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SPEAKING IN THE METAVERSE: VIRTUAL REALITY FOR ESP SKILL DEVELOPMENT

Abstract

The integration of immersive technologies, particularly virtual reality (VR), into English for Specific Purposes (ESP) is reshaping higher education through personalized, experiential, and collaborative learning in metaverse-ready environments. This study examines the impact of VR-based video production on speaking skills among commerce undergraduates and explores learners' perceptions of VR as a pedagogical tool. Using a quasi-experimental design, 146 students were assigned to a control or experimental group and asked to create promotional videos using either conventional social-media tools or VR applications. A speaking rubric and a Likert-scale questionnaire on VR perceptions were administered. Results show that the VR experimental group significantly outperformed the control group in speaking performance and valued VR for enhancing motivation, immersion and communicative competence, despite some concerns about required time and training. Framed by the Technology Acceptance Model (TAM), the Unified Theory of Acceptance and Use of Technology (UTAUT) and the Diffusion of Innovations Theory, the study demonstrates that VR-enhanced ESP instruction can improve learning outcomes and engagement while supporting innovative curriculum design in higher education.

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Key words

virtual reality, English for specific purposes (ESP), speaking skill, immersive learning, meta-education.

1. INTRODUCTION

The information and knowledge age demands that citizens master new competencies that enable active participation in social, academic, and professional life (Inamorato dos Santos et al., 2023). Education systems are therefore asked to redesign teaching, learning, and assessment processes so that they foster the so-called 21st-century skills, including critical thinking, collaboration, creativity, and digital competence (Muammar et al., 2023). This shift challenges traditional transmissive models centered on memorization and opens up opportunities for more dynamic, student-centered approaches that align with contemporary societal and labor-market needs. Within this scenario, digital literacy has become a core, transversal competence and university teachers are expected to design, implement, and evaluate technology-enhanced learning experiences that genuinely add pedagogical value, rather than simply reproducing traditional practices in digital form (Marnita et al., 2023). Models such as the Technological, Pedagogical and Content Knowledge (TPACK) highlight that effective technology integration depends on the interaction between disciplinary, pedagogical, and technological knowledge (Handayani et al., 2023), while European frameworks such as DigComp (Punie et al., 2013) and DigCompEdu (Punie & Redecker, 2017) provide detailed descriptors of digital competence for citizens and educators. Recent updates, for example DigComp 2.2 (Vuorikari et al., 2022), further consolidate digital competence as a reference for curriculum design and assessment in higher education. In this context, the integration of information technology (IT) into Languages for Specific Purposes (LSP) pedagogy represents a significant evolution beyond mere tool use, fundamentally reshaping teaching and learning paradigms. As Arnó-Macià (2012) elucidates, technology serves as a pivotal gateway to authentic discourse communities, granting unprecedented access to specialized corpora, facilitating computer-mediated communication, and enabling the creation of virtual learning environments. This transformation directly addresses the core LSP tenets of learner needs, authenticity, and specificity, allowing for tailored instruction that bridges the gap between the classroom and real-world academic and professional settings. Thus, university English for Specific Purposes (ESP) professors are called to contribute actively to students' digital literacy, regardless of their specific field focus (Kamsker et al., 2020; Leal Filho et al., 2024). In degree programs in commerce and business, ESP courses aim to develop students' ability to communicate effectively in international commercial settings: describing and promoting products, negotiating with partners, presenting data, and engaging with clients across cultures. A key requirement in this domain is oral communicative competence, yet speaking is often one of the most challenging skills to foster in large undergraduate classes. Time constraints, performance anxiety, and traditional assessment procedures may limit students' opportunities to practice extended, authentic spoken production. This pedagogical gap underscores the importance of adopting evidence-informed, task-based strategies that move beyond traditional

limitations and actively promote self-regulated learning, situated oral interaction, and real-world communicative outcomes. Digital technologies, and particularly immersive and interactive environments, offer promising tools to address these challenges. Virtual reality (VR) stands out as a particularly powerful medium: it allows learners to experience multisensory, three-dimensional environments, to manipulate virtual objects, and to interact with others in simulated professional scenarios. VR has increasingly been conceptualized as a disruptive educational technology capable of transforming English language teaching, especially in ESP contexts, by recreating authentic scenarios that support experiential and meaningful learning (Butarbutar, 2025). In the case of English for commerce, VR can situate learners in realistic settings where they are required to use specialized language in context, engage in collaborative tasks (e.g., simulations or problem-solving activities), and receive real-time feedback on their performance. Dedicated platforms such as VirtualSpeech or Polly, for instance, provide immediate corrective input on pronunciation, grammar and language use, while VR simulations of intercultural encounters help students develop global communicative competence and intercultural awareness. These affordances align with contemporary models of technology acceptance and use, such as the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT), which stress the importance of perceived usefulness, ease of use, and hedonic motivation in the adoption of new tools. In this study, students were asked to produce VR-based promotional videos, which requires learners to plan, script, and perform spoken texts that closely resemble real-world commercial communication, while simultaneously engaging with digital content creation and collaborative work. Yet empirical research on the impact of VR on ESP speaking performance in undergraduate business programs remains scarce, and students' perceptions of VR as a pedagogical resource in this domain are still underexplored. The present study addresses this gap by investigating the integration of VR into an undergraduate English for commerce course in a face-to-face public university in Madrid (Spain). Specifically, it compares the speaking performance of students who create promotional videos using conventional 2D and social-media tools with that of peers who use VR tools, and it examines commerce undergraduates' perceptions of VR. In doing so, the study contributes to the growing body of research on digital and immersive ESP pedagogy offering a data-driven exploration of how immersive technologies can shift instructional paradigms, enhance learner agency, and redefine what constitutes authentic oral communication in higher education settings.

