VR Exhibition Simulation for Textile Professional English: Measuring Improvements in Oral Fluency, Accuracy, and Specialized Vocabulary Use through Immersive Technology

Yingying Yang, Yeming Gai
Department of Primary Education, Chongqing Preschool Education College, Wanzhou 404047, Chongqing, China
Corresponding author: Yingying Yang (e-mail: 18723562099@163.com)

ABSTRACT Effective communication of fabric properties and technical specifications is an essential competency in the global textile industry and increasingly supports intelligent digital manufacturing environments. This study evaluates the effectiveness of a Virtual Reality textile trade fair simulation (VRTF-Sim) for improving the professional oral English proficiency required to convey complex textile information. A pre-test/post-test controlled experiment involving sixty undergraduate Textile Engineering students was conducted. The experimental group ($n = 30$) interacted with a custom immersive VR platform featuring interactive 3D fabric models, AI-driven dialogue, and task-oriented communication scenarios, whereas the control group ($n = 30$) received conventional classroom instruction using equivalent technical content. Oral performance was assessed in terms of fluency, grammatical accuracy, and specialized textile vocabulary use. Although both groups demonstrated statistically significant improvement, the VR group achieved substantially greater gains across all evaluated metrics ($p < 0.001$), particularly in accurately applying terminology related to fabric composition, structural properties, and finishing technologies. The results demonstrate that immersive simulation provides an effective bridge between theoretical textile knowledge and authentic professional communication. Furthermore, the integration of virtual interaction, multimodal information presentation, and real-time human–computer communication offers methodological insights for intelligent digital exhibition systems, wearable visualization platforms, and wireless electromagnetic information environments supporting next-generation engineering education and industrial collaboration.

INDEX TERMS virtual reality, immersive communication, textile professional English, multimodal interaction, electromagnetic information systems

I. INTRODUCTION

IN the highly globalized landscape of the 21st century, the textile industry functions as a complex, transnational network encompassing design, production, and commerce [1]. Within this ecosystem, proficiency in English—the undisputed lingua franca of international business—has evolved from a desirable skill to an indispensable professional competency [2,3]. For graduates of textile engineering, design, and management programs, technical expertise alone is no longer sufficient. The ability to articulate complex technical specifications, negotiate terms with international suppliers, and persuasively present innovative products to global clients at major trade fairs such as Première Vision or Intertextile is paramount for career advancement [4]. Recognizing this, higher education institutions have incorporated English for Specific Purposes (ESP) courses into their curricula. Nevertheless, a persistent pedagogical challenge remains: traditional classroom environments often fail to adequately replicate the dynamic, high-stakes, and context-specific communicative pressures of the professional world [5]. This disconnect frequently results in a “knowing-doing gap,” wherein students possess theoretical linguistic knowledge but lack the confidence and practical ability to deploy it effectively in real-world scenarios [6].

Technology has consistently played a major role in language teaching. From the language laboratories of the mid-20th century to the advent of Computer-Assisted Language Learning (CALL) and, more recently, Mobile-Assisted Language Learning (MALL), technological innovations have continually provided new tools to enhance the learning experience [7,8]. The latest paradigm shift is driven by immersive technologies, particularly Virtual Reality (VR). VR distinguishes itself from previous technologies by its capacity to induce a state of "presence"—the psychological sensation of being physically located and interacting within a simulated environment [9,10]. This capability allows for the creation of highly realistic, contextually rich learning scenarios previously unattainable. In language learning, VR facilitates situated learning, a theory posited by Lave and Wenger, which asserts that learning is most effective when it occurs in the authentic context of its application [11]. By simulating professional environments, VR enables learners to practice language as a tool for accomplishing specific, goal-oriented tasks, thereby fostering deeper and more meaningful acquisition [12].

