

## II. ARTICLES

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### The results of a pilot study on immersive Virtual Reality to boost learner-to-learner mediation strategies in Italian as a foreign language

**ABSTRACT.** The development of immersive technologies in language education has led to pedagogical experimentations on enhancing students' collaborative skills through task-based immersive Virtual Reality (iVR), a technology that allows users to experience real-like interactions with objects and other individuals. Despite positive correlations between the use of iVR in language learning and task accomplishment (Chen et al. 2022; Wu & Hung 2022; Romano et al. 2023), evidence is missing on the development of mediation strategies in a foreign language (FL), regarding learner-to-learner mediation strategies. Therefore, this study presents the results of a pilot study conducted at the University of Siena (Italy) on a pair of students of Italian as FL. The students were involved in digital multimodal composing (DMC) activities on the iVR platform *Immerse*. Results showed that mediation strategies surfaced through verbal and non-verbal facilitations of peer interactions, meaning-making, conceptual talk encouragement, and interaction management. It also highlighted methodological considerations on using iVR to involve language students in training scenarios for the development of mediation skills transferrable to real-life socio-pragmatic contexts.

**KEYWORDS:** immersive virtual reality, digital multimodal composing, mediation strategies, language pedagogy, teaching foreign languages in Italy.

#### 1. INTRODUCING CORE CONCEPTS: A LITERATURE REVIEW

Human beings are inherently social and have evolved to cooperate through language production by mediating decisions and devising strategies to effectively reach mutual goals. This social behaviour can be considered the foundation of cooperative language learning as it facilitates task-oriented interactions and the valorisation of group work as a collective effort toward goal attainment (Johnson & Johnson 2013). On a linguistic level, these behaviours are likely to

manifest through mediation strategies, which foster language learning effectiveness through cooperative meaning-making activities (Moore 2014; Rusbult & van Lange 2003). In this way, students may develop contextually driven, mutually beneficial relationships facilitating the establishment of trust, cooperation, and conflict resolution. Moreover, if integrated into the language curricula, these skills may increase leadership awareness, promote goal-oriented discussions, and clarification requests, as well as encourage feedback provision and critical reasoning (Loh & Ang 2020). To facilitate the curricular adoption of these skills and meet students' learning necessities, the Council of Europe revised language programs so that learners could more efficiently communicate and address the multifaceted demands of a digital society, and transfer their skills to interconnected disciplines (Herget 2020). This process led to the recognition of mediation strategies as key digital and social competences in the Common European Framework of Reference for Languages (CEFR 2020), which classified mediation strategies according to their behavioural impact on cognitive and creative thinking in co-constructive language learning processes (CEFR 2020: 108–112).

The framework foresees that mediation strategies can contribute to teamwork success as individuals act with a shared objective or communicative task in mind, making conscious interventions to orient discussions, balance contributions and overcome communication difficulties. The development of these skills is highly dependent on activity structure and content, as well as on the use of virtual tools to enhance memory retention, agency, and project-based work. However, the literature lacks investigations on the tasks and tools that may support language practices of social and linguistic mediation, which prompts further analysis of highly interactive virtual tools enabling such pedagogical support.

Due to recent technological advancements in language education, students often use virtual materials across multiple semiotics modes and adapt their knowledge to meet the socio-pragmatic demands of task-based digital activities (Siegel 2006; Liang & Lim 2020; Shen et al. 2022). In these virtual spaces, students collaborate in shared task projects through foreign language production using ubiquitous technologies to implement their agentive capabilities (Kukulska-Hulme et al. 2017; Ajabshir 2019; Cunningham 2019; Dai 2023). Practices for improving learner-to-learner foreign language interactions in task-based collaborative projects revealed positive results on the enhancement of goal-oriented strategies (Rattanasak 2023). Despite these findings, questions have been raised on the virtual spaces that could best facilitate students' synchronous collaboration through task attainment, with preferences leaning towards immersive Virtual Reality (iVR), a technology that immerses individuals in realistic virtual environments of avatar-like interactions (Han et al. 2023). The increased use of iVR tools in language learning curricula has sparked research on the educational

**Table 1.** Parameters and descriptions of mediation strategies adapted from the CEFR guidelines

Parameters	Descriptions of mediation strategies
1. Facilitating collaborative interactions	a. Collaborative participation by consciously managing one's own role and contributions to group communication.
	b. Active orientation of teamwork by helping to review key points and consider or define the next steps.
	c. Using questions and contributions to move the discussion forward in a productive way.
	d. Using questions and turn-taking to balance contributions from other group members with their own contributions.
2. Collaborating to construct meaning	a. Cognitively framing collaborative tasks by deciding on aims, processes, and steps.
	b. Co-constructing ideas / solutions.
	c. Asking others to explain their thinking and identifying inconsistencies in their thought processes.
	d. Summarising the discussion and deciding on the next steps.
3. Managing interactions	a. Leading plenary activity.
	b. Giving instructions and checking understanding of communicative task objectives.
	c. Monitoring and facilitating communication within the group without impeding the flow of communication between group participants.
	d. Reorienting communication in the group or sub-groups.
	e. Intervening to put the group back on task, adapting one's own contributions and interactive role to support group communication according to need.
4. Encouraging conceptual talk	a. Asking questions to stimulate logical reasoning (dialogic talk).
	b. Building contributions into logical, coherent discourse.

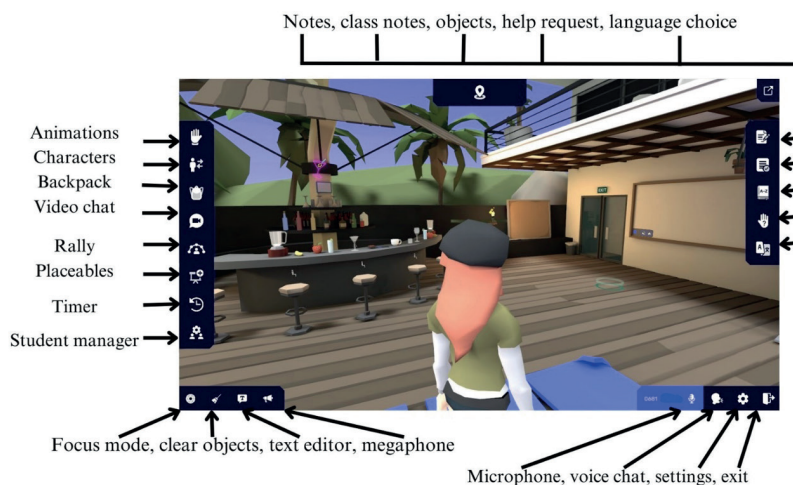
Source: current study.