2. MODELS OF VR ADOPTION IN ESP

The integration of VR into ESP speaking instruction can be fruitfully interpreted through three complementary models: TAM, UTAUT and Diffusion of Innovations

Theory. TAM (Davis, 1989) was originally formulated to explain why individuals decide to accept or reject a given technology. It posits that external factors (e.g., prior experience with digital tools, institutional support, task design) shape users' cognitive responses (perceived usefulness and perceived ease of use) which in turn influence their affective responses (behavioral intention) and, ultimately, their actual use behavior, as shown in Figure 1:

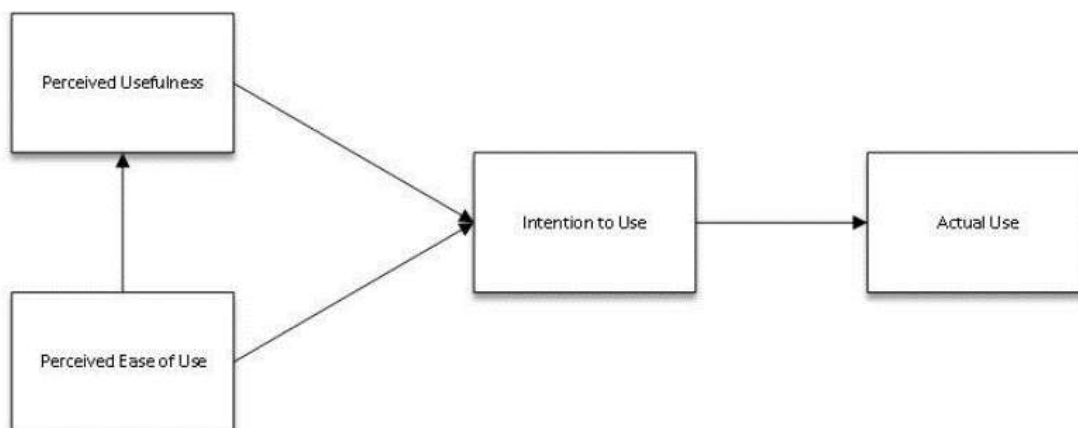


Figure 1. Technology Acceptance Model (Marikyan & Papagiannidis, 2025)

In the context of our VR intervention, commerce students are more likely to accept VR-based speaking tasks if they perceive that these activities genuinely help them improve their professional oral English (perceived usefulness) and if the VR tools are experienced as relatively straightforward and manageable (perceived ease of use). The design of our VR promotional video tasks explicitly sought to enhance both perceptions by aligning the activities with real-world commerce communication scenarios and by providing technical scaffolding throughout the process. In this sense, TAM addresses students' initial interaction with the technology at the individual level, particularly how they evaluate VR as a useful and usable tool for the successful completion of a speaking assignment. For example, students were more inclined to engage in the immersive tasks when they recognized that VR helped them improve their fluency, vocabulary range, and confidence in simulating real-world commercial communication. This initial cognitive appraisal is critical to understanding student motivation and engagement within technology-rich ESP contexts, where perceived task authenticity and relevance to future professional roles often determine sustained effort and willingness to adopt new tools.

UTAUT (Venkatesh et al., 2003) extends and consolidates earlier acceptance models such as TAM by introducing four core constructs: performance expectancy, effort expectancy, social influence and facilitating conditions, moderated by variables such as age, gender, experience and voluntariness of use. Performance expectancy, closely related to perceived usefulness and job-fit, reflects the extent to

which students believe that engaging with VR will lead to tangible gains in their ESP speaking performance and future employability. In our study, this was strengthened by framing the task of a realistic simulation of promotional work that students may encounter in professional commerce settings. Effort expectancy captures the perceived simplicity and usability of the VR tools. Figure 2 shows these constructs:

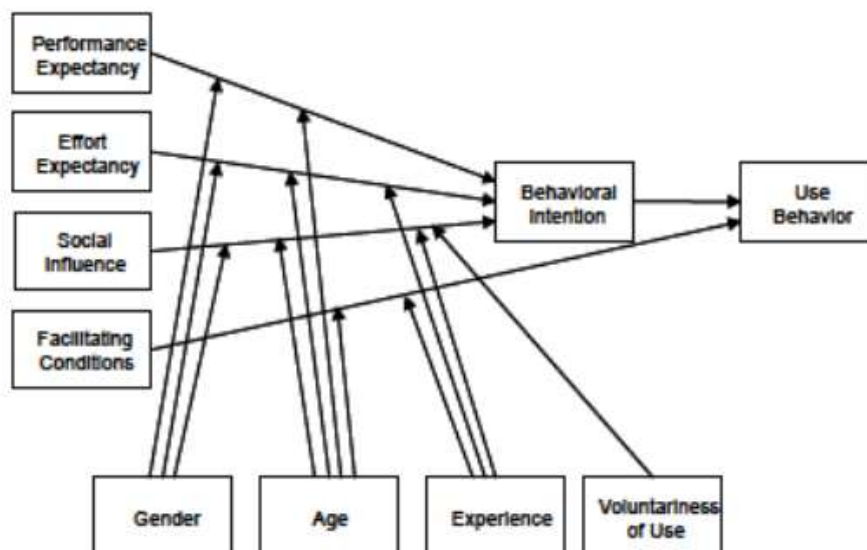


Figure 2. Unified Theory of Acceptance and Use of Technology (Venkatesh et al., 2003, p. 447)

This is addressed in our study by step-by-step instructions, demonstration sessions and opportunities for guided practice. Social influence highlights the role of peers and instructors. Moreover, the professor's explicit endorsement of VR and the collaborative nature of the video projects help construct VR use as a valued and legitimate practice within the learning community. Finally, facilitating conditions refer to the organizational and technical infrastructure supporting VR use (availability of devices, classroom time, technical assistance and assessment criteria that recognize VR tasks), all of which were deliberately put in place to encourage sustained engagement with immersive speaking activities.

