fundamental aspect of this model is the design of activities that are engaging, meaningful, and relevant to the learners' needs and interests. The approach aims at promoting language proficiency and skill development in a systematic and comprehensive manner, with the integration of information and communication technology.

RECTi model contains the following elements:

Revitalize	<ul style="list-style-type: none"> • Reviewing and practicing previously learned vocabulary and grammar structures • Discussing current events and cultural topics related to the language being studied • Reading and discussing works written in the target language
Enhance	<ul style="list-style-type: none"> • Practicing listening comprehension through audio recordings and videos • Engaging in role-playing scenarios to practice using the language in real-life situations • Participating in debates or discussions on controversial topics
Create	<ul style="list-style-type: none"> • Creating works related to a specific topic in the target language • Collaborating with peers to create a group project or presentation • Writing summaries or responses to articles, news stories, or literary works in the target language
Transfer	<ul style="list-style-type: none"> • Participating in community events or activities where the target language is spoken • Engaging in independent study or research projects related to the language and culture being studied • Applying for jobs or graduate programs that requires proficiency in the target language
Integrate	<ul style="list-style-type: none"> • Engaging in debates or discussions on current issues or topics of interest, which requires them to use their language skills to express and defend their opinion • Participating in role-plays, where they act out different scenarios using appropriate language and communication skills • Working in groups to complete a project, such as creating a presentation or a video, by using their language skills to communicate effectively and collaborate with others

The key is to design activities that are engaging, meaningful, and relevant to the learners' needs and interests, whilst promoting language proficiency and skill development in a systematic and comprehensive way.

(iii) Choice of WebXR platforms

We have developed two platform versions using different coding languages to test the accessibility and usability, as well as evaluate the efficiency of development and management. One version was created using A-frame as the primary coding language for development, while another was built using framevr.io. These tools have been utilized to create an immersive and engaging virtual learning environment for students to enhance their proficiency in the Chinese language.

In order to ensure the quality of our Virtual Chinese Language Learning Centre (VCCLC), we have also established a pre-launch test server running Apache 2 on an Ubuntu platform. Although it is currently only used for test-running purposes due to technical issues, we intend to make it available to students for testing by September 2023.



Figure 1: Two Scenes in Framevr.io



Figure 2: Developing Scene with A-frame

Challenges of Developing WebXR Platform for Learning and Teaching

Several infrastructure issues have been identified that require immediate attention. These issues include the server capacity, network access, and server maintenance. Failure to address these issues in a timely and effective manner could have a significant negative impact on the development and functionality of our virtual learning platform.

The success of our project is reliant on the provision of technical support from the IT department. However, our current capacity to develop tools and equipment is insufficient to meet our needs, as demonstrated by the inadequate computer performance that hinders smooth rendering in Blender, Unity or Real Engine 5. A need to upgrade the infrastructure is deemed essential.

In addition to hardware inadequacies, the lack of familiarity among teachers with the coding of WebXR poses another obstacle to the full-scale deployment of the system. To overcome this challenge, we are considering the solution of engaging student helpers who possess the requisite computer knowledge and skills.

Another critical aspect of our project is to ensure that we address the security challenges that may arise. The primary concerns are privacy, security, and data protection of our students. We must ensure that any virtual learning environment we have created is secure and protected against unauthorized access or data breaches. The potential security challenge arises from the issue of login credentials on non-university approved web platforms. If these credentials are compromised, it could result in the unauthorized access and leakage of students' data. This critical consideration brings us to another issue: whether to develop the platform or website entirely in-house or employ a ready-made hosting service. We must carefully weigh the pros and cons of each option to ensure that we make the best decision for our project.

Aside from the aforementioned challenges, there are other issues that need to be considered to ensure the success of the project. One such issue is the lack of native support for WebXR format in some browsers and tools. This, coupled with compatibility issues faced by outdated browsers and mobile devices, creates a challenge for both the developers and students. To address this issue, the replacement of outdated machines and devices may be necessary.

An additional challenge that must be addressed is the lack of computer proficiency among teachers and students from academic disciplines with limited digital literacy. The development, deployment, and utilization of the WebXR platform require a certain level of competency, which may not be met by all users. To overcome this challenge, we propose the organization of seminars and hands-on workshops which targets at enhancing the computer proficiencies of both teachers and students.

Expected Impacts of the Project

Notwithstanding the challenges that require attention, the development of the WebXR platform is progressing according to plan. Upon completion, the project is expected to yield several significant impacts that will benefit students, educators and alike.

One key goal would be the integration of the curriculum in a meaningful way that promotes effective learning. This, in turn, has the potential to improve academic outcomes and foster a more comprehensive understanding of the target language and culture.

Another goal is the establishment of a benchmark for the development of WebXR-based platforms for transdisciplinary collaborations with other courses. Our project is at the forerunner of innovative cross-disciplinary learning, and we anticipate that it will inspire other teachers to pursue similar initiatives in the future.

Future Planning

Upon completion, the final WebXR learning centre will be opened as a knowledge hub within the Virtual Chinese Language Learning Centre. This hub will provide students with an interactive and immersive learning experience that promotes their Chinese language proficiency. By integrating the WebXR platform into the virtual learning environment, students will have access to an extensive range of resources and tools that facilitate their language learning journey.

If additional funding becomes available, we plan to make students' WebXR works accessible to the public for educational purposes. This initiative will serve as a form of knowledge exchange, where students can share their knowledge and insights with the wider community. By providing access to these resources, we hope to foster a culture of collaboration and innovation that will benefit the wider academic community.

Conclusion

WebXR offers numerous benefits for learning and teaching in communication-intensive language courses. It provides a more realistic and immersive learning experience, increased accessibility and flexibility, and opportunities for collaboration and communication among learners and instructors. As this technology continues to evolve, it presents exciting prospects for the future of language education. By adopting the latest technology of WebXR, our project aims to empower students to envision, create, and deliver innovative learning experiences within the framework of their respective academic fields. The project's emphasis on providing a meaningful and relevant context for language development is intended to equip students with the tools and skills necessary to succeed in an increasingly interconnected and globalized world. With the creation of an immersive and engaging virtual learning environment, the

platform established by our project will offer students the opportunity to develop their Chinese language proficiency in a practical and relevant context.

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