benefits associated with social constructivist learning theories, which postulate that educational environments should be complex, realistic, and relevant to students' needs (Vygotsky 1978; Piaget 2001; Maroukias et al. 2023). Researchers have found that iVR experiences facilitate constructive learning experiences, increase students' perceived self-efficacy, collaborative participation, and reflective thinking which provide opportunities for social negotiation, shared responsibility, and ownership of group projects (Dede 2008; Madathil et al. 2017; Huang & Liaw 2018; Oigara 2018). From a linguistic point of view, iVR can boost communicative confidence, vocabulary acquisition, speaking and listening skills (Wu et al. 2020; Di Natale et al. 2020). It also improves oral comprehensibility

with consequential benefits for group-oriented interactions and students' well-being (Thrasher 2022). Despite these positive findings, disruptions in iVR tracking, rendering, and display interactions may hinder users' ability to accomplish task goals. They can impede both verbal and non-verbal self-expression, leading individuals to withdraw from social interactions. Potential solutions to these challenges have not yet been explored in the literature. Additional research is missing on iVR integrations in academic courses and curricula, and the impact of virtual technologies on teamwork and conflict management. Therefore, inquiries on the use of iVR in language education must take into account ways to involve students in FL learning spaces facilitating group-oriented interactions as well as the acquisition and use of task-oriented linguistic strategies. iVR may foster these communicative skills by involving language students in task-based, sensorial experiences through multi-user activities in hybrid learning environments. This is contingent upon structuring tasks in alignment with established pedagogical methodologies.

A language learning approach that has gained momentum in recent years is task-based language learning with technology (TBLLT) which involves students in initial brainstorming and technology training, followed by task planning through personalized content choices and group reports (Ellis 2003; Hampel 2010). Students are involved in activities of digital multimodal composing (DMC) that may include content production and personalization of virtual stories, portfolios, and multimedia presentations (Jiang 2017; Robin 2016). DMC has numerous benefits for collaborative language learning as it encourages the production of coherent narratives and the sharing of decisional practices improving speaking, reading, and writing skills (Liu et al. 2019; Nicoli et al. 2022). Through the combined use of the target language and digital tools, students collaboratively plan and design artifacts while evaluating other people's opinions. Some DMC interventions in language learning have involved the use of *izi.Travel*, a free application accessible on PCs and mobile phones where users create interactive and geo-localized city tours combining texts, interactive quizzes, video and audio recordings. When used for collaborative language learning purposes, *izi.Travel* allows students to deepen their cultural knowledge and boost collaborative planning skills (Spaliviero 2022; Fazzi 2021). Literature suggests that *izi.Travel* can be used to prepare students to showcase iVR group projects. Hence the need to identify iVR spaces effectively facilitating the deployment of mediation strategies. An option might be the platform *Immerse*, a multi-user virtual environment (MUVE) supporting social interactions and real-time language learning through avatar-based object manipulation and peer collaboration (Dooly et al. 2023). According to the literature, the affordances of *Immerse* also facilitate students' engagement in role-plays through customizable avatar features and interactable

objects in real-like locations (Bonner et al. 2023). While students join the application from *Meta Quest 2* headsets, teachers manage language classes from their computers using virtual whiteboards, scoreboards and labels, assigning learners to groups and sending chat messages (Figure 1).



**Figure 1.** View from a PC-based teacher interface. App features are outlined according to classroom and student management features.

Source: current study.

Language studies conducted with *Immerse* have also led to positive results in terms of speaking skills support and vocabulary acquisition through contextualized verbal and non-verbal digital interactions (Bonner et al. 2023). This suggests the potential integration of *Immerse* in immersive, task-based DMC language activities targeting students' mediation strategies development in iVR. Despite these results, the literature currently lacks evidence on the integration of DMC activities in iVR platforms and further enquiries are needed to understand its ability to foster mediation strategies in collaborative task attainment. Therefore, this study aims at better understanding the effects iVR on learner-to-learner mediation strategies, as well as proposing a methodology to enhance contextualized communication practices and facilitate language acquisition through goal-oriented interactions.

## 2. METHODOLOGY

This study uses the guidelines of the Council of Europe (2020) and a mixed-methods approach to investigate the mediation strategies deployed by 2 students

of Italian as a FL whilst conducting DMC group activities with the iVR platform *Immerse*. The research question it addresses is: “what are the effects of using iVR to boost mediation strategies amongst students of Italian as a FL in learner-to-learner interactional contexts?” Data was obtained through a mixed-methods design of qualitative and quantitative information (Dörnyei 2007), and included the administration of a pre-and post-activity questionnaire, the conduction of class observations as well as a focus group interview. While the questionnaires included qualitative queries, the majority of collected data consisted of qualitative information stemming from observations and feedback to focus group interviews. Due to the limited number of participants, the study is intended as a pilot for future investigations in language learning. It hypothesises that mediation strategies can emerge from students’ linguistic and non-linguistic output in the form of turn-taking, clarification-seeking, and meaning-making, as well as from facilitations of cooperative interactions.

## 2.1. Participants and research tools

Data was collected at the LabVR of the University of Siena from a case study on 2 female students of Italian as FL, who participated in the study voluntarily. They spoke Spanish as a native language and possessed advanced Italian proficiency. They used *izi.Travel* in 3 learning spaces of *Immerse*, called *Welcome Deck*, *Meeting Room*, and *Presentation*. The former represented a training space while the latter two reconstructed a meeting and a conference room (Figure 2).

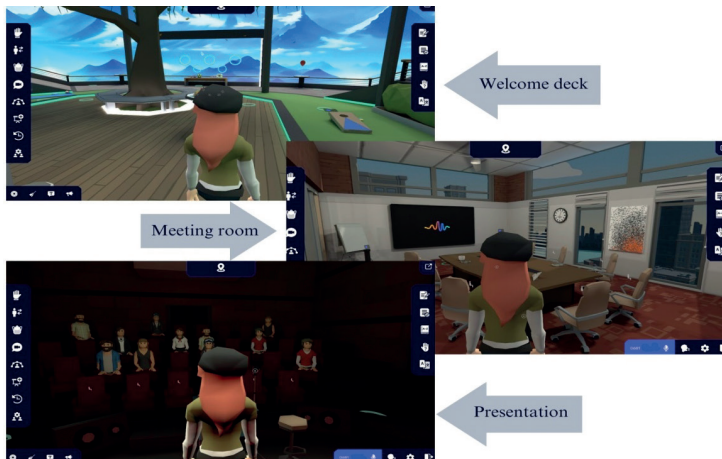


Figure 2. Visual perspectives of the 3 environments used to conduct the interventions.