The Diffusion of Innovations Theory (Rogers, 2003) situates these acceptance processes within a broader social and temporal dynamic. VR for ESP speaking is treated as an educational innovation that is communicated through specific channels (e.g., teacher training, peer exchange) and gradually adopted across the social system of the degree program and the institution. Key attributes of the innovation (relative advantage over traditional speaking tasks, compatibility with students' digital habits and professional goals, perceived complexity, trialability and observability) are directly relevant to our intervention. Relative advantage was demonstrated through VR's immersive and storytelling capabilities; compatibility was ensured by aligning the task with students' mobile-first digital habits and

interest in experiential learning; perceived complexity was addressed by providing detailed task instructions, technical demonstrations, and ongoing in-class support; trialability was facilitated by hands-on VR exploration in low-stakes settings; and observability was achieved by screening and discussing selected student videos in class. In complex organizations such as universities, the critical indicator is not merely initial adoption but the depth and quality of integration into regular teaching practice. Our design aims precisely at this sustained, embedded use rather than one-off experimentation.

The simultaneous use of TAM, UTAUT and Diffusion of Innovations Theory is justified by the layered nature of the intervention, which addresses individual perceptions and behaviors, social and instructional contexts, and broader institutional dynamics. Each model contributes a unique analytical lens: TAM explains students' personal engagement with the VR tools; UTAUT incorporates the role of peer interaction, institutional support, and usability factors; and Diffusion of Innovations Theory accounts for how the innovation spreads and stabilizes within the academic system. While TAM helps us understand why students initially accepted VR as a valuable tool, UTAUT reveals the importance of structured support and social legitimacy in sustaining usage, and Diffusion of Innovations Theory allows us to consider how immersive video creation might eventually become part of the regular ESP curriculum and professional career. This integrated framework not only underpins the intervention's theoretical coherence but also reinforces the argument that successful digital innovation in ESP requires alignment across individual, pedagogical, and institutional levels. The inclusion of all three models allows for a multidimensional analysis that connects learners' psychological orientations to broader systemic dynamics.

Taken together, TAM, UTAUT and Diffusion of Innovations Theory are underpinned by constructivist, experiential and connectivist perspectives on learning. Constructivism and experiential learning are reflected in the emphasis on learners' active construction of knowledge through meaningful, hands-on tasks (scripting, recording and refining VR-based promotional videos for commerce). Connectivism is evident in the focus on social influence, communication channels and digitally mediated networks through which practices, resources and feedback circulate. Within this theoretical pattern, our VR intervention does not merely introduce a new tool, but it reconfigures the learning environment into an immersive, networked space where commerce undergraduates co-construct ESP speaking competence through authentic, technology-rich experiences that may gradually become institutionalized as part of the program's regular repertoire. Finally, this theoretical alignment strengthens the study's explanatory power and clarifies the pathways through which immersive technologies can generate pedagogical transformation in ESP.

3. VR STUDIES IN ESP

Empirical studies in ESP further indicate that VR enhances the acquisition of specialized vocabulary and the comprehension of technical content (Klimova, 2021; Monteiro & Ribeiro, 2020), and that interactive simulations can substantially reduce learners' speaking anxiety (Wu et al., 2021), thereby fostering greater confidence and willingness to communicate. Platforms like IMMERSE exemplify the capacity of bridging the classroom and the target professional environment by offering synchronous, multiuser metaverse environments where learners can engage in realistic, scenario-based practice. This way, students can foster their linguistic competence while developing their soft skills and a sense of community of practice (Christoforou, 2022). Li et al.'s (2022) research has demonstrated that experiential learning-based VR approaches can significantly outperform traditional video-based methods in enhancing Geography vocabulary and fostering cognitive, social and behavioral engagement. Recent research in ESP has increasingly highlighted the pedagogical potential of VR. Studies with university students suggest a parallel, mutually reinforcing development between the use of digital technologies (e.g., mobile devices, apps, and immersive tools) and their level of English, provided that teachers possess adequate content, pedagogical and digital competencies (Granados Romero et al., 2020; Sangrà et al., 2023; Solís Muñoz et al., 2023). Some studies have shown that student engagement with multimodal and asynchronous tasks, such as video interviews or simulations, can enhance motivation and require strategic instructional design (Cheng, 2026; Tasić & Stamenković, 2024). Recent works (Tasić & Stamenković, 2024) have highlighted the relevance of students' perceptions of digital platforms in effective ESP instruction, particularly when transitioning from general to discipline-specific language learning. VR-based activities foster high levels of interest, active participation and intrinsic motivation, as well as more effective acquisition and retention of domain-specific lexis and content when compared with traditional textbook-based instruction (Chiao et al., 2018; Laba et al., 2020; Lin et al., 2021). From an ESP perspective, VR enables learners to describe virtual tours, practice professional interaction, and experience remote or otherwise inaccessible environments while using English in context. Both teachers and students tend to perceive VR as an intuitive and engaging resource that supports the teaching-learning process, although the literature also underlines the need for institutional investment and systematic teacher training to exploit its full potential (Chen et al., 2021; Pramasta & Wibowo, 2023).

