E·S·P·Today
JOURNAL OF ENGLISH FOR SPECIFIC PURPOSES AT TERTIARY LEVEL

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IMMERSIVE GLOSSARIES IN VIRTUAL REALITY FOR ESP VOCABULARY INSTRUCTION

Abstract

Virtual reality (VR) can be beneficial for both individual and collaborative learning by fostering a sense of presence and immersion (Chen, 2016; Dalgarno & Lee, 2010), particularly in the context of English for Specific Purposes (ESP) vocabulary teaching (Madini & Alshaikhi, 2017). This study investigates the use of immersive glossaries in VR as a form of ESP vocabulary instruction. In this context, immersive glossaries were integrated into a VR-based solution for specialised language learning, featuring interactive points that present specialist terms in textual, auditory and 3D visual formats. The study, conducted during the first semester of the 2025-26 academic year, employed a two-group pre- and post-test design. A total of twenty graduate students enrolled in the MA in Conference Interpreting participated in four training sessions focused on fashion vocabulary learning. Ten students engaged with the English-Italian immersive glossary in VR, while a control group of ten students used a traditional English-Italian glossary in Word format, typically employed in conference interpreting classes. Following the training, the pre- and post-test results were compared, revealing statistically comparable language gains in both groups. These findings suggest that immersive learning in VR can complement, rather than replace, traditional vocabulary instruction.

Key words

English for specific purposes (ESP) vocabulary instruction, virtual reality (VR), immersive glossaries, presence, language gain.

1. INTRODUCTION

The rapid development of digital technologies is bringing about a radical transformation in learning and teaching methods. In recent years, there has been "an unprecedented convergence of technologies, with Augmented Reality (AR), Virtual Reality (VR), and Artificial Intelligence (AI) poised at the forefront" (Hawkinson, 2025, p. 22), where the umbrella term of extended reality (XR) encompasses virtual reality (VR), augmented reality (AR) and mixed reality (MR). In this innovative interactive landscape, growing interest in the use of virtual reality (VR) and virtual reality or virtual learning environments (VRLEs or VLEs) has been observed in recent years. In line with constructivist principles of learning, according to which knowledge is constructed through interaction, participation and the contextualisation of experiences (Kiraly, 2000), VR and VLEs can support learning. They are designed to create a sense of presence and immersion (Braun et al., 2013, 2020; Chen, 2016; Dalgarno & Lee, 2010; Reisoğlu et al., 2017), representing a novel form of human-machine interaction (Baselli et al., 2025).

According to research dating back to the end of the 1990s (e.g., Biocca & Delaney, 1995; Slater & Wilbur, 1997), VR allows users to experience a fully immersive sensory illusion of being present in another environment, "where immersion, presence, and interactivity are regarded as the core characteristics of VR technologies" (Radianti et al., 2020, p. 3). In this study, VR is understood as a completely immersive environment where the real world is totally hidden from view (Martirosov & Kopecek, 2017). As in the case of XR, VR supports interaction and active learning "in novel ways by enabling students to experience and manipulate virtual objects and simulations, fostering deeper cognitive engagement. In tandem with XR, gamification incentivizes learners with challenges, rewards, and feedback for actively participating in the learning process" (Anesa, 2025, p. 11).

Against this background, the concept of immersion can be interpreted from two complementary perspectives, technological and psychological. From a technological point of view, Slater and Wilbur (1997, p. 604) define immersion as "the extent to which computer displays are capable of delivering an inclusive, extensive, surrounding, and vivid illusion of reality to the senses of a human participant." From a psychological perspective, immersion represents a subjective state of mental and sensory absorption, in which the user perceives a temporary detachment from the real world. Accordingly, "the perceived degree of immersion differs from person to person, and the technological attributes barely influence it" (Radianti et al., 2020, p. 3).

Building on these assumptions, immersion leads to a sense of presence, defined as the subjective experience of being in a place and the feeling of "being there" (Pack et al., 2020; Witmer & Singer, 1998). In fact, presence is a crucial attribute of VR environments used for educational purposes, as it provides users with a sense of immersion. From this perspective, immersion and presence are key concepts for understanding how VR can influence language learning. In the context

of immersive language learning, VR provides an experience that goes beyond mere exposure to language by integrating sensory and emotional dimensions. The use of immersive environments in educational settings can enhance the retention and retrieval of terms thanks to the combination of visual, auditory and motor stimuli (Kavaliauskienė & Janulevičienė, 2001). Immersion and presence lead to another state that favours concentration during tasks, which corresponds to the concept of "flow", the mental state in which a person is fully immersed in his or her activity (Csikszentmihályi, 1996; Csikszentmihályi & Csikszentmihályi, 1988). This state is a sort of deep involvement in tasks driven by motivational factors (Csikszentmihályi, 1990). According to Csikszentmihályi, this theoretical framing is further articulated through nine defining indicators that contribute to the emergence of flow, including "an altered sense of the experience of time" (Hancock et al., 2019, p. 1). Therefore, in this immersion of the self during language learning tasks, time perception may vary due to the above-mentioned state of flow, leading to increased concentration during vocabulary retention activities.

