Language Learning & Technology
ISSN 1094-3501 CC BY-NC-ND

October 2023, Volume 27, Issue 3
pp. 1–5

COMMENTARY

Extended reality (XR) in language learning: Developments and directions

Mark Pegrum, The University of Western Australia

Yu-Ju Lan, National Taiwan Normal University

APA Citation: Pegrum, M., & Lan, Y.-J. (2023). Extended reality (XR) in language learning: Developments and directions. *Language Learning & Technology*, *27*(3), 1–5. https://hdl.handle.net/10125/73528

Introduction

Recent years have seen growing interest in extended reality (XR) in education, covering the spectrum from virtual reality (VR) to augmented reality (AR), and including mixed reality (MR) which is sometimes understood as equivalent to AR and sometimes as equivalent to XR. VR offers potential for contextualized, interactive learning embedded in fully digitally simulated environments (Lan, 2020a). AR offers similar learning potential but embedded in real-world environments overlaid with digital data. In a broad definition, AR refers to the dynamic presentation of contextually relevant information and communication channels in a real-world setting, while in a narrow definition, it refers to the direct superimposition of these channels on our perceptions of the real-world setting, with the broad and narrow definitions increasingly merging as the technology advances (Pegrum, 2021). It is important to note that while AR most commonly adds digital data *to* our perceptions, it may also digitally hide real-world data *from* our perceptions, and in fact it can do both at the same time (Wen et al., this issue). Depending on the hardware used, XR interfaces may currently be experienced less immersively and directly (e.g., on the screen of a smartphone) or more immersively and directly (e.g., through a headset), with an apparent move towards greater immersiveness and directness. Today's discussions of XR may well connect in time with technology industry proposals for a worldwide metaverse.

Evidence has already begun to emerge of the language learning value of VR (e.g., Alfadil, 2020; Lan, 2020b; Lan et al., 2015), with research suggesting that social interaction in immersive VR is particularly effective in improving learning outcomes (e.g., Li & Lan, 2022). Evidence has also begun to emerge of the language learning value of AR (e.g., Chang et al., 2022; Parmaxi & Demetriou, 2020), with one notable early trend being towards the deployment of AR language learning trails grounded in digitally supported real-world immersion (e.g., Pegrum, 2019a, 2019b). However, with a number of studies suggesting that XR benefits some aspects of language learning more than others (e.g., Reinders et al., 2015; Wang, 2017; Wang et al., 2020; Wen et al., this issue), much more research is needed into what kinds of content and tasks lend themselves to XR approaches, as well as which learners stand to benefit most (Buchner & Kerres, 2023; Hockly, 2019; Lan, 2020a). One area of particular interest is applications of XR for learners with special educational needs (e.g., Lan, 2020b; Lan et al., 2018; Lan et al., in press). Another notable research area is students' own creation of XR content or contexts to develop their agency and autonomy, and to support their own and others' learning (e.g., Pegrum, 2019b; Yeh & Lan, 2018; Yeh et al., 2018).

Some benefits may vary as we move along the XR spectrum. VR may have a role to play in supporting telecollaboration, COIL (collaborative online international learning) or VE (virtual exchange) projects, such as by facilitating negotiation of meaning through embodied L2 communication (Chen & Sevilla-Pavón, 2023), by enriching digital storytelling exchanges between distant students and, broadly, by helping students build intercultural awareness and empathy for diverse others (Godwin-Jones, this issue; Taguchi, this issue). It may also have practical advantages over AR in an era of remote teaching and learning such as during the COVID-19 pandemic (Kukulska-Hulme, 2021). AR, by contrast, may help students leverage

the linguistic richness of everyday urban landscapes where multiple languages and dialects are in play, and where translanguaging may come to the fore; but it may also hide real-world distractions to focus students' attention more narrowly on key information. Other benefits, perhaps intertwined with challenges, may be common to the whole XR spectrum: 3-dimensional *multimodal immersive texts* add considerable complexity to the creation, interpretation, and exchange of meanings we are used to in 2-dimensional multimodal texts, thereby both fostering and necessitating students' development of new literacies such as *immersive literacy* or, more specifically, *XR literacy* (Pegrum et al., 2022).