Although the application of VR in general language acquisition has received increasing academic attention, research into its efficacy within specialized ESP domains remains limited [10]. Existing studies have typically focused on general conversation skills or scenarios such as virtual tourism. The unique communicative demands of highly technical fields, such as textile engineering, present distinct challenges and opportunities for VR-based instruction [13,14]. This domain requires not only general communicative fluency but also the precise and appropriate use of a specialized lexicon (e.g., yarn count, color fastness, hydrophobic finishing) within authentic professional discourse structures [15]. A critical gap exists in the literature regarding the empirical, quantitative measurement of VR's impact on these specific facets of oral proficiency in a technical ESP context. While anecdotal evidence and qualitative reports suggest VR enhances motivation and engagement, a rigorous analysis of its effect on core linguistic skills such as fluency, accuracy, and lexical sophistication is needed to validate its pedagogical value [10].

This paper aims to address this research gap by presenting an experimental study that investigates the effectiveness of a custom VR trade fair simulation (VRTF-Sim) designed for undergraduate textile engineering students. The core objective is to move beyond qualitative claims and provide robust quantitative data on the influence of this immersive intervention on foundational components of oral proficiency, namely fluency, grammatical accuracy, and the appropriate use of specialized vocabulary. By systematically comparing the performance gains of students using the VR simulation against a control group receiving high-quality traditional instruction, this study seeks to answer the following research questions: (1) To what extent does a VR-based trade fair simulation impact the oral fluency (measured by speech rate and pause frequency) of Textile English learners compared to traditional role-play instruction? (2) How does the VR simulation affect the grammatical accuracy (measured by the rate of error-free clauses) of learners' speech in a professional context? (3) What is the effect of the immersive, interactive VR environment on learners' ability to correctly and appropriately use specialized textile vocabulary? The central hypothesis is that the situated, multimodal, and interactive practice afforded by the VR environment will lead to significantly greater and more holistic improvements in oral communication skills than conventional, less contextualized methods employed in traditional classrooms.

II. METHODOLOGY

A. PARTICIPANTS

The study cohort comprised 60 third-year undergraduate students (31 male, 29 female; mean age = 21.4 years, SD = 0.8) pursuing a Bachelor of Engineering in Textile Engineering at a major polytechnic university. The selection criteria required all participants to have successfully passed the College English Test Band 4 (CET-4), ensuring a baseline of intermediate English proficiency (B1 level on the Common European Framework of Reference for Languages). The participants were enrolled in a mandatory 16-week "English for the Textile Industry" course. None of the participants reported prior experience with VR technology, thereby minimizing the potential confounding variable of pre-existing VR literacy. The 60 students were randomly assigned to one of two groups using a random number generator: an experimental group (n = 30), hereafter referred to as the VR group, and a control group (n = 30), referred to as the Traditional group. An independent-samples t-test conducted on the participants' CET-4 scores confirmed no statistically significant difference in their general English proficiency prior to the experiment ($t(58) = 0.54$, $p = 0.59$), ensuring the homogeneity of the two groups at the outset. All participants provided written informed consent, and the research proposal was approved by the Ethics Committee of Chongqing Preschool Education College.

B. RESEARCH DESIGN

A pre-test/post-test randomized control group design was employed to assess the causal impact of the VR intervention. While the random assignment of individual participants qualifies this as an experimental design, the study was conducted within the practical constraints of a single university course, which made certain measures, such as blinding participants to their assigned condition, infeasible. This design allowed for a direct comparison of learning outcomes between the group exposed to the VR simulation and the group receiving traditional instruction, while controlling for initial proficiency levels through the pre-test. The independent variable was the instructional method (VR simulation vs. traditional role-play). The dependent variables were measurable components of oral proficiency: fluency, accuracy, and specialized vocabulary use.