Furthermore, in these new virtual environments, the various pre-existing worlds allow users to create their visual representations of themselves in the form of avatars, enabling them to express different identities or possible body representations, whether closer to physical reality or fantasy (Colazzo & Maragliano, 2022, p. 85). This gives users the opportunity to experience new situations that can profoundly impact their lives, by motivating them and allowing them to express themselves freely and make mistakes without fear of judgment.

Since trainees in university conference interpreting courses often feel judged by peers and instructors (Baselli & Garzone, 2026), new teaching methods should be explored to increase students' motivation and reduce their fear of expressing themselves. Although universities are increasingly attempting to adapt to these changing scenarios by integrating VR and VLEs into English for Specific Purposes (ESP) contexts, ESP vocabulary instruction in VR through immersive glossaries remains an underexplored area, above all in conference interpreting university courses, where vocabulary learning and terminology preparation are still carried out using traditional methods. This often means that the most common way to prepare for an assignment and study terminology is by identifying reliable sources of information, extracting relevant content from them and compiling a glossary in Microsoft Word or Excel (Díaz-Galaz et al., 2015; Fantinuoli, 2018). At the tertiary level, MA students in conference interpreting typically prepare for simultaneous and consecutive interpreting lessons by creating Microsoft Word glossaries that include the English term, its definition and the Italian translation (see Table 1). Furthermore, a common type of master's thesis among conference interpreting trainees consists of a specialised term base, comprising entries that include a foreign-language specialist term with its definition and context of use, alongside the Italian translation with its corresponding definition and context, all compiled in Microsoft Word format.

2. LITERATURE REVIEW

2.1. Integrating virtual reality in ESP teaching

"English for Specific Purposes (ESP) distinguishes itself from more general language study through a focus on particular, purposeful uses of language" (Hyland, 2022, p. 202). While ESP has been defined and studied by many scholars, in this context, "it can broadly mean learning English to be used in specific fields related to labour market, such as science, nursing, technology, and business" (Madini & Alshaikhi, 2017, p. 113) or, for conference interpreting trainees, any specialised domain (e.g., among others medicine, energy or fashion). In English Language Teaching (ELT), English for Academic Purposes (EAP) and English for Specific Purposes (ESP) classes, activities are usually designed to provide students with opportunities to practice communication and language skills in order to achieve specific learning purposes. To this end, tasks often aim to simulate authentic interactive situations. Although real-world activities, such as role plays and mock conferences organised for conference interpreting trainees, are often used in academic settings, a gap inevitably remains between what can be practised in the classroom and what is actually required in real-life professional contexts. VR, however, has the potential to help bridge this gap (Coleman & Derry, 2023), while also enhancing student motivation (James, 2025) and engagement (Han et al., 2019; Parmaxi, 2020). Furthermore, as VR exercises are designed to provide safe learning environments, they could also have the potential to lower affective filters, thereby reducing anxiety and improving performance (Lan, 2020). Indeed, a substantial body of research highlights a negative correlation between students' anxiety levels and their perceived competence and self-efficacy (e.g., among others Rubić & Dević, 2026; Shang & Ma, 2024; Wu et al., 2022). In ESP, students also face challenges in mastering and using vocabulary and specialist terms in professional settings. This challenge highlights the need to explore emerging XR technologies and assess their potential to transform how learners acquire ESP terminology. In this regard, VR headsets represent a step in this direction by exposing users to authentic, practical training.