In this Issue

Given the recent excitement around the potential of XR for language learning, it was perhaps unsurprising that our call for papers in October 2021 led to the submission of 41 abstracts. However, after a rigorous review process, only two empirical papers have been included in this special issue. It seems that although the use of XR in language learning is a hot issue, there is still a lack of empirical research with solid theoretical foundations and multifaceted supporting evidence. The two empirical articles are accompanied by an extensive review of the spectrum of XR for language learning in Robert Godwin-Jones' regular Emerging Technologies column.

The first paper focuses on AR annotations and filters. In *Restructuring Multimodal Corrective Feedback Through Augmented Reality (AR)-enabled Videoconferencing in L2 Pronunciation Teaching*, Wen, Li, Xu, and Hu describe the development of a multimodal corrective feedback model for pronunciation which captured and juxtaposed learners' articulations of target sounds with videos of native speaker articulations. Taking into account multimedia design principles (see e.g., Mayer & Fiorella, 2022), the model utilized AR filters to reduce extraneous cognitive load by hiding inessential facial movements, as well as AR annotations to focus learners' attention on essential movements. In comparing an experimental group of university-level Chinese learners of English with a control group taking an offline multimedia corrective feedback class, the authors found that the experimental group improved significantly more in producing the English dark /ɬ/ consonant, which is challenging for L1 speakers of Mandarin; they suggest that this shows AR for *subtraction* of unnecessary information may be "the best addition to L2 learning" (p. 99). At the same time, they found that the control group improved their auditory identification of the dark /ɬ/ as well as the dental fricatives /ð/and /θ/ more than the experimental group, showing that different teaching modes are appropriate for different tasks, and indicating that AR cannot necessarily be expected to serve all language learning purposes. Despite some technical and other issues, students reported that the AR model helped them focus their attention and improved the efficiency of their learning.

The second paper focuses on immersive VR. In *Using Immersive Virtual Reality for the Assessment of Intercultural Conflict Mediation*, Taguchi describes the use of 360-degree videos accessed on VR headsets to develop US university students' intercultural competence, with a specific focus on intercultural conflict mediation. Following a pre-task where students observed a conflict in a 360-degree video and attempted to mediate it on the spot, they engaged in two conflict mediation classes, and then repeated the VR task with a different 360-degree video. Significant improvements were observed from pre-task to post-task on the five dimensions of social initiative, empathy, perspective-taking, solution, and clarity in discourse. Importantly, student survey responses indicated that they generally found the immersive VR realistic and lifelike, and that it evoked feelings of discomfort and intensity; this prompted them to engage in mediation, putting newly learned skills into practice in the post-task. Unlike more traditional questionnaire-based approaches to intercultural competence, immersive VR allows for situated learning experiences and performance-based assessments. However, as one student noted, the mock nature of the activity reduced her potential anxiety in carrying out the task, leading the author to remind us that "virtual reality is only realistic, and it is not real" (p. 124). The author concludes that VR simulations may provide practice opportunities in such a way as to support the eventual transfer of learning to real-life settings.

In his Emerging Technologies column, entitled *Presence and Agency in Real and Virtual Spaces: The Promise of Extended Reality for Language Learning*, Robert Godwin-Jones presents a broad survey of

current uses as well as the potential and limitations of XR for language learning. AR, he notes, is more accessible than VR because it can simply be accessed on today's widely available smartphones, but its main educational usage remains vocabulary learning or guided tours. More interactive options include learning trails or location-based gaming, with students typically responding positively to the opportunity to co-construct AR experiences. VR has developed in several waves, with the most recent wave, encompassing today's multimedia roleplay and vocabulary apps, unfortunately lacking the collaborative and creative ethos of earlier waves. Godwin-Jones goes on to illustrate some of the potential of VR for personalized, constructivist development; collaboration; experiential learning through simulations; virtual exchange and cultural learning; kinesthetic learning; and supporting students with special needs. There is clearly scope for educational projects which more fully explore the language learning potential of both AR and VR, emphasizing agency, presence and copresence, and creativity within complex linguistic settings. There is equally scope for research studies with larger numbers of participants and longer durations. The future may well belong to mixed reality devices which allow a blending of AR and VR, with generative artificial intelligence (AI) offering some promise for less scripted chatbot interactions and more personalised, adaptive learning.