Source: current study.

## 2.2. Activity structure

Approval to conduct the activities was received from the host institution before the start of the experiments, which lasted for a total of 12 hours and were conducted 3 times a week. Each intervention lasted for 2 hours, of which 30 minutes were spent in iVR. Before participating in the sessions, participants signed consent forms outlining the research aims, potential side-effects of iVR exposure, data collection and storage methods, and privacy protection procedures. Upon returning the signed consent forms, participants were sent email invitations with the date and time of the meetings. The participants initially used the application *izi.Travel* to conduct an in-person, guided tour of the city of Siena as part of pre-task training. They were supervised by the researcher during task-based activities focused on speaking, reading comprehension, and written production in Italian. In the next task phases, participants alternated iVR participation on *Immerse* with in-person activities where they planned and created digital tours on *izi.Travel*. They were trained to wear iVR headsets and use hand controllers to move around and grab virtual objects. Upon real-world emersion, they attended in-person classes during which they created a digital tour on *izi.Travel CMS* and published it online following a supervised analysis of written content. Lastly, they delivered a presentation of their digital tour on *Immerse*. An in-person reflection on the experience, the completion of a post-activity questionnaire, and a focus group interview constituted the last part of the activities (Table 2).

**Table 2.** Activity contents, related platforms and time partitioning

Intervention structure			
Classes	iVR activities	In person activities	Duration
1	None	Tour of the city of Siena with <i>izi.Travel</i> .	2 hours
2	Welcome deck	Training on <i>izi.Travel CMS</i> .	40 minutes in iVR 80 minutes in person
3	Meeting room	Collaborative written production in Italian.	55 minutes in iVR 65 minutes in person
4	Presentation	Self-assessment and reflection, post-activity questionnaire completion.	23 minutes in iVR 97 minutes in person.
5	None	Focus group interview.	2 hours

Source: current study.

## 2.3. Design checklist and activity contents

The design of the virtual experiences was underpinned by structural as well as linguistic considerations. Lesson plans were crafted using the interac-

tional affordances of the 4 iVR environments *Welcome deck*, the *Meeting room* and *Presentation*. Within these environments, the language learning activities were planned according to the TBLL methodology. Specifically, the *Welcome deck* was dedicated to tech training whilst *Meeting room* activities concerned content planning and group discussions. The *Presentation* environment enabled participants to showcase their project work. The activities were designed to maximise group interactions and included mediation tasks where students decided on tour destinations and virtual contents (Table 3). Throughout the iVR interventions, the participants embodied avatars, while the researcher provided technical assistance, time-monitored iVR exposure, observed participants' interactions, and provided feedback on their written production before content publication without explicit instruction on linguistic and structural contents.

## 2.4. Data collection methods

The mixed-methods design used for data collection purposes is outlined in Table 4. A few weeks before starting the activities, a pre-task questionnaire was distributed via email to the participants. It consisted of 39 items related to participants' demographic information, knowledge of conditional and subjunctive moods in Italian tested through gap-filling exercises. Questions also gathered information on technology use and habits, digital skills, online learning, and previous exposure to immersive language learning tools. The responses obtained from this preliminary investigation enabled the researcher to tailor class materials to students' needs and abilities.

The post-task questionnaire was distributed to the 2 participants during their last class so that they could complete it at the end of the group presentation. The questionnaire was organised into 4 sections on the experience of language learning, sense of presence, usability, and post-activity comfort with VR. To each parameter corresponded an assessment model on which survey items were structured. Specifically, the TAM model of Davis (1993) was used for experiential assessment purposes. Conversely, sense of presence was measured with the 32 items of the survey of Witmer et al. (2005), with judgements expressed on a 7-point Likert-scale. Perceived usability of VR tools was measured with the 10 questions from the revised System Usability Scale of Brooke (1996) by Wenk et al. (2021) and the participants expressed their judgements on a 5-point Likert scale ranging from strongly disagree (SD) to strongly agree (SA). Lastly, tool comfort was measured through 16 parameters from the list of Kennedy et al. (1993), with judgments being expressed on a 4-point Likert scale ranging from "none" to "severe".



Table 3. Summary and descriptions of task-based iVR activities.

	 <p><b>Welcome deck</b></p>	 <p><b>Meeting room</b></p>	 <p><b>Presentation</b></p>
<b>Description</b>	Training space allowing avatar interactions, handling of virtual objects and spatial movements.	Virtual office consisting of a round table, chairs and whiteboards.	Digital conference hall consisting of a backstage with interactive whiteboards, a stage with seats, a microphone and a virtual audience.
<b>Aims</b>	User familiarisation with iVR interactions.	Outline of digital storytelling principles and planning of digital tour contents.	Presentation of a digital tour.
<b>TBLL phase</b>	Pre-task.	Task cycle (task and planning).	Task cycle (report).
<b>Pair work tasks</b>	Suggesting items to wear based on their avatar appearance, answering queries on activity contents, playing group games to enhance familiarisation with virtual interactions.	Instruction on digital storytelling principles conducted with avatar-based participants. Role assignment, group story planning ordering of story contents for subsequent in-person story creation.	Backstage: participants rehearsed presentation contents. On stage: digital tour presentation and outline of the collaborative process followed by the participants during story planning.

Source: current study.

**Table 4.** Intervention and data collection stages

Research stages	Procedures	Collected data
Preparation	Pre-test survey.	Qualitative information from open-ended answers to the questionnaire.
Intervention 1	Walking tour with <i>izi.Travel</i> .	Quantitative information from interactional observations during group activities.
Intervention 2	Immerse tutorial.	Qualitative information from observations of group behaviours and transcript analysis.
Intervention 3	Immerse activity 1.	Qualitative information from observations of group behaviours and transcript analysis.
Intervention 4	Immerse activity 2.	Qualitative information from observations of group behaviours and transcript analysis.
Intervention 5	Immerse activity 3.	Qualitative information from observations of group behaviours and transcript analysis.
Post-intervention data	Focus group interview and post-activity questionnaire.	Qualitative information from observations of group behaviours, transcript analysis and open-ended answers to the questionnaire. Quantitative information from judgements expressed in the questionnaire.

Source: current study.

As for qualitative data, mediation strategies were identified from the transcripts of participants' interactions during the activities using the CEFR guidelines outlined in Table 1. Synthetised versions of the descriptors were used to analyse participants' interactions, transcribed with the software *Descript*. The focus group interview was conducted in Italian and designed according to the indications of Krueger and Casey (2015). It included questions on the experiential assessment of positive interdependence strategies unfolding between participants during the interventions. The interview transcripts underwent thematic analysis to identify instances and clarifications of the mediation strategies employed by the participants throughout the activities.