2.2. Previous studies

Over the past decade, the introduction of XR has increasingly affected teaching and learning practices. In this context, some of the explored topics include motivation, state of flow, immersion and presence in virtual environments. A comprehensive review of research carried out by Yudintseva (2023), encompassing 34 studies published between 2015 and 2022, showed how immersion and interaction can positively affect anxiety, motivation and engagement. The author concluded that immersion, interaction and creation in VR can provide real-life interactive

opportunities in second language learning and increase students' competencies. In line with these findings, Yang et al. (2018) explored the effects of state of flow and attention during immersive VR tasks. Sixty undergraduate students participated in an activity aimed to compare creative thinking in an immersive VR condition and a traditional paper-and-pencil condition. According to the surveys and electroencephalography (EEG) results, the students engaged in the immersive VR condition exhibited significantly higher levels of focus and creative thinking compared to those in the paper-and-pencil condition. A few years later, Wu (2024) conducted a study that analysed the relationship between students' motivation and language learning effectiveness. The study revealed that higher engagement and enhanced language acquisition can be achieved through VR, thus proposing its seamless integration into English teaching activities. Similarly, Chen et al. (2022) conducted a meta-analysis of quantitative studies examining students' linguistic and affective gains when using VR-enhanced tools for learning. "The results indicated that VR-assisted language learning had a medium effect on the linguistic gains" (Chen et al., 2022, p. 1). Among the studies reviewed by Chen et al. (2022), Chen (2016) found that students improved their knowledge of phonology, morphology, grammar and syntax. At the same time, VRLEs – with their unique features of immersion and ease of use – positively affected student language cognition and helped them develop a higher level of critical thinking skills. In a similar vein, Pinto et al. (2021) conducted a systematic review of research to determine whether using gaming strategies in VR is effective for second or foreign language learning. Their findings revealed that in over half of the studies analysed VR was found to be effective in supporting foreign language learning, with English being the most commonly used language in studies on gamified technology. However, the authors concluded that, as "the comparisons between newer technologies and traditional approaches are still lacking, […] it is only possible to recommend using technologies to support second language learning and not entirely replace traditional approaches" (Pinto et al., 2021, p. 16).

In order to analyse studies on VR-enhanced language learning and "in an attempt to assess the strengths and weaknesses of this new methodological approach" (Gioffrè, 2025, p. 38) in ELT settings, Gioffrè (2025), who selected the Meta Quest 3 VR headset as VR technology, conducted a systematic review on VR-assisted language learning applications. Her review revealed that *Immerse* is the only VR app developed with a specific functional pedagogical approach, whereas other applications fail to address grammar and vocabulary teaching. Furthermore, the VR-enhanced app *Immerse* allows users to interact with people from around the world, providing authenticity to all simulated scenarios.

In the context of ESP, Madini and Alshaikhi (2017) highlight several key topics in the literature. These include the relationship between the amount of vocabulary learned and comprehension skills (Ibrahim et al., 2016; Sidek & Rahim, 2015) as well as the categorization of learners types based on their vocabulary learning preferences (Mokhtar et al., 2009). In the context of ESP for professional courses,

Khan (2016) noted that some learners may face challenges in effectively using specialised ESP terminology in their future careers. This suggests that new technologies, e.g., VR, could be further employed and tested for teaching and learning ESP vocabulary. As Madini and Alshaikhi (2017) highlighted, the use of VR headsets in ESP vocabulary instruction could provide users with chances to be exposed to authentic, practical training without leaving the classroom.

Other authors have turned their attention to enhanced vocabulary retention in VR settings, which allow users to retain more information and apply concepts more effectively (Krokos et al., 2019). For instance, Alshumaimeri (2023) examined 138 articles from different perspectives, including VR, and found that gamified VR in English language learning can lead to improved vocabulary acquisition, better collaborative learning and lower anxiety levels. Similarly, Alfadil (2020) explored the influence of the VR game *House of Languages* on EFL vocabulary acquisition in a quasi-experimental study involving 64 students. The findings, which showed greater achievement in vocabulary acquisition in the experimental group than in the control group using the traditional method, highlighted that VR games significantly improve vocabulary retention in a foreign language. In line with these findings, Çakici and Dilman (2025) compared VR-integrated activities with traditional instruction among 47 participants and demonstrated that VR led to greater gains in both short-term and long-term vocabulary retention, while also positively influencing motivation, engagement, and collaborative learning. Lastly, a study conducted by Xie et al. (2025) assessed and compared vocabulary retention across two modalities: immersive virtual reality (IVR) and PowerPoint (PPT) presentations. The findings suggest that PPT facilitates immediate short-term retention, whereas IVR seems to enhance long-term vocabulary retention.