Conclusion

We hope that the current small but informative issue will spur more researchers to conduct studies in the emerging area of XR in language learning. In particular, we hope to see studies built on clear theoretical foundations and grounded in extensive reviews of the existing literature. Empirical studies are needed based on solid research designs which go beyond the collection of self-report data, and which involve randomized controlled trials with multimodal evidence to improve their validity and broaden their applicability. Moreover, studies are now needed with larger groups of learners and over longer durations than we have seen in much of the early educational XR research. It is already apparent that AR and VR are not appropriate for all aspects of language learning, but in areas where they can make an impact—from teaching pronunciation through to honing intercultural competence—their potential benefits may be substantial for a wide range of learners with a wide range of needs. Importantly, given the emergence of generative AI and its likely impact on language education, educators and researchers may wish to consider the possibility of judiciously combining XR and AI to produce effective and varied language learning experiences and prepare learners for future workplaces.

Acknowledgements

We would like to thank the editors of *Language Learning & Technology* for the invitation to edit this special issue on XR. We would also like to thank Skyler Riela and Becky Dingle for their support with the editing process, and the many peer reviewers who generously shared their time and expertise. We also thank the National Science and Technology Council, Taiwan, ROC, for partial support of this research under grant numbers MOST 110-2511-H-003-038-MY3 and MOST 111-2410-H-003-006-MY3.

References

Alfadil, M. (2020). Effectiveness of virtual reality game in foreign language vocabulary acquisition. *Computers & Education, 153.* https://doi.org/10.1016/j.compedu.2020.103893

Buchner, J., & Kerres, M. (2023). Media comparison studies dominate comparative research on augmented reality in education. *Computers & Education, 195.* https://doi.org/10.1016/j.compedu.2022.104711

Chang, H.-Y., Binali, T., Liang, J.-C., Chiou, G.-L., Cheng, K.-H., Lee, S. W.-Y., & Tsai, C.-C. (2022). Ten years of augmented reality in education: A meta-analysis of (quasi-)experimental studies to investigate the impact. *Computers & Education, 191.* https://doi.org/10.1016/j.compedu.2022.104641

Chen, H.-I., & Sevilla-Pavón, A. (2023). Negotiation of meaning via virtual exchange in

immersive virtual reality environments. *Language Learning & Technology*, *27*(2), 118-154. https://doi.org/10125/73506

Godwin-Jones, R. (2023). Presence and agency in real and virtual spaces: The promise of extended reality for language learning. *Language Learning & Technology*, *27*(3), 6–26. https://hdl.handle.net/10125/73529

Hockly, N. (2019). Augmented reality. *ELT Journal*, *73*(3), 328–334. https://doi.org/10.1093/elt/ccz020

Kukulska-Hulme, A. (2021). Conclusions: A lifelong perspective on mobile language learning. In V. Morgana & A. Kukulska-Hulme (Eds.), *Mobile assisted language learning across educational contexts* (pp. 122–133). Routledge.

Lan, Y.-J. (2020a). Immersion, interaction, and experience-oriented learning: Bringing virtual reality into FL learning. *Language Learning & Technology*, *24*(1), 1–15. https://doi.org/10125/44704`

Lan, Y.-J. (2020b). Immersion into virtual reality for language learning. *Psychology of Learning and Motivation, 72*, 1–26. https://doi.org/10.1016/bs.plm.2020.03.001

Lan, Y.-J., Fang, S.-Y., Legault, J., & Li, P. (2015). Second language acquisition of Mandarin Chinese vocabulary: Context of learning effects. *Educational Technology Research & Development, 63,* 671–690. https://doi.org/10.1007/s11423-015-9380-y

Lan, Y.-J., Hsiao, I. Y. T., & Shih, M.-F. (2018). Effective learning design of game-based 3D virtual language learning environments for special education students. *Educational Technology & Society, 21* (3), 213–227. https://drive.google.com/file/d/1Fw-Eualb9zrnSDDBHUNc7CqMpfF7JeWO/view

Lan, Y.-J., Shih, M.-F., & Hsiao, Y.-T. (in press). 3D immersive scaffolding game for enhancing Mandarin learning in children with ADHD. *Educational Technology & Society*, *27*(2), 4-24.