### 3. ANALYSIS

Results were grouped according to mediation strategy appearance and parametrical overlapping. Participants' names were anonymised and excerpts were provided in Italian together with their English translation. Manifestations of mediation strategies were highlighted next to their corresponding parameters in Table 2.

**Table 5.** Excerpts from participants' transcripts in iVR.

1a, 1b, 1c, 1d	<p>a. SPEAKER A: <i>[planning the project presentation]</i> Bene, "esposizione" direi che è l'introduzione no? <i>All right, I would say that "esposizione" is the introduction, right?</i></p> <p>SPEAKER B: <i>Ok ma aspetta... la presentazione con l'introduzione la facevi tu? Ok, but wait... the presentation with the introduction was on you?</i></p> <p>SPEAKER A: <i>Sì, la faccio io. Yes, I'll do it.</i></p> <p>SPEAKER B: <i>E anche perché mi ricordo che era con la presentazione e con la risoluzione e poi...? Also because I remember it was with the presentation and then solution and...?</i></p> <p>SPEAKER B; <i>Ok, e poi devo dire che la durata e come accedere. Ok, then I need to say how long it lasts for and how to access it.</i></p> <p>SPEAKER A: <i>Sì, gli ultimi due sono tuoi. Yes, the last ones are on you.</i></p>
2a, 3a, 3d	<p>b. SPEAKER A: <i>Non si può mettere *****? [mentions the creation of username to access the platform izi.Travel combining the names of both participants] Can't we put *****?</i></p> <p>SPEAKER B: <i>Eh no, meglio di no, si ricollega ai nostri nomi per privacy. Better not to. It can be linked to our names for privacy reasons.</i></p> <p>SPEAKER A: <i>Allora tipo qualcosa sulle donne... le donne di Siena... o qualcosa così. Something about women then... the women of Siena... or something like that.</i></p> <p>SPEAKER B: <i>Va bene. E la password? Sounds good. What about the password?</i></p> <p>SPEAKER A: <i>Cosa ne dici di ****? What do you think about ****? [says the name of a potential password]</i></p> <p>SPEAKER B: <i>Sì ottimo! Sounds great!</i></p> <p>SPEAKER A: <i>E per il correo... no la e-mail scusa? What about the [says the Spanish equivalent for mail, correo]... no sorry, the email?</i></p> <p>SPEAKER B: <i>Mettila tua poi mi dici qual è. Put yours and then you tell me what it is.</i></p> <p>SPEAKER A: <i>Va bene. All right.</i></p>
2b	<p>c. SPEAKER A: <i>[interpreting a piece of artwork displayed in the Meeting Room]</i> Possiamo dire che era una donna giovane che stava... mmm... abitando in centro e che... non so, stava aspettando qualcuno che tornava a casa? <i>We could say that she was a young woman who was... mmm... living in the city center and that... I don't know, was waiting for someone who was returning home?</i></p> <p>SPEAKER B: <i>Sì ma da quella immagine si può capire che sta aspettando uomo, no? Non vedi che è desnuda? (giggles) [describing a statue] Yes but from that picture we can understand that she is waiting for a man, right? Can't you see she is naked?</i></p> <p>SPEAKER A: <i>Mi sembra che però stia aspettando qualcuno che torni, non lo so, per lo sguardo... it seems to me she is waiting for someone to return, I don't know, because of her gaze...</i></p> <p>SPEAKER B: <i>Forse il ragazzo è lì fuori. O forse non viene... Maybe the guy is just outside. Or maybe he is not coming...</i></p> <p>SPEAKER A: <i>Forse dovremmo fare delle ricerche dopo... Maybe we should do some research afterwards.</i></p> <p>SPEAKER B: <i>È strana la sua posizione...e se ha ucciso qualcuno? Her position is strange... what if she has killed someone?</i></p> <p>SPEAKER A: <i>[referring to the position of the statue] Cosa c'è di strano? What's so strange about it?</i></p> <p>SPEAKER B: <i>Che è spogliata! That she is without clothes!</i></p>
2c	d. Not recorded in the transcripts.

2d	e. SPEAKER A: <i>[referring to the presentation sequence]</i> Comunque qua dovevo dire la durata del percorso e come accedere al tour. Poi dopo tu le prime tappe, no io le prime tappe e tu quelle due ultime e poi le motivazioni. Ok. L'hai fatto tu? <i>By the way, here I need to talk about the length of the tour and how to access it. Then it's your turn with the first destinations, no sorry, I start with the first destinations then you do the last ones and finally the motivations. Ok. Did you do it?</i>
3a	f. SPEAKER A: <i>[discussing the name of the tour on izi.Travel]</i> Che nome gli diamo?
3b	<i>What name should we give to it?</i>
3c	SPEAKER B: <i>Cariño!</i> (giggles) <i>Cariño</i> <i>[meaning "cute" in Spanish]</i>
3d	SPEAKER A: No dai stai seria! Perché poi lo devono cercare in tanti! <i>Come on, be serious! Because many people will look for it!</i>
3e	
4a	SPEAKER B: In effetti se poi tutti possono cercare il sito...! <i>Yeah right, if then everybody can look up the website...!</i> SPEAKER A: Sì è vero, deve essere qualcosa di più formale. <i>That's true, it must be something more formal.</i>
4b	g. SPEAKER A: <i>[in the Presentation room]</i> Ok. Comincio? <i>[rising excitement in her voice once she grabs the virtual microphone]</i> Noi siamo L ed A, due studentesse dell'Università degli Studi di Siena siamo anche delle creatori...creatrici di questa guida. Parleremo di quattro donne di Siena parleremo delle quattro donne che sono Pia de' Tolomei e...? <i>Ok, shall I start? We are L and A, two students of the University of Siena and we are also the creators of this tour. We will talk about four women of Siena wo are Pia de' Tolomei and...?</i> SPEAKER B: <i>[says one of the names of the women mentioned in the tour]</i> Margherita! SPEAKER A: Grazie. <i>Thank you.</i>

Source: current study.

In the post-task questionnaire, results on the behavioural facilitation of mediation strategies in iVR measured with the rating scales of strongly disagree (SD), disagree (D), agree (A), and strongly agree (SA) concurred with those obtained on ease of use (Tables 7 and 8).