However, while VR has sparked remarkable interest in language education, its application in conference interpreting training and vocabulary teaching is still in its infancy (Hu et al., 2025). Initial studies – such as the EVIVA and IVY projects[1] – have reported positive attitudes among trainees towards the functionality, usability and immersive learning offered by VR, suggesting its potential effectiveness in interpreting training and learning outcomes (Braun & Slater, 2014; Braun et al., 2013, 2020). However, concerns persist regarding technical limitations and learning efficiency (Hu et al., 2025), also considering the specific challenges faced by conference interpreting trainees, such as higher levels of cognitive load and the need for rapid terminological retrieval in the booth (Fantinuoli, 2018).

Some authors emphasised the positive benefits of VR in conference interpreting settings. For instance, Zhu and Liao (2023) highlighted how VR can be integrated into different modules of interpreting training – such as "Topic," "Language," "Practice" and "Skills" – to provide "conducive training for public speaking skills, reaction ability, psychological quality, professionalism, and interpreting skills required for conference interpreting" (Zhu & Liao, 2023, p. 4).

[1] Eviva and IVY, https://sites.google.com/view/teloslearning/projects/eviva-and-ivy

Similarly, Chan (2023) explored the use of the *Virtual Interpreting Practice (VIP)* app, which includes a range of learning resources and modules covering practical topics and contexts, fully immersive VR and non-VR practice, glossary lists, source and translated texts, as well as an online feedback platform. The findings showed that the use of *VIP* significantly raised the students' self-rated language and interpreting proficiency and their interpreting performance.

Against this background, this pilot study aims to explore the development and application of immersive glossaries in VR as a novel approach to ESP vocabulary learning. It seeks to evaluate the effectiveness of English specialist terminology training in VR, focusing specifically on the use of immersive glossaries and comparing this approach to traditional vocabulary acquisition methods for conference interpreting trainees, such as Microsoft Word glossaries. In line with Merchant et al. (2014) and Madini and Alshaikhi (2017), who highlighted the "need for adequate statistical information in order to see the effect size of the new VR tool on ESP learning" (Madini & Alshaikhi, 2017, p. 116), a mixed-methods research design combining qualitative and quantitative approaches was employed to assess ESP vocabulary retention in VR through immersive glossaries. To the best of the author's knowledge, no previous study has specifically assessed the effectiveness of immersive glossaries in VR for ESP vocabulary retention.

3. METHODOLOGY

3.1. Materials: The immersive glossary

To address the aforementioned gap in the existing literature, an immersive glossary was developed in the field of fashion as part of the departmental project "The Languages of Fashion: Made in Italy, Marketing, and Phygital Fashion." The project was carried out in the Department of Humanities at IULM University in collaboration with the International Centre for Research on Collaborative Translation (IULM).

The first stage of the project involved creating an English corpus specifically for the fashion industry using the software Sketch Engine.[2] The first functional iteration of the English corpus – developed in collaboration with Maka Language Consulting[3] – contained 597,067 words and 683,871 tokens. After extracting the keywords from this corpus, an English-Italian glossary was compiled in Microsoft Word format, which included Italian and English terms along with their respective definitions in both languages. The Microsoft Word glossary is commonly used by students for terminological research activities and for preparation of their MA theses. This glossary was subsequently uploaded to the MicrolinguaLab[4] platform

[2] Sketch Engine, https://www.sketchengine.eu/
[3] Maka Language Consulting, https://www.makaitalia.com/en/
[4] MicrolinguaLab, https://education.carraro-lab.com/microlingua-lab/

provided by CarraroLab[5] to develop an immersive glossary in the fashion field, accessible both in desktop and VR modes.

The MicrolinguaLab platform is a solution that integrates VR and AI for specialised language learning in both academic and professional settings. It consists of two modules: *Immersive Glossary* and *Immersive Conversation*. In the *Immersive Glossary* module, users are placed in a 3D VR environment. As they explore this virtual space, they encounter interactive points that show the specialised terms included in the glossary. These terms are presented in both textual and audio formats, visually supported by 3D reconstructions. In the *Immersive Conversation* module, the learning experience offers conversational interaction scenarios with a 3D AI-based avatar. In this setting, users can ask questions on the topics of the glossary and be tested by the avatar on the specialist terminology they have studied.