Within the specific domain of English for business and commerce, VR demonstrates considerable practical applicability through immersive scenario-based learning. These applications include simulating business meetings, delivering product presentations to virtual clients, practicing persuasive negotiation and conflict resolution, handling international customer service dialogues with culturally diverse avatars, and interacting at commercial fairs to describe products and establish professional contacts. However, their pedagogical efficacy depends

not only on technical implementation but on sound instructional design grounded in clear communicative objectives, learner scaffolding, and contextual relevance. As Chen et al. (2011) corroborate, the perceived sense of immersion is significantly enhanced by well-designed environments and expressive characters, underscoring the necessity for high-quality instructional design in VR. Despite this potential, implementation faces notable challenges, including substantial technological infrastructure requirements, which can be prohibitive for resource-constrained institutions (Ayimkhan, 2024), and the need for comprehensive teacher training in both technology integration and pedagogical design. More importantly, these limitations highlight that the successful integration of VR depends on a combination of factors beyond hardware alone (including institutional readiness, staff expertise, and alignment with learning outcomes). Furthermore, VR is most effective as part of a broader technological ecosystem. Complementary approaches, such as the use of reverse subtitling of authentic commercial videos to improve written production skills, as evidenced by Ávila-Cabrera and Corral Esteban's (2021) project, highlight the value of a multifaceted strategy. Therefore, while VR offers a powerful tool for fostering autonomous learning, motivation, and professional communication competencies in business contexts, its successful adoption relies on rigorous pedagogical planning, adequate investment, and its integration within a comprehensive educational framework that combines active methodologies and authentic materials. In addition, there is a common concern about the lack of pedagogical foundation in many VR applications whose main purpose is entertainment rather than education (Christoforou, 2022; Li et al., 2022). Moreover, the cost of hardware, insufficient teaching training, and the limited availability of high-quality discipline-specific VR content, make its implementation a bit challenging and pose real barriers to scalability and long-term impact. Overall, VR emerges as a powerful tool in ESP for creating immersive, contextualized and professionally relevant learning experiences that enhance motivation, participation and language development. However, its impact is maximized only when embedded within a coherent pedagogical vision that prioritizes learning outcomes over technological novelty.

4. OBJECTIVES

The overall aim of the study is to investigate the pedagogical impact of VR-based video production in an ESP context and to explore how commerce undergraduates perceive VR as a learning tool. The specific objectives are:

- (1) To compare the ESP speaking performance of students who create videos using conventional 2D/social-media tools with that of students who use VR-based tools.
- (2) To describe students' perceptions and acceptance of VR.

(3) To explore the potential patterns between students' global perception of VR and their ESP speaking performance within the experimental group.

Accordingly, the study addresses the following research questions:

RQ1. Does VR-based video production lead to higher ESP speaking performance than video production using conventional 2D/social-media tools?

RQ2. How do commerce undergraduates perceive VR as a pedagogical tool in ESP?

RQ3. Within the experimental group, are there any observable trends between students' perceptions of VR and their ESP speaking performance?

The following hypotheses are formulated:

H1. Students in the experimental group who use VR-based tools will obtain significantly higher ESP speaking scores than students in the control group who use conventional 2D/social-media tools.

H2. Students will report generally positive perceptions of VR as a pedagogical tool, with mean scores on the VR perception subscales above the midpoint of the Likert scale.

H3. There may be a relationship between students' perceptions of VR and their ESP speaking performance within the experimental group, although no specific direction is hypothesized.

5. METHODOLOGY

The study adopted a quasi-experimental, mixed-methods design with nonequivalent groups.

5.1. Participants

The sample was selected incidentally and nonprobabilistically, based on accessibility to second-year students enrolled in English for Commercial Management in the bachelor's degree program in commerce at a public university in Spain. Out of 158 students initially enrolled in the course, 146 completed the video production task, constituting the final sample (41.79% male, 58.21% female) aged 18-25 (M= 20.52). The control group consisted of 74 students whereas the experimental group comprised 72 students. All participants were native Spanish speakers. Out of these 72 students of the experimental group, 69 completed a questionnaire on their VR perception.

Selection criteria included consent to participate, regular class attendance, completion of the speaking tasks, and completion of the questionnaire. Students were informed in advance about the purpose of the study and the voluntary nature of their participation, and they were assured that nonparticipation would not affect their course grade. The study complied with the ethical principles of the Declaration of Helsinki. Ethics committee approval was not deemed necessary, as the study was based on regular classroom practices, posed minimal risk to participants, relied on voluntary and anonymous involvement, and did not entail the collection of sensitive information.

Most students reported frequent use of mobile devices and social media platforms in their daily lives, but the majority had little or no prior experience with immersive virtual reality tools, particularly in educational or language-learning contexts.

5.2. Data collection and materials

Data collection was carried out over one academic semester (from February to June 2025) to examine whether the use of VR tools in a metaverse environment improves ESP oral performance and influences students' acceptance of this technology in a face-to-face higher education setting.

Two main instruments were used:

1. *ESP speaking performance video*: Oral ESP performance was assessed through a series of video-based tasks in which students prepared and recorded short product-pitch presentations and service descriptions in English, aligned with the course syllabus of English for Commercial Management. Both the control and experimental groups completed equivalent tasks, differing only in the technological tools used (conventional 2D applications versus VR/metaverse tools). These videos were evaluated using a task-specific analytic rubric, which included dimensions such as pronunciation, fluency, lexical range and accuracy (with emphasis on commerce-related vocabulary), grammatical accuracy, discourse organization, and pragmatic appropriateness in professional contexts. Each dimension was rated on a Likert-type scale (0–10), and a global score was also computed. To validate the rubric, content validity was established through review by a panel of three university professors with expertise in ESP and language assessment. These expert judges evaluated the relevance, clarity, and representativeness of each descriptor and suggested minor wording revisions when necessary. Inter-rater agreement among experts on each of the six rubric criteria relevance was examined using Cohen's Kappa coefficient, classifying each item as "agree" or "disagree", yielding an adequate value ($\kappa = .72$) with a p -value of .029, indicating that the level of agreement among raters was statistically significant and substantially higher than would be expected by chance. According to commonly used benchmarks, this value reflects

substantial inter-rater reliability, supporting the consistency of the rubric-based evaluation of the students' video speaking performances.