**Table 6.** Participants' answers to the survey question "Think about your experience of learning Italian through Virtual Reality in pairs and rate your agreement with the following statements"

Items	SD	D	A	SA
Virtual Reality facilitated language interactions with my classmate.	0	0	2	0
Virtual Reality was useful for collaboration.	0	0	1	1
The use of Virtual Reality facilitated me in requesting the help of my classmate when there were issues with task conduction.	0	1	1	0
Using hand controllers and VR headset facilitated language interactions with my classmate.	1	1	0	0
Conversations flowed as easily as they would in face-to-face contexts.	0	1	0	1

Source: current study.

**Table 7.** Participants' answers to the question "Think about your experience with Virtual Reality and rate your agreement with the following statements"

Items	SD	D	A	SA
I found it difficult to interact with my classmate in Virtual Reality.	1	1	0	0
I felt inhibited from expressing my opinions in Virtual Reality.	2	0	0	0
I felt prevented from being a group leader in Virtual Reality.	0	2	0	0
I felt Virtual Reality prevented me from proposing new ideas to my classmate.	0	2	0	0

Source: current study.

Additional information on the mediation strategies deployed by the participants during the interventions was retrieved from excerpts of the focus group interview. Participants' contributions were grouped by thematic area and translated into English.

**Table 8.** Extract from participants' contributions to the focus group interviews

Questions	Answers and translations
1. What did you enjoy the most about learning Italian with Virtual Reality together with your partners?	a. È stato interessante scambiare le idee con lei quando stavamo parlando del percorso e pensare insieme. Poi anche vedere nella realtà virtuale è stato più interessante. <i>It was interesting to share ideas when we were discussing about the tour and think together. Also seeing [says the other participants' name] in Virtual Reality was interesting.</i>
2. What was the most challenging aspect of it?	b. Ho imparato tanto della realtà virtuale di cui non conoscevo niente. Questa esperienza mi ha obbligato a studiare davvero. <i>I felt I learned a lot about Virtual Reality about which I knew nothing before. This experience forced me to really study.</i> c. È stato difficile renderle visibili, non più difficili, il fatto di dovette prendere delle decisioni, esprimere visibili incertezze e difficoltà. <i>It was difficult to show, not to do, the fact of taking decisions, express visible uncertainties and difficulties.</i>
3. How much did Virtual Reality limit your group interactions?	d. Per me è la visione, perché a volte era un po' sfocato ed era difficile concentrarsi, così quando si muove tutto e poi leggere, ci vuole tempo per aggiustarsi. Ma con la differenza tra una realtà che io vedo bene e poi mi salta fuori una sfida in più, ma devo imparare. <i>For me is the vision, because sometimes things were a bit blurred and it was difficult to concentrate, so that when everything moves and we had to read, we needed time to adjust [to the environment]. With the difference with a reality in which I see well and then there is a new challenge that appears, but I need to learn</i>

	<p>e. Forse i movimenti non li controllavo molto bene, tipo sedermi o calcolare la distanza quando andavo avanti. Per questi problemi tecnologici a volte ci sentivamo tagliate fuori. Come per la direzione dell'audio. Una volta abbiamo provato ad interagire ma non ci siamo riusciti perché non capivamo da dove veniva la voce. Eravamo confuse. <i>Maybe I could not control the movements very well, like when sitting down or calculating distances as I was moving forward.</i></p> <p><i>For these technological problems we sometimes felt we were cut out, like for audio direction. Once we tried to interact but we could not because we could not understand from where the voices were coming from. We were confused.</i></p>
<p>4. How much did these influence your language production in Italian?</p>	<p>f. Non penso che questo abbia avuto un'influenza sull'italiano. Noi lo conoscevamo bene e questo non ci ha impedito di parlare. Nell'aula fisica dove di solito uno studente capisce di star bene però forse può non ascoltare bene le pronunce. Mentre nella realtà virtuale si può fare bene. <i>I don't think this had an impact on [the use of] Italian. We knew it well and this did not prevent us from talking. In the physical room a student understands to feel well but maybe he cannot hear pronunciations well. Conversely this is something you can do well in Virtual Reality.</i></p>
<p>5. How much did Virtual Reality facilitate your group interactions?</p>	<p>g. È la vicinanza che consente di avvicinare le persone. Quando sei da sola con il computer...non è la stessa cosa. In questo esperimento c'eravamo tutti e due nella stessa stanza. Per questo non sento che questo strumento abbia facilitato o interferito nelle mie interazioni. <i>It is proximity that helps people to connect. When you are alone with your computer it is not the same thing. In this experiment we were both together in the same room. This is why I don't feel that this instrument has nor facilitated nor interfered with our interactions.</i></p> <p>h. No non credo che la realtà virtuale abbia fatto più difficile interagire con il sociale. E tutti possono sentire quello che stai facendo. Si va in classe per parlare. Forse se non avessimo questa presenza virtuale qua e non lo so, alzare la mano, qualcosa per parlare forse lì sarebbe più difficile. Ma per me queste va tutto bene, è stato normale e per quanto riguarda l'aiuto reciproco è andato bene aiutarci sia dal punto di vista linguistico, sia pratico. <i>No, I do not think that Virtual Reality has made social interactions more difficult. Everybody could hear what was said. We were in [the virtual] class to speak. Maybe if we didn't have this virtual presence, or the chance to, I don't know, raise our hands, or something to talk, it would have been more difficult. But all went well. It was good to help each other from a practical and linguistic side.</i></p>
<p>6. How did you facilitate your mutual interactions in Virtual Reality?</p>	<p>i. Ci siamo fatte tante domande e abbiamo discusso sulle scelte da fare. È stato naturale chiederci domande soprattutto perché avevamo chiaro cosa fare. Ed è stato facile perché avevamo tanti strumenti per lavorare. Però non poteva durare a lungo. Sì, soprattutto per quello che non puoi stare più di venti minuti, perché si viene la stanchezza. <i>We asked each other many questions and we discussed the choices to make. It was natural to ask each other questions because we knew what to do. And it was easy because we had many instruments to do our work but it could not last long, especially because you cannot stay for more than 20 minutes [in Virtual Reality] otherwise you get tired.</i></p>

Source: current study.

