Using Virtual Reality to improve interdependent language learning: training and strategies for teachers

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Abstract

This paper addresses the integration of Virtual Reality (VR) in language education to foster interdependent language learning among students through immersive technologies. Interdependent language learning promotes cooperative relationships and skill development through shared goals, but there is a gap in understanding how VR can effectively support these dynamics. This study assesses the impact of VR on teachers' acceptance and perceived usability of immersive experiences designed to enhance student interactions and mediation strategies, using data derived from interventions conducted with language teachers at the University of Arizona. Insights are revealed into their practices regarding the use of VR in class planning and delivery, improved by perceptions of its usefulness and a greater willingness to incorporate it into language teaching through involvement in interdependent activities for class planning. Additionally, the study presents methodological strategies for designing VR-based language learning activities that foster collaboration between students and actively involve teachers in the planning process. The insights aim to support educators in adapting their instructional methods to leverage VR technology for fostering cooperative and equitable learning environments.

Keywords: Virtual Reality, interdependent language learning, teacher training, educator development

1. Introduction

Interdependent language learning centres on developing contextually driven, goal-oriented relationships among students who rely on one another to co-construct meanings and mediate decisions for achieving their goals (Johnson, Johnson, 2005). Involving students in interdependent language activities can enhance teamwork, creativity, and critical skills (Ellis 2003). With the continuous integration of technology in language education, teachers face the challenge of effectively utilising digital tools that support students' positive interdependence. Virtual Reality (VR), due to its highly interactive features, offers an opportunity to foster interdependent relationships by providing immersive and engaging experiences for digital co-creation. However, while VR has been extensively explored as a language learning tool through desktop and headset-based applications, less attention has been given to its acceptability and usability for enhancing learners' interdependence. Furthermore, there is a lack of methodological guidance on planning and implementing VR-based language classes that foster positive interdependence, including strategies for mediation, clarification seeking, and opinion requests.

To address this gap, this paper presents findings from interventions conducted at the University of Arizona involving teachers who participated in study groups focused on using VR

for language class planning and delivery. During these online meetings, teachers discussed practices for leveraging VR to enhance interdependence among language learners, which they later practiced in person using VR headsets. The study aimed to assess the impact of these activities on teachers' acceptance and perceived usability of VR experiences designed to promote goal-oriented interactions and mediation strategies among students.

By engaging teachers in the planning and implementation of VR educational activities, this study also seeks to provide methodological insights that can inform teacher training practices centred on enhancing students' positive interdependence. It is hypothesised that teachers' acceptance and perceived usefulness of using VR for language education would improve because they were participating in the study group activities, leading to a greater readiness to incorporate this technology into their teaching. Additionally, the study aims to identify methodological strategies for creating VR language learning activities that promote interdependence through task-based planning and exposure to technology.

Ultimately, the findings regarding teachers' methodologies, acceptability, and perceived usefulness of VR are envisaged to assist educators in adapting their instructional approaches to evolving technologies while fostering students' interdependent skills and promoting equitable and collaborative digital learning environments.

2. Literature review

Analysing the use of Virtual Reality (VR) for language learning is especially significant due to its immersive properties. Broadly defined as an "advanced form of human-computer interface that allows users to interact with and become immersed in a computer-generated environment in a naturalistic fashion" (Eichenberg 2012: 3), VR is categorised based on levels of immersion. This term refers to the technical capability of delivering an illusion of reality, profoundly impacting users' behaviours (Slater, Wilbur 1997).

2.1 Types of VR

Immersive VR (iVR) offers a comprehensive digital experience where virtual reality predominates over reality. This is facilitated through head-mounted displays (HMDs) and hand controllers that physically disconnect users from the real world. These tools are equipped with hand tracking, head-tracking and stereoscopic displays, which enable depth perception and realistic movement visualisations (Wenk et al. 2021).