C. INSTRUMENTS AND MATERIALS

(1) A custom, high-fidelity VR application was developed for this study using a widely adopted game engine (Unity 3D, version 2021.3.15f1) and deployed on commercially available standalone headsets (Meta Quest 2). The headsets operated at a resolution of $1,832 \times 1,920$ pixels per eye with

a 90 Hz refresh rate, and the application was optimized to maintain a consistent 90 frames per second (fps) to minimize motion sickness. The system utilized standard motion controllers for hand interactions, with a teleportation mechanic for user movement within the virtual environment. The VRTF-Sim was designed in collaboration with faculty from the Textile Engineering department and a VR development studio to ensure both pedagogical soundness and professional authenticity. The virtual environment meticulously replicated a modern, well-lit booth at an international textile exhibition.

Environment and Interactivity: The booth featured realistic corporate branding, product displays, and lighting. Students could freely teleport within the booth space. The core interactive elements were high-resolution 3D models of 15 different types of fabrics, ranging from common textiles such as cotton twill and silk charmeuse to advanced technical fabrics like Gore-Tex and Cordura. Students could use their virtual hands to pick up fabric swatches, stretch them, and inspect texture and weave.

AI-Powered Non-Player Character (NPC): To simulate realistic interaction, the simulation featured a conversational AI-driven NPC, "Mr. Anderson," designed to act as a potential buyer from a European apparel brand. The dialogue system was powered by a generative Large Language Model (LLM) with 13 billion parameters. The base model was fine-tuned on a custom dataset comprising over 2,000 dialogue exchanges specific to textile specifications and trade negotiations, ensuring high relevance and dialogue diversity. During the simulation, the model was guided by a system prompt that defined the NPC's persona (e.g., an experienced buyer from a high-end fashion brand), its conversational goals (e.g., to inquire about fabric composition, minimum order quantity, and finishing treatments), and its knowledge constraints. This setup enabled the NPC to engage in unscripted, contextually aware conversations, allowing it to ask relevant follow-up questions based on the student's responses rather than following a rigid dialogue tree. The NPC was programmed to initiate dialogue and ask a series of relevant technical and commercial questions (e.g., "What is the primary application for this material?", "Can you elaborate on its moisture-wicking properties?", "What is your minimum order quantity?").

Scenario-Based Task Structure: The learning experience was structured around a sequence of five professional tasks: (1) Greeting the client and establishing rapport; (2) Introducing the company's featured textile collection; (3) Presenting a specific technical fabric, explaining its composition, properties, and benefits; (4) Presenting a fashion fabric, focusing on its aesthetic qualities, handfeel, and drape; (5) Answering client questions and closing the conversation. The simulation provided subtle visual cues and prompts to guide the student if needed.

(2) Traditional Classroom Materials: The control group's instruction was designed to mirror the content and objectives of the VR simulation as closely as possible. Materials included a comprehensive PowerPoint presentation with high-resolution images and videos of the same 15 fabrics. Detailed datasheets for each fabric were provided. The core activity was based on structured role-play scripts and scenarios that paralleled the tasks in the VRTF-Sim. This traditional instructional design was intentionally based on established principles of Communicative Language Teaching (CLT) and Task-Based Language Teaching (TBLT), representing a robust and widely practiced pedagogical model. The use of structured role-plays with specific communicative goals is a hallmark of TBLT, designed to encourage active language use and meaningful peer-to-peer interaction. Furthermore, the inclusion of instructor and peer feedback following the performances is a standard and effective method for reinforcing learning and addressing errors in a conventional classroom setting, ensuring the control condition was both high-quality and pedagogically sound.

(3) Oral Proficiency Test (Pre-test and Post-test): A standardized oral performance test was designed and administered individually to all participants before and after the intervention period. The test required each student to engage in a seven-minute, one-on-one simulated dialogue with a trained research assistant who played the role of a buyer. The scenario and technical content were identical to those in the intervention but used different, though comparable, fabric examples to avoid simple recall. All test sessions were conducted in a soundproof room and audio-recorded using high-fidelity microphones for later analysis.

D. PROCEDURE

The experiment was conducted over an eight-week period, integrated into the students' regular course schedule.

(1) Week 1 (Pre-test): All 60 participants individually completed the oral proficiency pre-test. The sessions were recorded.

(2) Weeks 2–7 (Intervention): For six consecutive weeks, both groups attended a 90-minute session dedicated to this study.