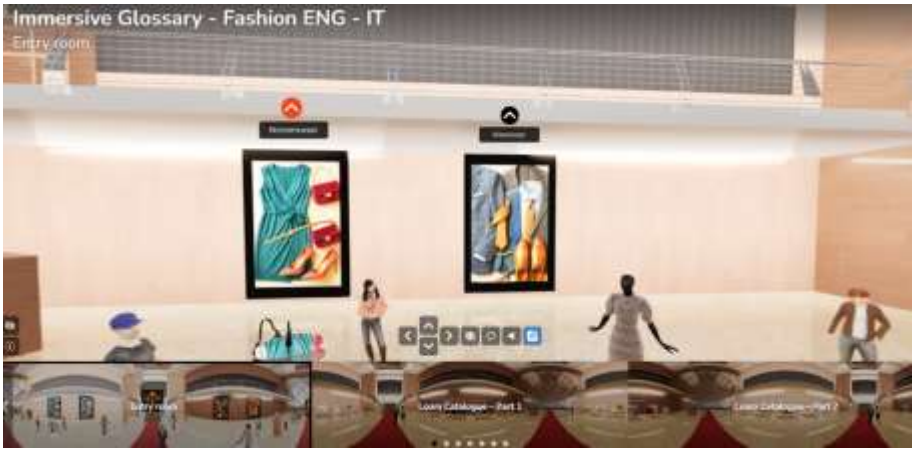

Figure 1. Image of the immersive glossary main hall

As shown in Figure 1, by navigating through the various subcategories of the glossary – women's wear, men's wear, knitting stitches, loom, accessories, fabrics and fashion shows –users can view the terms alongside their definitions, related images and translations. In addition, users can access the pronunciation and definition of each term, features that further enhance the accessibility and inclusivity of the interface. As previously mentioned, the immersive glossary can be accessed in two formats: on a desktop computer, laptop, tablet and smartphone, or alternatively, through VR headsets. In the desktop version, users can navigate the virtual environment using the cursors. For this exploratory pilot study, only the VR mode of the *Immersive Glossary* module was used.

[5] CarraroLab, https://www.carraro-lab.com/home/

3.2. Study design and results

This quasi-experimental pilot study employs a mixed-method approach, comprising quantitative analysis followed by a survey, to explore the usefulness of VR immersive glossaries compared to traditional learning methods through Microsoft Word glossaries. The study was conducted in the first semester of the 2025-26 academic year and involved twenty students from the master's degree course in Specialised Translation and Conference Interpreting at IULM University. The participants were divided into two groups on a voluntary basis, as not all students could tolerate 20-minute training tasks wearing VR headsets (Group 1 – Experimental group, n = 10; Group 2 – Control group, n = 10) considering that some of the students had reported signs of cybersickness during the first hour of training prior to the pilot study.

All participants took part in a pre-test, four 20-minute glossary study sessions over four weeks, and a post-test session. The control group studied the terminology using the traditional method – English term, definition and Italian translation in a Microsoft Word document (Table 1). The experimental group, instead, used the 128 GB Meta Oculus Meta Quest 3 VR headsets[6] to navigate the immersive glossary in VR format. For the purposes of this study, access to the AI-based conversational module was not included.

Italian
Doppio petto: Giacca o mantello con i due davanti più o meno sovrapposti e chiusi da due file di bottoni. A. Donnanno. (2018). *Modabolario. Parole e immagini della moda. Dizionario tecnico-creativo.* Ikon.
English
Double-breasted: Coat with overlapping front and a double line of buttons to close front. R.B. Maglie. (2010). *English 4 fashion*. Wip Edizioni.

Table 1. Example of a simplified Microsoft Word glossary term (Italian: doppio petto – English: Double-breasted) used during the study for the traditional learning method

All responses were scored by assigning one point to each correct answer.

Overall, the students' language gain scores ranged from 7.60 to 12.00 on a fifteen-point scale. Vocabulary acquisition improved both for the experimental and

[6] The Meta Quest 3 VR headsets weigh 515 grams and have a horizontal field of view of 110 degrees and a vertical field of view of 96 degrees. Each display provides a resolution of 2064 x 2208 pixels per eye. For more information on the 128 GB Meta Oculus Quest 3 VR headsets used in the study, see https://www.meta.com/it/en/quest/quest-3/

control groups as a result of the terminology learning sessions. Table 2 shows the pre-test, post-test and language gain scores for each group.