In contrast, non-immersive VR (non-iVR) offers partial immersion, as users rely on screen interfaces to access virtual activities. They view these on two-dimensional monitors or mobile devices, using a keyboard or mouse for interaction (Kaplan-Rakowski, Gruber 2019). Consequently, real-world awareness persists during these experiences, as actual stimuli influence sensory involvement in the physical environment.

Despite the different pedagogical implications of using iVR and non-iVR in educational contexts, both possess educationally relevant aspects for analysing interdependence-boosting technologies in language learning. They have been investigated in language education to support virtual group work through collaborative virtual environments (CVEs), where team members share the same digital space while being physically situated elsewhere (Horvat *et al.* 2022).

2.2 Avatars and social presence in VR

Utilising immersive technologies fosters deep psychological, sensory, and behavioural immersion among platform users, allowing for synchronous collaboration during virtual tasks. VR interactions unfold through the embodiment of avatars, which represent users' digital versions (Green et al., 2020). Given the realistic interactions afforded by the correspondence between

sensory feedback, motor output, and human resemblance, avatars facilitate human-controlled interactions and behaviours (Della Longa *et al.* 2022). Based on collaborative language learning perspectives, users are more inclined to utilise their language skills in iVR-based task attainment than in non-iVR settings, as avatars emulate real-life human behaviours of empathy and mutual assistance (Guegan et al., 2020).

In their self-representative capacity, avatars are essential elements of collaborative self-presence, enhancing communication and task execution. They facilitate interactions and personalization through their scalability, affordability, and general adaptability to various operating systems (Pakanen *et al.* 2022). Given their ability to increase co-presence, understanding the affordances of VR, its pedagogical implications, and experiential components is crucial for its effective implementation in educational contexts.

2.3 Theoretical framework from educational perspectives

Educators need to develop the skill of mastery of these aspects. Practical uses of class-based VR include teachers' understanding of the utility value of the experiences supporting perceptions of self-efficacy and the professional knowledge required for the successful adoption of technology in educational practices. Considerations must be made on the redefinitions that social activities undergo within virtual learning spaces at the crossroads of pedagogy and VR.

Building on existing literature on VR-based learning, this paper proposes a framework redefining students' social skills through the lens of positive interdependence, developed and practised through VR use. Specifically, in addition to the key elements of VR learning, which consist of immersion, exploration, and motoric agency, this paper highlights the parameters of social agency as a key pedagogical element that teachers need to consider when planning VR-based language activities to boost students' positive interdependence.

Social agency is proposed as an additional level of inquiry, contextualised within Leontiev's theory of human activity, as interpreted by Engeström (1999). This theory explains human interactions as intertwined, constantly evolving, societally constituted forms of mediation, characterised by instruments, rules, and labour division. The framework accounts for the changing social dynamics amongst students interacting in VR spaces and justifies behavioural adjustments arising from potential interactional imbalances. The framework could also help teachers adjust their instructional practices to design language activities that support interdependence.

2.4 Communication in virtual environments

VR devices support highly rich multimedia input and output, consisting of numerous cues, medium support, feedback immediacy, language use, and content personalisation, thereby replicating realistic face-to-face communication (Ishii et al., 2019). Video conferencing, a computer-mediated method that allows engagement through real-time visual and auditory network interactions (Queiroz et al., 2023), enhances the realism of virtual communication.

The increasing presence of video affordances on social communication tools has amplified the potential to conduct video interactions on almost all digital devices. Video conferencing in language education has introduced unprecedented flexibility from accessibility and interactional perspectives. It has provided students with the choice of interactive engagement and classroom access, and permitted teachers to choose their preferred lesson delivery according to the lesson content.

However, drawbacks have been identified regarding information overload, learning experiences and performance, activity disengagement and social exhaustion (Ebardo *et al.* 2021). These are some of the downsides associated with using high-media-rich devices for social activities, as they can trigger fatigue from information overload and nonverbal overload (Bailenson 2021). As these downsides may affect users across professional and educational sectors, they also impact language teachers who operate and use virtual devices for educational purposes. Hence,

the importance of considering social and perceptual parameters in assessing the acceptability and usability parameters of VR implementation in language education.