2. *VR perceptions questionnaire*: Students' perceptions and acceptance of VR in ESP were measured using Cicek's et al. (2021) survey questionnaire. The instrument included Likert-type items (1 = strongly disagree to 5 = strongly agree) grouped into subscales such as (i) sense of passage of time, (ii) sense of immersion, (iii) opinion on VR technology, (iv) interest in using VR inside and outside the classroom for educational purposes, (v) importance of interaction and socializing in the educational process, (vi) improvement and understanding of the teaching content, (vii) efficiency of VR in the learning process, (viii) information transfer and evaluation, and (ix) integration of VR in education. After piloting the questionnaire with a small group of students not included in the main sample, minor modifications were made for clarity. The reliability analysis showed that the scale presented acceptable internal consistency, with a Cronbach's alpha of .739. These indices support the reliability of the instrument for use in this study.

These two instruments were administered in class time, under similar conditions for all participants. The speaking tasks were recorded using the equipment and platforms available in the university's language lab and students' own devices, depending on the condition, while the questionnaires were completed online through the university's learning management system (Moodle).

5.3. Procedure

First, the necessary permissions were obtained from the corresponding academic authorities to conduct the research within the English for Commercial Management course. Once authorization was granted, the instructional sequence and assessment instruments were designed, and the allocation of groups to experimental conditions was organized based on existing class groups, resulting in a quasi-experimental design with a control group and an experimental group.

At the beginning of the semester (February), students were informed about the study. The objectives, procedures, and ethical considerations were explained, and written informed consent was obtained from those who agreed to participate. All students followed the same course syllabus, taught by the same instructor, with identical weekly schedule and classroom conditions (including ventilation and lighting).

The course extended over approximately fifteen weeks, and integrated ESP content related to commerce, including vocabulary for product and service descriptions, sales and marketing language, and communicative strategies for customer interaction, as well as relevant grammatical structures. Both groups completed comparable communicative tasks and assessment activities; the only systematic difference between conditions was the technological environment used to design and record the oral tasks. In the control group, students planned and

recorded their product-pitch videos using commonly available 2D tools and social media-type applications (e.g., standard video recording and basic editing tools). Instruction followed a communicative approach, with an emphasis on task-based interaction and feedback on speaking performance. However, in the experimental group, students carried out the same communicative tasks in an immersive VR environment, interacting within a metaverse-like platform that simulated professional commerce scenarios (e.g., virtual shops, trade fairs, or meeting rooms). They designed and recorded their product-pitch videos using avatars and 3D spaces. Instruction combined communicative language teaching with principles of experiential and game-based learning, emphasizing immersion, collaboration, and authentic situational practice.

Prior to the intervention, a diagnostic speaking pretest was administered during the first week of class to ensure that the control and experimental groups started from a comparable baseline, which was generally modest. Descriptive analyses showed that the control group obtained a mean score of 6.51 (SD = 3.01), while the experimental group achieved a mean score of 5.58 (SD = 4.36), indicating that both groups demonstrated relatively limited ESP speaking mastery at the outset. A Mann–Whitney U test was subsequently conducted to compare diagnostic pretest performance, revealing no statistically significant differences between the two groups ($p = .830$). These results confirm that the control and experimental groups began the study with a similar and relatively low level of speaking performance.

Throughout the intervention, technical support was provided as needed, especially for the experimental group, to ensure that difficulties in handling VR equipment did not unduly interfere with language learning. Data confidentiality and anonymity were preserved at all times; identifiers were replaced by codes in the dataset, and only aggregated results were reported. Immediately after the intervention, students also completed the VR perceptions questionnaire.

5.4. Data analysis

A descriptive analysis of the speaking performance from the video productions was conducted, which included the means and standard deviations of the speaking scores as well as an analysis of the questionnaire responses. Prior to inferential analyses, the normality of the continuous variables was examined using the Kolmogorov–Smirnov test. None of the variables met the assumption of normality ($p < .05$), so nonparametric tests were employed. To compare the speaking performance between the VR and control groups, the Mann–Whitney U test was used. Nonparametric effect sizes were calculated using the Common Language Effect Size (CLES) (McGraw & Wong, 1992) and rank-biserial correlation.

Regarding the questionnaire, descriptive statistics were computed for each subscale (sense of passage of time, sense of immersion, opinion on VR technology,

interest in using VR inside and outside the classroom for educational purposes, importance of interaction and socializing in the educational process, improvement and understanding of the teaching content, efficiency of VR in the learning process, information transfer and evaluation, and integration of VR in education). Internal consistency was assessed using Cronbach's alpha (.739) and Spearman's rho correlations were calculated to explore the relationships between technology acceptance variables and ESP speaking performance. Statistical analyses were performed using SPSS (IBM Corp., Version 24.0), and a significance level of $p < .05$ was adopted for all tests.

6. RESULTS

Frequencies and percentages were calculated to describe the distribution of participants across background variables. Specifically, the sample was characterized in terms of prior experience with virtual reality tools or similar digital environments (36.2% with previous experience, they had tried VR more than once; 31.9% had tried VR just once, and 31.9% had never tried it). Regarding the fact of having any kind of VR system in their cellphones or at home, 58% of students answered that they did not have any kind of VR device whereas the remaining 42% indicated they did.

In order to address Objective 2, Research Question 2 and Hypothesis 2, descriptive statistics were calculated for all 27 items of the VR perception questionnaire (see Table 1). For the 69 valid cases, item means on the 1–5 Likert scale ranged from 2.81 to 4.81. Overall, students responded to 48.14% of the questions (13 items) above the scale midpoint, 44.44% of the statements showed high levels of agreement (12 items reported means above 4.00) and 7.40% were under the midpoint (items 20 and 21). Standard deviations were generally moderate (approximately 0.44–1.06), suggesting some variability in students' perceptions but no extreme dispersion. These findings suggest a generally favorable orientation toward the integration of VR in ESP instruction, although some aspects of the implementation (particularly related to authenticity and information transfer) elicited more ambivalent responses.