Li, P, & Lan, Y. J. (2022). Digital language learning (DLL): Insights from behavior, cognition, and the brain. Bilingualism: Language and Cognition, 25(3), 361–378. https://doi.org/10.1017/S1366728921000353

Mayer, R. E., & Fiorella, L. (Eds.). (2022). *The Cambridge handbook of multimedia learning* (3rd ed.). Cambridge University Press.

Parmaxi, A., & Demetriou, A. A. (2020). Augmented reality in language learning: A state-of-the-art review of 2014–2019. *Journal of Computer Assisted Learning*, *36*(6), 861–875. https://doi.org/10.1111/jcal.12486

Pegrum, M. (2019a). Mobile AR trails and games for authentic language learning. In Y. Zhang & D. Cristol (Eds.), *Handbook of mobile teaching and learning* (2nd ed.). Springer.

Pegrum, M. (2019b). *Mobile lenses on learning: Languages and literacies on the move*. Springer.

Pegrum, M. (2021). Augmented reality learning: Education in real-world contexts. In T. Beaven & F. Rosell-Aguilar (Eds.), *Innovative language pedagogy report* (pp. 115-120). Research-publishing.net. https://doi.org/10.14705/rpnet.2021.50.1245

Pegrum, M., Hockly, N., & Dudeney, G. (2022). *Digital literacies* (2nd ed.). Routledge.

Reinders, H., Lakarnchua, O., & Pegrum, M. (2015). A trade-off in learning: Mobile augmented reality for language learning. In M. Thomas & H. Reinders (Eds.), *Contemporary task-based language teaching in Asia* (pp. 244–256). Bloomsbury.

Taguchi, N. (2023). Using immersive virtual reality for the assessment of intercultural conflict mediation. *Language Learning & Technology*, *27*(3), 108–128. https://hdl.handle.net/10125/73534

Wang, C.-P., Lan, Y.-J., Tseng, W.-T., Lin, Y.-T. R., & Gupta, K. C.-L. (2020). On the effects of 3D virtual worlds in language learning: A meta-analysis. *Computer Assisted Language Learning*, *33*(8), 891–915. https://doi.org/10.1080/09588221.2019.1598444

Wang, Y.-H. (2017). Exploring the effectiveness of integrating augmented reality-based materials to support writing activities. *Computers & Education*, *113*, 162–176. https://doi.org/10.1016/j.compedu.2017.04.013

Wen, Y., Li, J., Xu, H., & Hu, H. (2023). Restructuring multimodal corrective feedback through Augmented Reality (AR)-enabled videoconferencing in L2 pronunciation teaching. *Language Learning & Technology*, *27*(3), 83–107. https://hdl.handle.net/10125/73533

Yeh, Y.-L., & Lan, Y.-J. (2018). Fostering student autonomy in English learning through creations in a 3D virtual world. *Educational Technology Research and Development*, *66*(3), 693–708. https://doi.org/10.1007/s11423-017-9566-6

Yeh, Y.-L., Lan, Y.-J., & Lin, Y.-T. R. (2018). Gender-related differences in collaborative learning in a 3D virtual reality environment by elementary school students. *Educational Technology & Society*, *21*(4), 204–216. https://www.j-ets.net/collection/published-issues/21_4

About the Authors

Mark Pegrum is Professor in the Graduate School of Education at The University of Western Australia, where he is the Deputy Head of School (International). He specializes in digital technologies in education, with a particular focus on mobile learning. His current research focuses on mobile and emerging technologies, including XR and generative AI; digital literacies and especially attentional literacy; and the forms digital learning takes in diverse contexts across the Global North and South.

E-mail: mark.pegrum@uwa.edu.au

Yu-Ju Lan is Research Chair Professor in the Department of Chinese as a Second Language at National Taiwan Normal University. She is currently the Editor-in-Chief of *Educational Technology & Society*. Her research interests include technology-enhanced foreign language learning, virtual reality, AI chatbots, and online synchronous teacher training.

E-mail: yujulan@gmail.com