3. Methodology

3.1 Research design and intervention

The intervention design involved drafting consent forms, planning activities, data collection, and surveying intervention facilities. The principal investigator worked with the institutional review boards of Ca' Foscari University of Venice and the University of Arizona to ensure that data collection followed the General Data Protection Regulation (GDPR) and institutional requirements. After approval from the data protection officers, planning for activities and recruitment strategies began, with digital flyers created on Canva[1].

These flyers included links to a Google registration module shared among language practitioners, educators, and students in the Department of Second Language Acquisition and Teaching at the University of Arizona. The registration module featured a pre-activity survey to gather participants' demographics and technological experience. Email addresses were used to send consent forms.

3.2 Participants

Recruitment unfolded in three phases, targeting doctoral students, graduate assistants, and experienced language teachers in educational technology courses. Out of 51 expressions of interest, 30 participants returned signed consent forms. They were divided into three cohorts: nine in the undergraduate cohort, eleven in the doctoral cohort, and ten experienced language teachers in the teacher cohort.

There were 14 males and 15 females from diverse educational backgrounds, all of whom were English speakers, with 18 being non-native. They had varied teaching specialisations, tech competencies, and VR experiences. Most taught foreign languages, while others focused on bilingualism, translation, and educational technologies. When assessing their technical skills, most participants categorised themselves as intermediate users, spending two to eight hours daily on computers. While most had VR experience, only a few used it for language teaching.

3.3 Research tools

The principal researcher conducted online meetings by sending Zoom links and passcodes to participants via institutional email. Initially, participants' addresses were included in the blind carbon copy (BCC) field to prevent sharing, and only after gaining consent were they made visible. Tools included recording devices and a stable internet connection. Online participants joined from personal computers, while in-person sessions were held at the University of Arizona's Digital Innovation and Learning Lab (DIALL), using four Meta Quest 2 headsets, one owned by the principal investigator.

3.4 VR applications and functionalities

The participants utilized immersive and non-immersive applications. Non-iVR platforms included ThingLink[2] and StoryMaps[3], while iVR platforms comprised Wander[4], WondaVR[5]

[1] https://www.canva.com/.
[2] https://www.thinglink.com/it/.
[3] https://storymaps.com/.
[4] https://www.meta.com/it-it/experiences/wander/2078376005587859/?utm_source=sidequest.
[5] https://www.wondavr.com/.

Immerse[6], and Anne Frank House VR[7]. Two hybrid platforms, Spatial.io[8] and Horizon Workrooms[9] were also included.

All applications offered highly interactive features for engaging with virtual objects and fellow users. ThingLink and StoryMaps enabled the creation of digital stories in interactive 360° formats, while Wander and Spatial.io provided exploratory iVR activities via Google Maps and virtual galleries. Anne Frank House VR allowed users to explore recreated spaces used by Anne Frank's family during WWII. Finally, WondaVR and Horizon Workrooms are hybrid platforms for multi-user VR experiences, facilitating interactions among avatars.

3.5 Activity structure

The participants were involved in meetings, henceforth named study groups, which lasted thirty-four hours, comprising one-hour Zoom sessions and two-hour in-person activities at the DIALL lab. Each session focused on themes related to key pedagogical parameters for interacting with groups in VR environments, structured around Task-Based Language Learning (TBLL) principles. The sessions included:

- Pre-task:
  - (online) Overview of VR technologies
  - (in person) Tutorial and exploration of iVR environments
- Task cycle:
  - (online) Discussion on non-iVR cooperative activities
  - (in person) Planning and conducting cooperative language activities
- Planning:
  - (online) Preparation of non-iVR lessons
  - (in person) Testing iVR lessons in groups
- Report:
  - (online) Presentations of non-iVR lessons
  - (in person) iVR lesson delivery
- Post-task:
  - Analysis: (online & in person) Discussions on planning challenges
  - Practice: (online & in person) Discussions on pedagogical applications of activities

Four Meta Quest 2 headsets allowed for small-group activities, enabling participants to use VR on a rotation basis and encouraging cooperative interactions. Post-meeting emails included class slides and were uploaded to Google Drive by the principal investigator.