## 4. DISCUSSION

A discussion on the results departs from a transcript analysis and observations of students' interactions. The most significant patterns of mediation strategies arose from facilitations of peer interactions and teamwork management, meaning co-construction and conceptual talk encouragement, which corresponded to the elements of positive interdependence cited in the literature by Moore (2014) and of Rusbult and van Lange (2003). Specifically, participants managed each other's roles by selecting tour destinations and directing decisions (Table 5, 1b, 1c, 1d). They also mediated interactions by assigning and revising their roles, making use of subjunctive moods in Italian (*direi che è, mi ricordo che, devo dire che*). Additionally, participants utilised subjunctive and conditional moods to assist their meaning-making process as they decoded the virtual elements displayed in the iVR environments. The presence of modal verbs (*possiamo dire che, devo dire che*) and adverbs of doubt (*forse*) emphasized participants' behavioural intention to decode meanings (Table 5, 1b). This led to the production of coherent narratives while participants presented the contents of their digital stories, which is in line with the identified benefits of DMC for language learning purposes as seen in the literature of Liu et al. (2019) and of Nicoli et al. (2022). It also prompted participants to produce words in their native language, only to ask each other their Italian equivalent (*correo... no la e-mail scusa?*), disambiguating meanings (*cariño*) and engaging in clarification requests (*esposizione" direi che è l'introduzione no?*) as shown in Table 5 a, b, f. The above-mentioned competences are in line with the CEFR guidelines of 2020 on mediation strategy development (Table 2). Missing data on participants' requests for justifications of thinking and planning processes from their partners are believed to be due to limited time in conducting the activities (Table 5, 2c, d). Mediation strategies were also supported by iVR gestural affordances as participants used non-verbal avatar communication to facilitate task conduction whilst passing iVR objects to one another (Table 5, 4b). This instance supports the findings of Bonner et al. (2023) as well as those of Dooly, Thrasher and Sadler (2023) in terms of avatar-based cooperation support. Team-bonding was also enhanced by goal-oriented behaviours as individuals took notes on virtual notepads during the tour planning process and proposed to create a password containing their names, hinting that they considered the product design as a cooperative endeavour (Table 5, b). These findings are in line with the theories of Ajabshir (2019), Cunningham (2019), Dai (2023) and Rattanasak (2023), as they outline the benefits of ubiquitous technologies and the TBLLT methodology in boosting students' sense of agency and goal oriented behaviours. Moreover, facilitations of mediation strategies in iVR were further confirmed by post-activity questionnaires as participants stated that

the end product was the result of mutual contributions. Participants also appeared positively inclined to cooperatively repeat the iVR experiences, hence signalling experiential enjoyment which eased cooperative relationships and favoured mediating dispositions (Table 6). However, they also revealed contrasting opinions on their ability to request help and interact through headsets and hand controllers. Even more polarized were their answers on facilitating iVR conversations (Table 7). Conversely, strong disagreements were reached in terms of preventing the expression of opinions in iVR, idea proposition and leadership, signifying positive implications for teamwork conduction. From methodological perspectives, data suggest that planning language activities targeted at developing students' mediation strategies in iVR should consider linguistic and behavioural aspects of cooperative task attainment. Moreover, the provision of a pre-activity tech training, scaffolding of activity goals and interactional iVR complexity highlighted that TBLLT might be a successful methodology for iVR incorporation in language education curricula.

In the focus group, participants claimed the iVR experiences on *Immerse* were fascinating as they motivated them to learn contents (Table 8, 1a, 2b). Participants also compared iVR with other remote language learning experiences they had been exposed to and emphasized that audio affordance capabilities facilitated pronunciation understanding (Table 8, 4f). They also recognised the need to keep iVR experiences short to maintain high attention levels and support the natural flow of interactions (Table 8, 5g, 5h, 6i). Moreover, participants seemed to enjoy with exchanging opinions in Italian (Table 8, 1a and Table 5, 2d), whose production appeared unaffected by iVR interactions due to their advanced Italian proficiency (Table 8, 4f). Despite not perceiving agentive limitations in iVR, blurred vision and audio directionality affected participants' interactions in their ability to locate the position of their partner in virtual space (Table 8, 3d, 3e). Limiting factors were attributed to iVR affordances as they prevented readable intentions and hampered the ability to concentrate (Table 8, 5c, 5d). These findings are in line with the results of Bonner et al. (2023), suggesting that mediation strategies are subject to the interpretation of communication cues in iVR scenarios and promote positive group dynamics related to sharing a collective responsibility over task goals. These findings aligned with the studies of Dede (2008), Madathil et al. (2017), Oigara (2018) and Adams et al. (2021). They also confirm the negative outcomes of iVR cybersickness, a downside that could be avoided through repeated tech exposure. Other factors preventing the deployment of mediation strategies were attributed to movement control and audio directionality (Table 8, 3e, 6e). With regards to the focus group interview, participants understood that iVR can bring people closer in remote learning settings by promoting a natural and real-like interaction flow in Italian (Table 8, 5h). Additional attitudes hinting at consolidations of media-



tion strategies were traced in preferences for the first-person plural pronoun “we” (*noi*) instead of its singular equivalent “I” (*io*) as participants described their tour planning process (Table 8, 1a, 3d, 3e, 5h, 6i).

A major limitation of this pilot study was its small population size that implies the necessity of conducting further research on a wider sample. Potential replications of this study could be extended to other education levels, prior to activity adaptations to students’ educational contexts. This would imply close collaboration between researchers and school teachers in assessing students’ needs and institutional resources to purchase the necessary equipment and design a collaborative-centred task-based language curriculum with iVR.

## 5. CONCLUSION

Results from this pilot study cast light on the effects of iVR technologies on enhancing students’ mediation strategies in Italian as an FL through multimodal group activities blending in-person with remote task-based language learning practices. Positive results were identified in the enhancement of peer interactions, meaning co-construction, conceptual talk encouragement, and interaction management as outlined in the CEFR guidelines of 2020. Moreover, since investigations on iVR-based mediation strategies in Italian as an FL are still largely unexplored, results from this study suggest that further research contributions in the field are needed. While the small sample size precludes generalizations, the study underscored significant insights for innovating language learning methodologies and mitigating the limitations associated with virtual and unimodal learning platforms. It is hoped that results may inspire language educators to foster mediation skills amongst their students through iVR technologies. Future project implementations may include assessing participants’ inclination towards engaging in mediation-oriented conversations and examining the influence of presence and tool comfort on the mediation strategies deployed by language students.