SUBSCALES AND ITEMS	MEAN	STANDARD DEVIATION
i. Sense of passage of time. Item 1	4.27	0.82
ii. Sense of immersion	3.68	0.57
Item 2	3.78	0.68
Item 3	3.57	0.69
iii. Opinion about VR technology	3.74	0.53
Item 4	3.68	0.84
Item 5	4.28	0.72
Item 6	3.27	0.80
iv. Interest in VR in & outside the classroom	4.42	0.23
Item 8	4.46	0.63
Item 12	4.65	0.50

Item 13	4.81	0.46
Item 14	4.17	0.51
Item 16	4.02	0.64
v. Interaction in education	4.63	0.38
Item 9	4.53	0.50
Item 11	4.73	0.44
vi. Improvement & understanding of content	3.47	0.47
Item 7	3.53	0.69
Item 10	3.65	0.80
Item 15	3.24	1.06
vii. Efficiency in the learning process	3.94	0.38
Item 17	3.86	0.48
Item 18	4.02	0.45
viii. Information transmission & evaluation	3.18	0.33
Item 19	3.26	0.86
Item 20	2.81	0.97
Item 21	2.86	0.85
Item 22	3.49	0.71
Item 23	3.47	0.81
ix. Integration of VR in education	4.01	0.36
Item 24	4.05	0.68
Item 25	4.39	0.59
Item 26	3.65	1.21
Item 27	3.94	0.61

Table 1. Descriptive statistics of the questionnaire

As shown in Table 1, the highest mean score was obtained for subscale v. that assesses the importance of social interaction in the educational process (M = 4.63, SD = 0.38). Students strongly endorsed statements emphasizing the need for interaction with real people as a central component of their ESP learning, as well as the idea that “people learn better through interaction” and that shared experiences in a common environment are important. These results suggest that, even in technology-rich contexts, students continue to attribute a key role to human presence, dialogue, and collaboration in the construction of knowledge and ESP learning. They appear to perceive VR and other digital tools not as a substitute for interpersonal contact, but as resources that should complement and enrich socially grounded learning experiences.

Subscale iv. measuring interest in using VR inside and outside the classroom for educational purposes also obtained a high mean score (M = 4.42, SD = 0.23), indicating a generally positive disposition towards the integration of immersive technologies in university teaching. Students agreed that introducing VR into the ESP classroom can turn learning into a more entertaining and engaging process, that interactive VR content would increase their interest in courses, and that such tools could help them apply theoretical knowledge to practical situations, explore language in greater depth, and learn more actively. In addition, subscale i., related to the sense of passage of time also yielded a high mean (M = 4.27, SD = 0.82),

suggesting that students tend to experience time as passing more quickly when engaging with VR content than with traditional 2D displays. This perception of temporal distortion is consistent with a higher level of immersion and absorption in the learning activity and may reflect the potential of VR to foster focused attention and sustained engagement during academic tasks. This aligns with the sense of immersion subscale ii., which reaches a moderately high mean ($M = 3.68$, $SD = 0.57$). The items within this dimension (e.g., fascination with VR visual stimuli and the belief that multisensory stimulation supports better understanding) indicate that students recognize the immersive potential of VR at a perceptual level. However, the fact that immersion scores do not reach the very highest range suggests that, although students feel more absorbed than with conventional formats, they may still experience some distance from the virtual environment, possibly due to technical constraints, limited prior experience with VR, or a continued awareness of being in a classroom setting.

Results in the mid-to-high range (means between 3.00 and 3.99) provide a more nuanced picture of how students perceive VR in relation to learning. Subscale iii., measuring opinion about VR technology ($M = 3.74$, $SD = 0.53$) reflects a generally favorable but critical perspective: students value the added interaction and stimulation that VR provides (e.g., learning better through interaction), but some express reservations, such as feeling somewhat frightened by complete immersion (item 6, "Complete immersion in the virtual world frightens me", $M = 3.27$, $SD = 0.80$), which may temper their enthusiasm. Dimension vi. Improvement and understanding of content ($M = 3.47$, $SD = 0.47$) shows that students believe VR helps them to understand and retain their English for commerce better (items on faster time passage and continued exploration after the VR experience, with means around 3.50 and 3.65), although this support is perceived as moderate, possibly because VR was used to complement, rather than fully replace, other teaching strategies and resources. Similarly, subscale vii. Efficiency in the learning process reaches a relatively high mean ($M = 3.94$, $SD = 0.38$). Students agree that VR allows them to move beyond passive information consumption (item 17, "With VR, I'm not limited to passively consuming information and images displayed on the screen", $M = 3.86$, $SD = 0.48$), and they slightly exceed the "agree" threshold when considering that exploring different locations through VR could inspire and intrigue them (item 18, "Being able to see and experience the various locations around the world within the classroom provided by VR can inspire and intrigue students", $M = 4.02$, $SD = 0.45$), indicating that they see VR as a facilitator of more active, exploratory learning and can virtually experience future labor scenarios within a safe context.

By contrast, subscale viii. Information transmission and evaluation ($M = 3.18$, $SD = 0.33$) reveals more ambivalent attitudes. While students are moderately positive about some aspects such as the role of interaction among students with the teacher as a guide (item 22, "In the classrooms, there should be mostly interaction between students; the professor only serves as a "guide" to the conversation", $M = 3.49$, $SD = 0.71$) and the need for visual representations to understand abstract

concepts (item 23, “It’s difficult for me to understand abstract contents and concepts, (e.g., energy transfer, and similar) without a visual representation of the same”, $M = 3.47$, $SD = 0.81$), they are less convinced that VR-based environments transmit information and assess learning as effectively as traditional methods. The lowest means in the questionnaire are found in this area (subscale viii. Information transmission and evaluation). Students express relatively weak agreement that virtual environment models teach and train with the same efficiency as reality (item 19, $M = 3.26$, $SD = 0.86$), and they report limited feelings of presence in the virtual world (item 20, $M = 2.81$, $SD = 0.97$). Likewise, they tend to disagree that VR would distract them from the educational content (item 21, $M = 2.86$, $SD = 0.85$), which suggests that, although they do not perceive VR as detrimental, they are also cautious about attributing to it the same level of authenticity and evaluative accuracy as real-world experiences and conventional assessment systems. Overall, these lower and mid-range scores indicate that students welcome VR as a motivational and supportive tool but still draw a clear distinction between immersive simulations and real practice and evaluation, which may explain why their perceptions are more reserved in these specific dimensions.