3.6 Quantitative and qualitative data assessment

A quantitative data collection approach was adopted to analyse VR technology use in educational contexts, particularly focusing on cooperative learning among teachers. Data were collected through online questionnaires, including pre-task and post-task surveys, as well as short questionnaires administered after each activity. The researchers used the term "cooperation" instead of "interdependence" in their questions to avoid confusion among teacher participants.

The methodology was guided by the Technology Acceptance Model (TAM) of Davis (1993). It included measurements of various parameters: technological proficiency, usability,

[6] https://www.immerse.com/.
[7] https://www.meta.com/it-it/experiences/anne-frank-house-vr/1958100334295482/?srsltid=AfmBOorArJOEfa2igr2bv3-Cvl-kdzIYmbsH6znblN4Z2YsUgD4l6gOF.
[8] http://spatial.io/.
[9] https://forwork.meta.com/gb/horizon-workrooms/.

acceptability, presence, immersion, agency, and cooperative affordances of VR applications (O'Brien, Toms 2010; Witmer *et al.* 1998; Kennedy *et al.* 1993). Most questionnaires employed Likert scales, with some using 4-point scales to elicit more precise feedback and avoid information overload. Additional specific questionnaires assessed avatar embodiment, engagement, sense of presence, tool comfort (cybersickness), and system usability.

The first set of questions assessed participants' perceptions of VR in educational contexts, comprising five questions about the facilitation of foreign language interactions, student cooperation, conversation flow, learning efficiency, and task orientation in VR compared to in-person activities. A second set of four questions assessed the ease of peer cooperation in VR environments, focusing on difficulties in working cooperatively, classroom management challenges, designing collaborative activities, and concerns related to technology proficiency. A third set examined application usability with six questions about ease of use, teaching quality, efficacy improvement, classroom management, student interaction enhancement, and inclination to use the app. Three additional questions measured immersion levels. Two multiple-choice questions assessed avatar experiences, asking if avatar creation was engaging, fun, awkward, annoying, time-consuming, or disturbing, and whether avatars enhance cooperation.

The final post-task questionnaire included 31 questions measuring engagement (covering aspects like absorption, curiosity, visual appeal, and frustration), 32 questions assessing sense of presence (examining control, responsiveness, naturalness, sensory involvement, and proficiency), 16 questions evaluating tool comfort (measuring discomfort, fatigue, headache, nausea, etc.), and 10 questions on system usability (addressing complexity, integration, learnability, and confidence in using VR for teaching).

Additional qualitative data collection methods included content analysis of interactions, observations of behavioural patterns, and assessment of group activities. The CEFR framework (Council of Europe 2020) was used to map mediation strategies in cooperative relationships, analysing how participants requested clarifications, shared opinions, and provided constructive feedback. The researchers also collected qualitative information through open-ended questions in online questionnaires and focus group interviews, which were conducted via Zoom and in-person at the DIALL lab. These interviews explored participants' experiences with VR technology, the challenges they faced in planning VR classes, and their suggestions for future implementations. In one activity, participants ranked flashcards listing skills practised during VR sessions.

Overall, in terms of qualitative insights, discussions on VR integration in curricula yielded guidelines for teacher training sessions, emphasising pre-activity assessments and aligning objectives with educators' needs. The analysis revealed a need for customised training tailored to teachers' contexts and ongoing support for successful VR integration.

4. Results and discussion

This study contributes to language pedagogy research by proposing VR-based task-based training activities, in which teachers assume student roles while engaging in interdependent tasks. It explores positive interdependence as a core principle of teachers' pedagogical practices and professional development. Evaluating perceptual data on presence and engagement revealed a readiness among teachers to utilise VR for education, enhancing their technological skills and promoting cooperation for meaningful discussions around VR teaching. The training's effectiveness was improved through collaboration among teachers with shared interests in immersive technologies, influencing perceptions of usability for VR platforms and sparking discussions on classroom implementation.