Group	Pre-test	Post-test	Language gain
Experimental group	7.70	12.00	4,30
Control group	7.60	11.60	4,00

Table 2. Students' mean pre-test, post-test and language gain scores

While both groups showed positive language gains between pre-test and post-test (approximately 4 points out of 15), the highest post-test score was recorded in the experimental group, with a mean of 12.00 (*SD* = 1.88) and a pre-test of 7.70 (*SD* = 2.62), compared to the control group, which obtained an average score of 11.60 (*SD* = 2.95) in the post-test and 7.60 (*SD* = 2.91) in the pre-test. However, in order to evaluate the language gain scores, dependent and independent sample *t*-tests were used to compare the scores between and within the experimental and the control groups. All statistical analyses were performed using SPSS software.[7]

Univariate group comparison revealed a statistically significant improvement ($p < 0.01$) from pre-test to post-test scores, indicating that the average difference between pre-test and post-test results was significant for both groups (Experimental group: M = 4.300, *SD* = 1.829; Control group: M = 4.000, *SD* = 2.625). However, a univariate comparison of language gain scores showed no statistically significant difference between the experimental and control groups ($F = 0.88$; $p = 0.770$). This suggests that both groups – those using the immersive VR glossary and those using the traditional Microsoft Word glossary – achieved comparable language gains.

4. THE SURVEY

After the pilot study, a survey [8] was administered to the participants in the experimental group through Google Forms to collect feedback on their immersive learning experience (see the Appendix). The survey allowed us to collect students' perceptions of the VR training sessions. This section analyses the survey results and assesses the effectiveness of the immersive glossary in studying ESP terminology. The analysis is organised into three main areas: overall perceptions of the VR activity, students' perceptions of the usefulness of the immersive glossary and their suggestions on how to improve the learning experience. For the seven items related to the overall perceptions of the VR activity, the respondents were asked to indicate

[7] SPSS, https://www.ibm.com/it-it/products/spss-statistics
[8] The survey was adapted from Ginzbursky-Blum and Blum (2025).

their level of agreement on a 5-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree).

4.1. Students' perception of the VR activity

Table 3 presents descriptive statistics from the Likert-scale items of the survey administered to the experimental group. As the survey was newly developed, its validity and reliability were assessed and the responses to the seven items were analysed for internal consistency using SPSS. The survey revealed acceptable internal consistency, with a Cronbach's alpha of 0.71.

	ITEMS	MEAN	STANDARD DEVIATION	SKEWNESS
1	The goals of this VR session were clear	4.40	0.84	-1.00
2	The challenge of this activity matched my language skills	4.50	0.53	-0.00
3	I felt completely focused on the VR language task	3.20	1.40	-0.13
4	I lost track of time during the VR activity	3.40	1.26	-0.28
5	The VR technology was easy to use	3.40	0.97	-0.11
6	The virtual environment felt realistic and immersive	3.20	1.32	-1.18
7	I would like to participate in more VR language learning sessions	3.80	1.32	-1.01

Table 3. Closed-ended Likert-scale items administered to the experimental group

Descriptive statistics show skewness values ranging from −1.183 to 0.280, suggesting generally acceptable normality, although items 6 and 7 displayed slight negative skewness, indicating a tendency toward higher agreement. Mean scores varied across the items, with relatively high values for clarity of the task goal (4.40), challenge to language skills (4.50) and willingness to participate in more VR language learning sessions (3.80). Scores were lower for focus (3.20), time perception (3.40), user-friendliness of the technology (3.40) and realism and immersion of the virtual environment (3.20).

Item 1 received relatively high scores (M = 4.40, *SD* = 0.84). When asked whether the goals of the VR session were clear, six students strongly agreed, two agreed and two were neutral.

Item 2 focused on whether the level of difficulty was aligned with the students' language skills. Responses (M = 4.50, *SD* = 0.53) indicate that all students agreed or strongly agreed that this immersive learning activity matched their language skills (five strongly agreed and five agreed). This suggests that the task difficulty was appropriate, since it is the highest-rated item and the responses were evenly distributed.

As far as item 3 is concerned, responses about concentration during the VR learning activity were mixed (M = 3.20, *SD* = 1.40), reflecting varying levels of focus among participants. Half of the students claimed that the immersive environment enhanced their concentration (three strongly agreed and two agreed), while four students described the VR activity as distracting (three strongly disagreed and one disagreed). This suggests that not all students experienced the state of flow (Csikszentmihályi, 1990), which leads to more focus and concentration during language learning.

Responses to item 4 (M = 3.40, *SD* = 1.26) report the participants' perceptions of time during the VR task, reflecting a distribution similar to that of the previous responses. Indeed, this is strictly connected to the previous indicator, since the state of flow seems to be associated with a distorted sense of time (Hancock et al., 2019). Overall, three students strongly agreed and one agreed on having lost track of time during the VR activity, while three expressed a neutral opinion and three disagreed.