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## REFERENCES

- Abrams, Z.I. (2013). Sociopragmatic features of learner-to-learner computer-mediated communication. *CALICO Journal*, 26(1), 1–27.
- Ajabshir, Z.F. (2019). The effect of synchronous and asynchronous computer-mediated communication (CMC) on EFL learners' pragmatic competence. *Computers in Human Behavior*, 92, 169–177. <https://doi.org/10.1016/j.chb.2018.11.015>
- Bonner, E. / Lege, R. / Frazier, E. (2023). Teaching CLIL courses entirely in virtual reality: Educator experiences. *CALICO Journal*, 40(1), 45–67. <https://eric.ed.gov/?id=EJ1379989>
- Brooke, J. (1995). SUS: A quick and dirty usability scale. In: P.W. Jordan / B. Thomas / I.L. McClelland / B. Weerdmeester (eds.), *Usability evaluation in industry* (pp. 107–114) London: CRC Press. <https://doi.org/10.1201/9781498710411>.
- Chen, B. / Wang, Y. / Wang, L. (2022). The effects of virtual reality-assisted language learning: A meta-analysis. *Sustainability*, 14(6). <https://doi.org/10.3390/su14063147>
- Council of Europe (2020). *Common European framework of reference for languages: Learning, teaching, assessment. Companion volume*. Strasbourg: Council of Europe Publishing. <https://rm.coe.int/common-european-framework-of-reference-for-languages-learning-teaching/16809ea0d4>
- Cunningham, D.J. (2019). L2 pragmatic learning in computer-mediated communication. In: N. Taguchi (ed.), *Routledge handbook of SLA and pragmatics* (pp. 372–386). Abingdon: Routledge.
- Dai, D.W. (2023). What do second language speakers really need for real-world interaction? A needs analysis of L2 Chinese interactional competence. *Language Teaching Research*, 0(0), 1–38. <https://doi.org/10.1177/13621688221144836>.
- Davis, F.D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, 13(3), 319–340. <https://doi.org/10.2307/249008>
- Dede, C. (2008). Theoretical perspectives influencing the use of information technology in teaching and learning. In: J. Voogt / G. Knezek (eds.), *International handbook of information technology in primary and secondary education* (pp. 43–62). Boston, MA: Springer US. [http://dx.doi.org/10.1007/978-0-387-73315-9\\_3](http://dx.doi.org/10.1007/978-0-387-73315-9_3)
- Di Natale, A.F. / Repetto, C. / Riva, G. / Villani, D. (2020). Immersive virtual reality in K-12 and higher education: A 10-year systematic review of empirical research. *British Journal of Educational Technology*, 51(6), 2006–2033. <https://doi.org/10.1111/bjet.13030>
- Dooly, M. / Thrasher, T. / Sadler, R. (2023). “Whoa! Incredible!” Language learning experiences in virtual reality. *RELC Journal*, 54(2), 321–339. <https://doi.org/10.1177/00336882231167610>
- Dörnyei, Z. (2007). *Research methods in applied linguistics*. Oxford: Oxford University Press.
- Ellis, R. (2003). *Task-based language learning and teaching*. Oxford: Oxford University Press.
- Fazzi, F. (2021). izi.Travel: una piattaforma digitale per promuovere l'apprendimento linguistico dentro e fuori la classe. *Bollettino Itals*, 19, 104–113. <https://iris.unive.it/handle/10278/3740018>
- Hampel, R. (2010). Task design for a virtual learning environment in a distance language course. In: M. Thomas / H. Reinders (eds.), *Task-based language learning and teaching with technology* (pp. 63–81). London, UK: Continuum Publishing Group.
- Han, E. / Miller, M.R. / DeVeaux, C. / Jun, H. / Nowak, K.L. / Hancock, J.T. / Ram, N. / Bailenson, J.N. (2023). People, places, and time: a large-scale, longitudinal study of transformed

- avatars and environmental context in group interaction in the metaverse. *Journal of Computer-Mediated Communication*, 28(2), <https://doi.org/10.1093/jcmc/zmac031>
- Herget, K. (2020). Project-based learning in the languages for specific purposes classroom. *Journal of Higher Education Theory and Practice*, 20(15), 163–168. <https://doi.org/10.33423/jhetp.v20i15.3945>
- Huang, H.-M. / Liaw, S.S. (2018). An analysis of learners' intentions toward virtual reality learning based on constructivist and technology acceptance approaches. *International Review of Research in Open and Distributed Learning*, 19(1), 91–115. <https://doi.org/10.19173/irrodl.v19i1.2503>
- Jiang, L. (2017). The affordances of digital multimodal composing for EFL learning. *ELT Journal*, 71(4), 413–422. <https://doi.org/10.1093/elt/ccw098>
- Johnson, D.W. / Johnson, R.T. (2013). Restorative approaches in schools: Necessary roles of cooperative learning and constructive conflict. In: E. Sellman / H. Cremin / G. McCluskey (eds.), *Restorative approaches to conflict in schools: Interdisciplinary perspectives on whole school approaches to managing relationships* (pp. 159–174). Abingdon: Routledge/Taylor & Francis Group.
- Kennedy, R.S. / Lane, N.E. / Berbaum, K.S. / Lilienthal, M.G. (1993). Simulator sickness questionnaire: An enhanced method for quantifying simulator sickness. *The International Journal of Aviation Psychology*, 3(3), 203–220. [https://doi.org/10.1207/s15327108ijap0303\\_3](https://doi.org/10.1207/s15327108ijap0303_3)
- Krueger, R. / Casey, M. (2015). Focus group interviewing. In: K.E. Newcomer / H.P. Hatry / J.S. Wholey (eds.), *Handbook of practical program evaluation* (pp. 506–534). London: Wiley. <https://doi.org/10.1002/9781119171386>
- Kukulska-Hulme, A. / Lee, H. / Norris, L. (2017). Mobile learning revolution, implications for language pedagogy. In: C.A. Chappelle / S. Sauro (eds.), *The handbook of technology and second language teaching and learning* (pp. 217–233). John Wiley & Sons. <https://doi.org/10.1002/9781118914069.ch15>
- Liang, W.J. / Lim, F.V. (2021). A pedagogical framework for digital multimodal composing in the English language classroom. *Innovation in Language Learning and Teaching*, 15(4), 306–320. <https://doi.org/10.1080/17501229.2020.1800709>
- Liu, C.C. / Yang, C.Y. / Chao, P.Y. (2019). A longitudinal analysis of student participation in a digital collaborative storytelling activity. *Education Technology Research Development*, 67, 907–929. <https://doi.org/10.1007/s11423-019-09666-3>
- Loh, R. / Ang, C. (2020). Unravelling cooperative learning in higher education: a review of research. *Research in Social Science and Technology*, 5(2), 22–39. <https://doi.org/10.46303/ressat.05.02.2>
- Madathil, K.C. / Frady, K. / Hartley, R. / Bertrand, J. / Alfred, M. / Gramopadhye, A. (2017). An empirical study investigating the effectiveness of integrating virtual reality-based case studies into an online asynchronous learning environment. *Computers in Education Journal*, 8(3), 1–10. <https://coed.asee.org/wp-content/uploads/2020/08/7-An-Empirical-Study-Investigating-the-Effectiveness-of-Integrating-Virtual-Reality-based-Case-Studies-into-an-Online-Asynchronous-Learning-Environment.pdf>
- Maroungkas, A. / Troussas, C. / Krouska, A. / Sgouropoulou, C. (2023). Virtual reality in Education: A review of learning theories, approaches and methodologies for the last decade. *Electronics*, 12(13). <https://doi.org/10.3390/electronics12132832>
- Moore, Ch.W. (2014). *The mediation process: Practical strategies for resolving conflict*. New York et al.: John Wiley & Sons.
- Nicoli, N. / Henriksen, K. / Komodromos, M. / Tsagalas, D. (2022). Investigating digital storytelling for the creation of positively engaging digital content. *EuroMed Journal of Business*, 17(2), 157–173. <https://doi.org/10.1108/EMJB-03-2021-0036>