4.1 Key findings on teacher perceptions

The quantitative analysis of pre- and post-intervention surveys revealed significant results in teachers' perceptions toward VR technology, aligning with Davis's (1993) Technology Acceptance Model parameters for usability and acceptance. Despite some reservations expressed on implementing VR in language classrooms, citing concerns about technical complexity and curricular integration, most participants reported increased confidence and curiosity in their ability to design and implement VR-based language activities. The experiential training approach, which placed teachers in student roles, provided insights into learner experiences that support Ellis's (2003) task-based language learning principles. As one participant noted: "I feel like the collaborative spirit really speeds up the comfort level and encourages the opportunity for implementation of VR in language classes step by step". This sentiment was echoed across cohorts, with many participants emphasising how the experiential nature of the training, placing them in student roles, provided invaluable insights into potential learners' experiences and challenges. As one teacher remarked:

> If you make students more comfortable with VR interactions, you, as a teacher, can create a community of learners even though you are training them and yourself. And then, once they're on the training part, they can start introducing language little by little and have them constantly reflect on it.

The intervention contributed to sparking notable transformations in teachers' pedagogical thinking. Post-intervention data revealed more sophisticated understandings of VR's affordances, particularly regarding:

- Task authenticity: Teachers developed nuanced perspectives on how VR environments enable contextualised language use with real-world relevance, moving beyond simulated scenarios toward genuine communicative interactions.
- Multimodal communication: Participants identified specific ways VR expands communication beyond verbal exchanges to include gestural communication, spatial positioning, and collaborative manipulation of virtual objects—all aspects that enhance language learning through multiple sensory channels.
- Affective filters: Teachers reported helping each other navigate the complexity of VR environments, reducing anxiety among peers during VR activities, and recognising the avatar-mediated interaction as a potential scaffold for learners with performance anxiety.
- Integration possibilities: The intervention prompted participants to develop frameworks for structuring their lessons on language performance and collaborative skills within virtual environments.

4.2 Interdependence as a central construct

The most significant finding concerned the reinterpretation of interdependence within VR contexts. Analysis of teacher-designed activities revealed progressive sophistication in creating interdependent tasks. These findings extend Johnson and Johnson's (2005) social interdependence theory into virtual environments, demonstrating how such principles can be applied to language acquisition in immersive settings. Early attempts primarily focused on basic information gap activities, while later designs incorporated complex role interdependence, resource sharing, and goal alignment. For example, it was observed that participants engaged in the following interdependence-building activities:

- Clarification requests for agency enhancement: Participants asking questions about how to use VR platforms, as shown in examples from both Zoom sessions and VR environments.

- Spatial indication provision: Participants helping each other navigate virtual spaces by providing directions and explanations about accessing features or moving within the environment.
- Meaning-making from experiential input: Conversations where participants interpret their experiences and share knowledge, such as exploring historical contexts in the Anne Frank House VR.
- Real-virtual interactional continuum: Examples of participants bridging real and virtual worlds through information requests include discussing whether learning activities would occur online or in person and describing virtual environments to those not wearing headsets.
- Assistance provision across real-virtual environments: Instances of participants helping each other navigate between physical and virtual spaces, such as sharing QR codes for AR applications or guiding someone wearing a VR headset.

4.3 Implementation challenges identified

The intervention also highlighted specific implementation challenges that must be addressed for successful VR integration in language curricula:

- Technical infrastructure: Beyond headset availability, teachers identified concerns about network stability, space requirements, and technical support needs.
- Cognitive load management: Participants noted the dual challenge of navigating new technology while engaging in language production, suggesting the need for a scaffolded introduction to VR environments.
- Student variability: Teachers expressed concern about differing levels of technological comfort among students and potential motion sickness issues for some learners.
- Assessment integration: While VR environments offer rich interaction data, teachers identified challenges in capturing, analysing, and evaluating these communications within existing assessment frameworks.
- Ethical considerations: Participants raised important questions about student privacy, data collection, and potential exclusionary aspects of VR implementation in diverse educational settings.