For item 5 (M = 3.40, *SD* = 0.97), participants were asked whether the VR technology was easy to use. Five students reported that they did not encounter any technological difficulties while using the VR headsets, two did not find the VR technology easy to use and three were neutral. These results suggest that further preparatory training with VR may be needed before performing the language task, since user-friendliness probably influenced the overall effectiveness of the immersive glossary and technological frustration probably acted as a confounding factor in the learning process. These responses also reflect the qualitative feedback reported below.

Item 6 aimed to assess students' perceptions of the virtual environment in terms of realism and immersion. Responses (M = 3.20, *SD* = 1.32) revealed that the vast majority of students (seven) agreed that the technology was truly realistic and immersive, while two strongly disagreed and one disagreed.

Lastly, item 7 was designed to gauge students' willingness to take part in further VR sessions based on this experience. Responses (M = 3.80, *SD* = 1.32) showed that six participants were in favour (two agreed and four strongly agreed), three expressed a neutral opinion and one strongly disagreed. Overall, these findings suggest a positive attitude toward the future use of VR, with many students expressing interest in continuing this kind of learning experience.

4.2. Students' perceptions of the usefulness of the immersive glossary

The first open-ended question of the survey aimed at understanding what the participants enjoyed most about their VR experience. On the one hand, they particularly valued the immersive and interactive learning environment, describing it as a new experience that enabled the immediate association between each term, its definition and its visual representation. Notably, participants stated that they

enjoyed the feeling of being transported into "another virtual environment" and appreciated that immersion leads to greater focus on the specialist terminology (e.g., "The immersive environment that makes you focus only on learning new specialist terms."). The "association between image and definition" was described as making learning "more immediate," suggesting that enjoyment stemmed from a clearer link between visual representation and meaning, which is especially useful for ESP terminology. From this perspective, for some participants, enjoyment was associated with a lower level of distraction and a stronger sense of presence, since they felt immersed in the task rather than merely observing it. Indeed, VR was praised for being "interactive," "dynamic" and a "different way to experience learning." In this sense, their enjoyment appears to be closely related to active engagement, rather than passive reception of content.

On the other hand, the responses suggest a strong novelty effect, a factor that may contribute to lower learning outcomes during initial VR experiences (Miguel-Alonso et al., 2024). Many participants focused on the excitement of using VR rather than the pedagogical effectiveness of the glossary itself, suggesting that this initial enthusiasm may have influenced both the overall survey responses and the observed language gains during the immersive VR experience. A recurring theme in the responses is that VR was perceived as refreshing, mainly because it disrupted established learning routines. Several participants explicitly attributed their enjoyment to the new medium, especially for second-time headset users. For instance, one participant described the experience as "something new," while also noting that the technology was "not easy to use."

4.3. Students' suggestions on how to improve the learning experience

The second open-ended question concerned students' suggestions on how the VR activity could be improved in order to enhance language learning. Participants provided several suggestions to improve the VR activity and better support immersive language learning.

Although the VR headsets were connected to a fast and dedicated Wi-Fi network required by VR and immersive apps, almost all the issues reported were related to technical problems and poor connectivity (e.g., "I understand most problems were related to Wi-Fi connection issues; perhaps ensuring a faster connection so that the interface and commands are visualised rapidly."). Participants noted that slow or unstable connections negatively affected usability, navigation and overall immersion.

Furthermore, inadequate basic training on the use of the VR headsets represented another challenge, considering that some participants reported confusion and frustration when technical issues arose (e.g., "When we experienced problems with the VR technology, it was frustrating."). Respondents highlighted the

importance of allocating "a little more time to learning how VR works" in order to become familiar with the VR environment before engaging in language tasks. Some users also experienced difficulties "moving from one room to another," which hindered their ability to focus on vocabulary learning. Furthermore, participants suggested incorporating interactive assessment features, such as in-environment tests, to evaluate how many terms they "have learned at the end of the session directly in the virtual environment." Lastly, there was interest in improving accessibility, with some participants expressing a desire "to have VR headsets at home in order to use them and practice every day."

5. CONCLUSIONS

This study investigated university students' vocabulary retention, language gain and perceptions of using a prototype English-Italian VR immersive glossary as an alternative to the traditional Microsoft Word glossaries used by conference interpreting trainees to learn specialised terminology. The findings indicate overall positive attitudes toward the immersive environment, despite the technical issues related to the Wi-Fi connection encountered by some participants and their limited prior familiarity with VR. At the time of writing, measures have already been taken to improve the internet connectivity.