VR Group: Sessions were held in the university's VR laboratory. After a brief orientation in the first session, students individually donned a headset and engaged with the VRTF-Sim for approximately 45–50 minutes, working through the communicative tasks at their own pace. The remaining time was used for debriefing and answering questions. All in-simulation audio from the students was recorded by the application.

Traditional Group: Sessions were held in a standard multimedia classroom. The instructor presented the target fabrics and vocabulary using PowerPoint slides (20 minutes). Students were paired and given role-play cards with assigned roles (buyer or exhibitor) and objectives. They practiced these dialogues for approximately 30 minutes, after which some pairs performed for the class, receiving feedback from the instructor and peers.

(3) Week 8 (Post-test): All 60 participants individually completed the oral proficiency post-test, which was struc-

turally identical to the pre-test. These sessions were also recorded.

E. DATA ANALYSIS

The audio recordings from the pre-tests and post-tests were transcribed verbatim by two trained research assistants. Quantitative analysis was performed by two independent raters based on the following operationalized metrics. To prevent expectation bias, the rating process was conducted under double-blind conditions. The audio files were coded with random identifiers, and the raters were unaware of both the participant's group assignment (VR vs. Traditional) and whether the recording was from the pre-test or post-test.

(1) Fluency: Assessed using two measures:

Speech Rate: The total number of intelligible words produced divided by the total speaking time in seconds, multiplied by 60 to yield words per minute (WPM).

Unfilled Pauses: The frequency of silent hesitations longer than 250 milliseconds per minute of speech. Pauses were identified and measured using Praat, a phonetic analysis software.

(2) Accuracy: This was measured by calculating the number of error-free clauses produced per minute. A clause was defined as a unit of speech containing a unified predicate. An error was coded if it involved a grammatical (e.g., subject-verb agreement, tense), lexical (e.g., wrong word choice), or phonological deviation that could potentially impede listener comprehension.

(3) Lexical Sophistication: Operationalized as the frequency and appropriateness of use of a pre-compiled list of 50 key technical textile terms. This list was derived from industry-standard glossaries and the course textbook (e.g., abrasion resistance, hydrophilic, sublimation printing, warp-knitted, grams per square meter (GSM). The raters counted the number of distinct target terms used correctly within the communicative context. This metric was selected to assess the students' ability to actively use the foundational, professionally mandated vocabulary that constituted the explicit learning objective for both groups.

To ensure reliability, the two raters independently scored a random subsample comprising 20% of the data. Given that the primary oral proficiency metrics were continuous variables (speech rate, pause frequency, vocabulary count), inter-rater reliability was assessed using the Intraclass Correlation Coefficient (ICC) with a two-way mixed-effects model for absolute agreement. The analysis indicated a high degree of reliability between the raters (ICC = 0.91). All statistical analyses were performed using SPSS version 26.0. Independent-samples t-tests were used to compare pre-test and post-test scores between the VR and Traditional groups, while paired-samples t-tests were used to analyze the significance of gains from pre-test to post-test within each group. The alpha level for statistical significance was set at $p < 0.05$.

III. RESULTS

The analysis of collected data aimed to evaluate the differential impact of the VRTF-Sim intervention compared to traditional instruction. Results are presented based on the pre-test baseline and post-test performance gains for both groups.

A. PRE-TEST BASELINE EQUIVALENCE

To ensure a valid comparison, the pre-test scores of the VR group and the Traditional group were first analyzed using an independent-samples t-test. As detailed in Table 1, the analysis revealed no statistically significant differences between the two groups on any of the measured oral proficiency metrics at the beginning of the study. This confirms that random assignment resulted in two groups of comparable initial ability in Textile English communication.

B. POST-TEST PERFORMANCE COMPARISON

After the six-week intervention period, an independent-samples t-test was conducted on the post-test scores. The results, summarized in Table 2, show a marked and statistically significant difference between the two groups across all metrics, with the VR group consistently outperforming the Traditional group.