To address Objective 1, Research question 1 and Hypothesis 1, we conducted an inferential analysis of the grades obtained in the video production in both groups. Students in the control group obtained a mean video grade of 4.39 ($SD = 3.96$), which is close to the fail threshold and shows a very high dispersion of scores, whereas the experimental group achieved a much higher mean of 8.47 ($SD = 1.53$), placing them in the good–excellent range with considerably more homogeneous performance. This marked difference between groups suggests that the VR-based instructional approach was more effective in supporting the development of ESP speaking performance than conventional methods. However, this outcome should be interpreted in light of the multicomponent nature of the intervention.

Finally, to examine the potential patterns between students’ perceptions of VR and their speaking performance (Objective 3, Research question 3 and Hypothesis 3), the 69 students in the experimental group who completed the questionnaire were divided into two categories. First, we joined lower and medium perception levels into one group and contrasted them with the higher perception levels. Students with lower and medium VR perception obtained slightly higher video speaking grades ($M = 4.80$, $SD = 3.97$, $n = 46$) than those with higher perception ($M = 3.85$, $SD = 3.94$, $n = 23$). However, a Mann–Whitney U test indicated that this difference was not statistically significant, $U = 458.00$, $p = .348$. Taken together with the nonsignificant Kruskal–Wallis results for the three perception levels, these findings do not indicate a meaningful relationship between attitudes and outcomes. Considering the nonsignificant differences and small effect sizes, the analysis is best interpreted as exploratory. In addition, a correlation analysis was conducted to examine the relationship between overall VR perception and ESP speaking performance within the experimental group. The correlation between the dichotomized VR perception variable and video speaking grades was small and

nonsignificant ($\rho = -.12, p = .347, n = 69$), indicating that speaking performance was not systematically related to students' global perception of VR. In contrast, speaking grades correlated positively and significantly with the instructional condition (control vs. experimental; $r = .56, p < .001$), reflecting the higher performance of students in the experimental VR group.

7. DISCUSSION

The present study set out to examine whether integrating VR-based video production into an undergraduate English for commerce course would enhance students' ESP speaking performance and how learners perceived VR as a pedagogical tool. Overall, the results indicate that the intervention was successful in improving oral production while also eliciting largely positive, though nuanced, attitudes towards VR. Students in the experimental group, who created promotional videos using VR tools outperformed the control group, whose videos were produced with conventional 2D and social-media applications. The performance gap observed between groups highlights the potential pedagogical value of VR-based instructional design, though caution is warranted in attributing this effect solely to the use of immersive technologies. It is more plausible that the observed gains reflect the synergy between immersive environments and other integrated instructional components, such as scaffolded rehearsal, collaborative scripting, and authentic task design. These results are consistent with previous work showing that VR-enhanced tasks can outperform traditional approaches in developing domain-specific vocabulary and understanding of technical content (Klimova, 2021; Li et al., 2022; Monteiro & Ribeiro, 2020). Students' background with immersive technologies helps contextualize these gains. Only one third of the participants had used VR more than once before the course, another third had tried it only once, so the strong performance of the experimental group cannot be attributed to a cohort of highly experienced VR users but to well-designed VR tasks with appropriate scaffolding and technical support. This aligns with research showing that experiential VR activities can quickly foster engagement and learning even among novices, provided that instructional design and teacher mediation are strong (Makransky & Petersen, 2021; Radianti et al., 2020). Thus, the instructional design (rather than the novelty of the tool *per se*) appears to be the central factor in supporting speaking development. Moreover, the magnitude of the performance difference between the experimental and control groups necessitates a cautious interpretation. Although the findings suggest that VR contributed positively to learning, the intervention incorporated multiple pedagogical features beyond the immersive tools themselves (including peer collaboration, multimodal input, repeated oral rehearsal, and task-based assessment) that may also have played a role. The study does not isolate the specific contribution of VR, and no claim of a direct causal effect can be made.

The perception questionnaire offers further insight into how students engaged with VR in this ESP context. Although learners generally reported high levels of interest and engagement with VR, the lack of a clear relationship between perception and performance suggests that positive attitudes alone do not necessarily translate into measurable skill gains. While we initially hypothesized that positive perceptions of VR might be associated with stronger performance, this relationship was not observed in our data. These analyses are best understood as exploratory in nature. Prior studies in educational technology have suggested that learner perceptions (e.g., motivation, perceived usefulness) can influence engagement and task success (Lee, 2014). However, in our context, affective responses to VR did not show a significant association with assessed speaking outcomes. This aligns with findings by Rubić and Dević (2026), who argue that while learner agency and motivation are central to ESP success, affective factors such as anxiety and digital readiness can modulate how effectively students engage with new instructional formats, including immersive technologies. This may reflect the complexity of separating attitudes from performance, especially when both are influenced by broader instructional and contextual variables. As shown in other VR studies (Radianti et al., 2020; Vergara et al., 2020; Wu et al., 2021), participants expressed a generally positive, though critical, disposition towards VR. The pattern of the questionnaire findings can be fruitfully interpreted through the lens of the TAM, the UTAUT, and the Diffusion of Innovations Theory. High scores on subscales related to interest, interaction and perceived learning benefits point to high perceived usefulness and performance expectancy, while the generally positive yet moderate ratings regarding fear of immersion and information transmission suggest that effort expectancy and facilitating conditions are acceptable but not entirely unproblematic. The lack of a strong link between attitudes and performance may reflect the early stages of diffusion in this context: as an innovation, VR is still transitioning from trial use by early adopters to broader institutional integration. According to the Diffusion of Innovations Theory (Rogers, 2003), adoption becomes more stable when potential users observe concrete advantages, compatibility with existing practices and manageable complexity. Our data indicate that students clearly perceive advantages in terms of motivation, engagement and speaking practice, but remain cautious about issues of realism, evaluation and infrastructure. This ambivalence echoes concerns in the literature about the cost of hardware, the need for teacher training and the limited availability of high-quality discipline-specific content (Ayimkhan, 2024; Christoforou, 2022). These findings serve as a reminder that successful implementation of VR in ESP settings require more than enthusiasm or access. It depends on careful alignment of technological tools with pedagogical goals, institutional support, and learner readiness.