- Oigara, J.N. (2018). Integrating virtual reality tools into classroom instruction. In: Information Resources Management Association (ed.), *Handbook of research on mobile technology, constructivism, and meaningful learning* (pp. 369–381). Hershey, PA: IGI Global.
- Piaget, J. (2001). *The language and thought of the child*. New York et al.: Routledge.
- Rattanasak, S. (2023). The interplay between the Internet-based reading resources and learner-to-learner interactions in blended language learning. *Online Journal of Communication and Media Technologies*, 13(2), 1–15. <https://doi.org/10.30935/ojcm/13050>
- Romano, M. / Frolli, A. / Aloisio, A. / Russello, C. / Rega, A. / Cerciello, F. / Bisogni, F. (2023). Exploring the potential of immersive virtual reality in Italian schools: A practical workshop with high school teachers. *Multimodal Technologies and Interaction*, 7(12), 1–2. <https://doi.org/10.3390/mti7120111>
- Rusbult, C.E. / Lange van, P.A.M. (2003). Interdependence, interaction, and relationships. *Annual Review of Psychology*, 54, 351–375. <https://doi.org/10.1146/annurev.psych.54.101601.145059>
- Shen, X. / Hao, C. / Peng, J.E. (2022). Promoting EFL learners' willingness to communicate through transmediation in a digital storytelling workshop. *Journal of Multilingual and Multicultural Development*, 1–18. <https://doi.org/10.1080/01434632.2022.2086257>
- Siegel, M. (2006). Rereading the signs: Multimodal transformation in the field of literacy education. *Language Arts*, 84(1), 65–77. [https://www.academia.edu/93625493/Rereading\\_the\\_signs\\_Multimodal\\_transformations\\_in\\_the\\_field\\_of\\_literacy\\_education](https://www.academia.edu/93625493/Rereading_the_signs_Multimodal_transformations_in_the_field_of_literacy_education)
- Spaliviero, C. (2022). Teaching Italian as a second language through digital storytelling: Students' perceptions towards izi.TRAVEL. *EuroAmerican Journal of Applied Linguistics and Languages*, 9, 91–121. <https://doi.org/10.21283/2376905X.15.1.265>
- Thrasher, T. (2022). The impact of virtual reality on L2 French learners' language anxiety and oral comprehensibility: an exploratory study. *CALICO Journal*. <https://eric.ed.gov/?id=EJ1351515>
- Vygotsky, L.S. (1978). *Mind in society: Development of higher psychological processes*. Cambridge, MA: Harvard University Press. <https://www.jstor.org/stable/j.ctvjf9vz4>
- Wenk, N. / Penalver-Andres, J. / Buetler, K.A. / Nef, T. / Müri, R.M. / Marchal-Crespo, L. (2021). Effect of immersive visualization technologies on cognitive load, motivation, usability, and embodiment. *Virtual Reality*, 27, 307–331. <https://doi.org/10.1007/s10055-021-00565-8>
- Witmer, B.G. / Singer, M.J. (1998). Measuring presence in virtual environments: A presence questionnaire. *Presence: Teleoperators and Virtual Environments*, 7(3), 225–240. <https://doi.org/10.1162/105474698565686>
- Wu, B. / Yu, X. / Gu, X. (2020). Effectiveness of immersive virtual reality using head-mounted displays on learning performance: A meta-analysis. *British Journal of Educational Technology*, 51(6), 1991–2005. <https://doi.org/10.1111/bjet.13023>
- Wu, Y.H. / Hung, S.T. (2022). The effects of virtual reality infused instruction on elementary school students' English-speaking performance, willingness to communicate, and learning autonomy. *Journal of Educational Computing Research*, 60(6), 1558–1587. <https://doi.org/10.1177/073563312111068207>

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### **Wyniki badania pilotażowego dotyczącego immersyjnej wirtualnej rzeczywistości w celu wzmocnienia strategii mediacyjnych między uczącymi się w języku włoskim jako obcym**

ABSTRAKT. Rozwój technologii immersyjnych w edukacji językowej umożliwił eksperymenty pedagogiczne mające na celu poprawę umiejętności współpracy uczniów poprzez zadaniową immersyjną

wirtualną rzeczywistość (iVR), technologię umożliwiającą użytkownikom doświadczanie interakcji przypominających rzeczywiste kontakty z obiektami i innymi osobami. Pomimo pozytywnych korelacji pomiędzy wykorzystaniem iVR w nauce języka a realizacją zadań (Chen i in. 2022; Wu & Hung 2022; Romano i in. 2023), brakuje dowodów na rozwój strategii mediacyjnych w języku obcym (JO), zwłaszcza w odniesieniu do strategii mediacyjnych między uczącymi się. W związku z tym niniejsze badanie przedstawia wyniki badania pilotażowego przeprowadzonego na Uniwersytecie w Sienie (Włochy) na dwóch studentach uczących się języka włoskiego jako JO. Studenci uczestniczyli w działaniach związanych z cyfrową kompozycją multimodalną na platformie iVR Immerse. Wyniki pokazały, że strategie mediacyjne pojawiały się dzięki werbalnym i niewerbalnym ułatwieniom interakcji między uczestnikami, np. wspomaganie tworzenia znaczeń, zachęcanie do rozmów konceptualnych oraz zarządzanie interakcjami. W artykule zwrócono również uwagę na metodologiczne kwestie związane z wykorzystaniem iVR do angażowania osób uczących się języków w scenariuszach zajęć, które rozwijają umiejętności mediacyjne, które mogłyby być przenoszone na rzeczywiste konteksty społeczno-pragmatyczne.

SŁOWA KLUCZOWE: imersyjna wirtualna rzeczywistość, cyfrowa kompozycja multimodalna, strategie mediacyjne, pedagogika językowa, nauczanie języków obcych we Włoszech.

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