The VR group achieved a significantly higher mean speech rate and a lower frequency of unfilled pauses, indicating greater fluency. They also produced a significantly higher number of error-free clauses per minute, demonstrating superior grammatical accuracy.

A particularly large difference was observed in the use of specialized vocabulary, with the VR group's score nearly double that of the Traditional group.

C. ANALYSIS OF PROFICIENCY GAINS

To analyze learning progression within each group, paired-samples t-tests were performed, comparing each participant's pre-test and post-test scores. Both groups demonstrated statistically significant improvements from their baseline scores, indicating that both instructional methods were effective to some degree. However, the magnitude of these gains, as visualized in Figure 1, was substantially different.

For the VR group, the mean speech rate increased by 30.3 WPM ($t(29) = -10.51$, $p < 0.001$), while the Traditional group's rate increased by only 8.9 WPM ($t(29) = -3.45$, $p = 0.002$). In terms of accuracy, the VR group's average error-free clauses per minute surged from 2.1 to 5.3, a gain of 3.2 ($t(29) = -13.67$, $p < 0.001$). The Traditional group's accuracy improved by a smaller margin of 0.9, from 2.2 to 3.1 ($t(29) = -4.88$, $p < 0.001$). The disparity was especially pronounced in lexical sophistication. The VR group's correct use of specialized terms increased by an average of 8.3 terms ($t(29) = -12.98$, $p < 0.001$). In contrast, the Traditional group's usage increased by only 2.5 terms ($t(29) = -5.62$, $p < 0.001$). This indicates that, while both methods helped students learn the vocabulary, the VR simulation was profoundly more

TABLE 1. Comparison of Pre-Test Scores Between VR and Traditional Groups

Variable	Group	N	Mean	Std. Deviation	t value	p value
Speech Rate (WPM)	VR	30	85.4	12.1	-0.28	0.78
	Traditional	30	86.2	11.5		
Unfilled Pauses (/min)	VR	30	10.8	3.1	0.45	0.65
	Traditional	30	10.4	2.9		
Error-Free Clauses (/min)	VR	30	2.1	0.8	-0.19	0.85
	Traditional	30	2.2	0.9		
Specialized Vocabulary Use	VR	30	4.5	2.3	0.61	0.54
	Traditional	30	4.2	2.1		

Note: WPM = Words Per Minute. VR = Virtual Reality. Specialized Vocabulary Use refers to the count of correctly used target terms.

TABLE 2. Comparison of Post-Test Scores Between VR and Traditional Groups

Variable	Group	N	Mean	Std. Deviation	t value	p value
Speech Rate (WPM)	VR	30	115.7	14.3	6.89	< 0.001
	Traditional	30	95.1	13.0		
Unfilled Pauses (/min)	VR	30	5.2	1.8	-5.73	< 0.001
	Traditional	30	8.1	2.5		
Error-Free Clauses (/min)	VR	30	5.3	1.2	8.21	< 0.001
	Traditional	30	3.1	1.0		
Specialized Vocabulary Use	VR	30	12.8	3.5	9.55	< 0.001
	Traditional	30	6.7	2.8		

Note: WPM = Words Per Minute. VR = Virtual Reality.