Pedagogically, the results support a view of VR-enhanced ESP instruction grounded in constructivist, experiential and connectivist learning theories. The VR task required learners to collaboratively design, script and record promotional videos for specific products, drawing on both their disciplinary knowledge of commerce and

their linguistic resources in ESP. This process involved authentic problem-solving, negotiation of meaning, and the creation of shared digital artefacts, thereby operationalizing key principles of project-based learning and task-based learning (Chong & Reinders, 2020). The immersive environments and 360-degree visuals provided rich experiential input, situating language use in realistic commercial scenarios and enabling students to rehearse professional communication in a low risk, yet contextually faithful, setting. At the same time, the intervention demanded that students connect multiple digital tools (VR platforms, editing software, online resources), consistent with connectivist conceptions of learning as the ability to navigate and build networks of information and resources (Punie & Redecker, 2017).

Several limitations must be acknowledged. The study was conducted with a single cohort of commerce undergraduates in one public university, which restricts the generalization of the findings to other ESP domains, proficiency levels or institutional contexts. The intervention was relatively short, and no delayed posttest was administered, so long-term retention of speaking gains and vocabulary development could not be assessed. The perception data were self-reported and may be influenced by novelty effects or social desirability. Finally, the study did not systematically compare different VR platforms or task types, nor did it disentangle the specific contribution of VR from other active-learning components of the project (e.g., collaborative planning, repeated rehearsal, multimodal input) which limits strong causal claims regarding the effects of VR in isolation.

Despite these constraints, the study contributes to a growing body of empirical evidence that supports the pedagogical value of VR in ESP (Butarbutar, 2025; Klimova, 2021; Lin et al., 2021). It demonstrates that even a relatively short VR-based project can substantially enhance speaking performance in an English for commerce course, while fostering generally positive attitudes toward immersive technologies among students with varied prior experience. The findings also highlight that learners value VR most when it supports interaction, contextualized practice and active exploration, but remain cautious about relying on it for information transmission and assessment. For curriculum designers and teachers, this suggests that VR should be integrated as part of a broader, carefully planned instructional framework, with clear learning objectives, robust assessment tools and strong teacher mediation (Granados Romero et al., 2020; Sangrà et al., 2023). In this respect, the contribution of this study lies not only in demonstrating learning gains, but in offering a critical lens through which to evaluate when, how, and why VR can serve as an effective pedagogical tool in ESP contexts. Future research should employ longitudinal and mixed methods designs, include larger and more diverse samples, and explore in more depth how specific features of VR tasks such as degree of immersion, type of scenario, and feedback mechanisms interact with learner variables to shape both performance and perceptions in ESP contexts.

8. CONCLUSIONS

This study validates VR as a highly promising pedagogical tool within ESP for commerce, demonstrating a significant positive impact on learning outcomes. The empirical data reveal that the experimental group, which utilized VR for their speaking tasks, achieved markedly higher and more consistent performance compared to the control group. These findings provide compelling support for the inclusion of immersive tools in ESP instruction, particularly when embedded in a structured, task-based framework designed to simulate real-world communication. The positive reception of this technology among students is a key factor in its successful implementation. Despite nearly 60% of the sample having little to no prior experience with VR, participants showed a strong interest in its educational use and valued VR for fostering a more active, engaging, and exploratory learning process, with many experiencing a high sense of immersion and temporal distortion, indicative of deep engagement. Crucially, students perceived VR not as a replacement for human interaction but as a platform that enriches it, strongly endorsing the importance of social interaction within virtual environments, in line with other ESP and VR studies (Chen et al., 2011; Christoforou, 2022; Wu et al., 2021).

However, the findings also introduce critical nuances that temper unqualified enthusiasm. Student perceptions were not uniformly positive across all dimensions. Reservations were evident regarding the efficiency of VR for information transmission and evaluation, with students expressing limited feelings of presence and distinguishing between the simulated authenticity of VR and real-world practice. Furthermore, a particularly insightful result is the nonsignificant relationship between students' overall perception of VR and their actual speaking performance. This suggests that students' enjoyment or motivation, despite being valuable, may not be sufficient in itself to yield measurable language development without effective pedagogical mediation. Therefore, we can conclude that the successful integration of VR into ESP curricula centers on a strategic and critical approach. VR should not be treated as a technological fix but as a pedagogical asset that must be critically aligned with learning goals and assessment criteria. This framework must prioritize the design of high-fidelity, professionally relevant scenarios that maximize the sense of presence, address initial student reservations through guided immersion, and leverage VR's unique capacity to facilitate socially grounded, experiential learning. When implemented as a powerful component of a holistic educational strategy, complementing rather than replacing other methods, VR proves to be an invaluable asset for preparing students for the linguistic and pragmatic demands of the global commercial landscape.

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