As far as language gain and vocabulary retention are concerned, the results show a statistically significant improvement ($p < 0.01$) in language gain from pre-test to post-test in both groups. The difference in language gain between the experimental and control groups was only 0.30, which cannot be considered statistically significant ($p > 0.05$). However, although the language gain in the VR group was comparable to that of the control group, the results of the immersive activity assessment survey reveal a positive impact of VR on the acquisition of specialised ESP terminology. In line with the findings of Yudintseva (2023), the absence of significant differences in language gain scores between the two groups may have been caused by technology challenges as well as the novelty effect experienced by students (Miguel-Alonso et al., 2024). Indeed, the initial excitement from the novelty effect may have influenced the results and obscured the true cognitive effort needed for vocabulary retention.

Furthermore, a limitation of this study is that, in order to better isolate the effect of VR, the control group could ideally have used the same digital glossary featuring the audio and visual components available in the standard *Immersive Glossary* web page. However, given the limited sample size and timeframe, these findings should be considered preliminary and are intended to provide a foundation for future research currently in development. Future studies will incorporate more extensive training on the basic use of VR headsets to establish a more comparable digital baseline for participants. Additionally, these studies will involve a larger sample size, with the control group utilizing the digital glossary and the experimental group engaging with

the VR version of the glossary. Additionally, a longitudinal research design could be adopted to investigate how participants' attitudes vary over the sessions with increased exposure to the immersive glossary in VR.

Moreover, considering that using VR technology is only one of the many dimensions of ESP immersive learning – and specifically of vocabulary retention – other aspects of this technology warrant further investigation, such as immersion, interaction, presence, perceived ease of use and usefulness (Barrett et al., 2021). Students should also be made aware of both the advantages and the drawbacks of learning vocabulary in VR. On the one hand, advantages include, but are not limited to, the chance to focus more on the language task, increased motivation and willingness to learn new specialised terminology and the enjoyment linked to the sense of presence and immersion provided by VR technology. On the other hand, challenges include technical issues related to the internet connectivity, discomfort caused by prolonged use of VR headsets and the need for adequate training on the use of VR systems.

In conclusion, in an era of rapid transformation, it is essential to reflect on and strategise a future where technology enhances, rather than diminishes, the essence of learning (Hawkinson, 2025). While traditional teaching remains a fundamental pillar in this rapidly evolving era, VR represents an innovative frontier of ESP and ELT teaching, with the potential to motivate and engage students while creating authentic communicative settings. However, considering the technical issues encountered during the training sessions, as well as the ethical and social considerations linked to VR, it is important to approach this technology with caution. As Gioffrè (2025, p. 58) notes, "it is essential to treat virtual reality as a supplement to, rather than a substitute for, traditional teaching and learning methods." A blended-learning approach that combines immersive and interactive VR activities with traditional teaching methods may therefore lead to effective learning outcomes.

[Paper submitted 7 Dec 2025]
[Revised version received 30 Mar 2026]
[Revised version accepted for publication 18 Apr 2026]

Acknowledgement

This research is part of the *The Languages of Fashion: Made in Italy, Marketing, and Phygital Fashion* project funded by the Department of Humanities and the International Center for Research on Collaborative Translation (IULM). The author would like to thank the International Center for Research on Collaborative Translation (IULM) for the ongoing financial and logistical support before and during this project.

The author acknowledges the use of the artificial intelligence tool *Grammarly* for grammar checking during the preparation of this manuscript. Responsibility for the final content and interpretation rests solely with the author.

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Appendix

The survey

For all items, participants were asked to respond on a 5-point Likert scale (strongly agree, agree, neither agree nor disagree, disagree, strongly disagree).

Part 1: Overall perceptions of the activity carried out in VR
Item 1 - The goals of this VR session were clear
Item 2 - The challenge of this activity matched my language skills
Item 3 - I felt completely focused on the VR language task
Item 4 - I lost track of time during the VR activity
Item 5 - The VR technology was easy to use
Item 6 - The virtual environment felt realistic and immersive
Item 7 - I would like to participate in more VR language learning sessions

Part 2: Students' perceptions on the usefulness of the immersive glossary
Open-ended question: What did you enjoy about the VR language learning experience?

Part 3: Students' suggestions on how to improve the learning experience
Open-ended question: How could the VR activity be improved to enhance your language learning?