The study faced additional challenges, such as a limited participant pool that could not access all VR synchronously, leading to a focus on methodological implications rather than practical classroom applications. Additionally, regarding implementation challenges, teachers expressed concerns about cognitive load management when navigating new technology while engaging in language production. This aligns with Wenk *et al*.'s (2021) research on the effects of immersive technologies on cognitive load and usability. Without targeted training, these concerns could impede teachers' ability to harness VR affordances for enhancing cooperative language learning. Finally, the lack of concrete examples of VR language classes left educators reliant on theoretical discussions, potentially limiting their understanding of practical implementations.

There are risks associated with using VR in language education. The costs of purchasing and maintaining VR tools, along with the need for IT support, may deter educational institutions from adopting these technologies. Additionally, VR tools could become outdated quickly, leading to more expenses for replacements and training for teachers and students. Teachers' reactions to VR can also lead to disengagement and rejection of the tools, underscoring the importance of tailored training for specific contexts. Ethical assessments of VR platforms are essential to protect data in compliance with GDPR guidelines, as many VR applications may not align with EU regulations. Teachers must evaluate these applications before introducing them in classes to promote safe and effective VR usage.

4.4 Theoretical implications

The findings extend current understanding of technology-mediated language learning in several important ways. First, they challenge the traditional separation between technological and pedagogical knowledge, suggesting that VR competence develops through an integrated process where technical and pedagogical learning are mutually reinforcing. Second, the study offers empirical support for integrating interdependence-based instruction in virtual environments, demonstrating how avatar-mediated interactions create unique opportunities for language socialisation that expand on the learning capabilities of face-to-face and traditional computer-mediated communication.

4.5 Institutional support requirements

A recurring theme in post-intervention discussions was the need for institutional support structures to facilitate sustainable VR implementation. Teachers identified several critical components:

- Ongoing professional development opportunities focused specifically on VR for language education
- Technical support personnel familiar with VR hardware and applications
- Curricular frameworks that legitimise VR activities within language programs
- Assessment protocols designed specifically for virtual environment interactions
- Time allocation for teacher preparation and VR environment customisation

These requirements suggest that successful VR integration requires systemic rather than individual approaches, with implications for language program administration and institutional resource allocation.

4.6 Future research opportunities

The findings from this study thus present a complex picture of both opportunities and challenges in VR integration for language education, while offering empirically-grounded insights into teacher preparation approaches for this emerging pedagogical frontier. Firstly, it showed that the increasing digitalisation of educational practices has raised teachers' awareness of the importance of incorporating immersive technologies into language education practices to enhance digital literacy and cooperation. The accelerated digital evolution of the language learning and teaching sectors has created opportunities for educators to improve and experiment with new teaching practices. This study has fostered their development by allowing experimentation with different types of immersive technologies, ranging from non-immersive to immersive VR and AI. It allowed teachers to be involved in tailored training on using immersive technologies. Additionally, it facilitated discussions on involving human subjects as active agents in learning and teaching, empowering interpersonal communication skills and competencies, and promoting digital literacy.

5. Conclusion

This study emphasises the importance of developing VR practices for students and teachers in an evolving educational landscape shaped by technology. Since its commencement, advancements in technology have significantly impacted language education, leading to the creation of multimodal tools. However, understanding and testing the pedagogical potential of these tools is crucial to ensure positive outcomes for students.

Comprehensive training is necessary for both teachers and students to manage these technologies effectively and confidently. Mastery of VR for specific teaching goals will enhance communication and skill development. This study highlights the need for language teachers to blend pedagogical and technical knowledge to adapt immersive technologies to diverse learning contexts. The research highlights the importance of mediation strategies in fostering interactive and meaningful discussions, expanding educational boundaries, and facilitating effective task-based learning. It is hoped that these results will encourage language teachers to harness the power of VR tools to enhance their communicative abilities and digital skills through engaging, collaborative learning experiences.

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