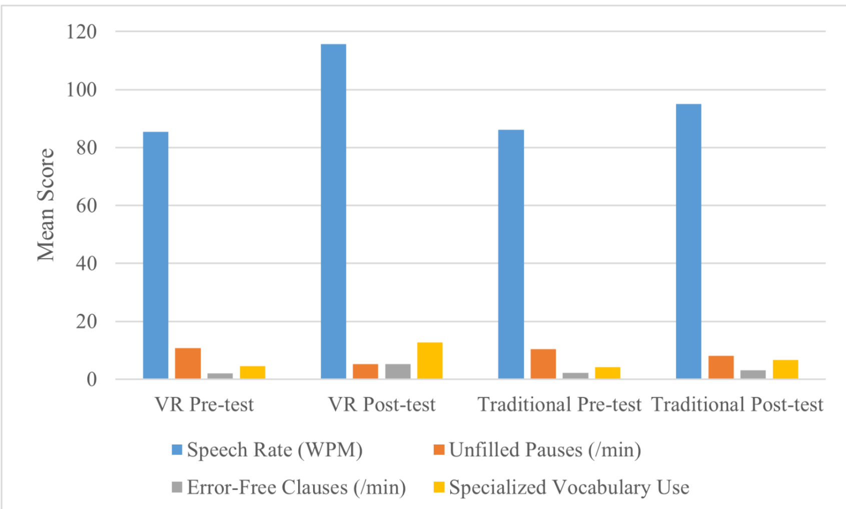

FIGURE 1. Comparison of Mean Scores for Oral Proficiency Metrics from Pre-test to Post-test for the VR and Traditional Groups. Error bars represent the standard error of the mean

effective at enabling students to actively recall and correctly apply these terms in a communicative context.

IV. DISCUSSION

The results of this empirical study provide compelling evidence that integrating a custom VR trade fair simulation into a Textile English curriculum yields significantly greater improvements in students' oral proficiency compared to traditional, non-immersive pedagogical methods. The superior performance of the VR group across the metrics of fluency, accuracy, and especially lexical sophistication warrants a deeper discussion of the underlying cognitive and affective mechanisms involved.

Beyond affective benefits, the situated nature of the VR environment likely had a direct cognitive impact on fluency. In traditional role-play, learners must simultaneously retrieve linguistic items, construct sentences, and mentally simulate the professional context, imposing a high cognitive load that often manifests as hesitations and pauses. The VR simulation, by providing an immersive and persistent context, reduces the demand for mental simulation. With the environment and communicative purpose immediately apparent, learners can allocate more cognitive resources directly to language production. This reduction in extraneous cognitive load offers a persuasive explanation for the lower frequency of unfilled pauses and faster overall speech rate observed in the VR group.

The observed enhancements in fluency and accuracy within the VR group align with theories related to the "affective filter hypothesis." The traditional classroom, with its inherent social pressures and potential for peer judgment, can heighten learners' anxiety, creating an affective filter that impedes language output. In contrast, the VR environment may create a psychologically safer space. It is hypothesized that interacting privately with an AI character, rather than performing in front of peers, reduces the fear of making mistakes, thereby lowering the affective filter. This reduced communication apprehension likely empowered students to experiment more with the language, speak more freely, and focus on the communicative task rather than self-monitoring for errors. This increased volume of practice, in a less inhibited state, naturally fosters greater automaticity in speech production, resulting in faster speech rates, fewer hesitations, and more confident delivery of grammatically accurate sentences.

The most profound finding of this research is the dramatic superiority of the VR simulation in fostering the use of specialized vocabulary. This can be best explained through the lens of Embodied Cognition and Situated Learning theories. In the traditional classroom, technical terms were presented as abstract concepts, linked to 2D images and textual definitions. While students could memorize these terms, the cognitive load required to recall and integrate them into spontaneous dialogue was high. The VRTF-Sim, however, created a multimodal, embodied learning experience. Students did not merely read the term "tensile strength"; they picked up a virtual fabric, stretched it, and used the term to describe that physical action and its result to the AI client. This direct, sensory-motor link between the word, the virtual object, and the communicative action creates a richer, more deeply encoded memory trace. Language becomes a tool for interacting with and making sense of the environment. This "learning by doing" in a context that mirrors the target professional environment is the key differentiator that transforms passive vocabulary knowledge into active, deployable communicative skill.

Furthermore, the interactive nature of the AI-powered NPC likely played a crucial role. Unlike a static role-play script, the AI's questions required students to react and formulate responses in real time, compelling them to access and utilize their technical lexicon on demand. This repeated, retrieval-based practice is known to be highly effective for long-term memory consolidation. The simulation effectively provided each student with a personal, non-judgmental conversation partner available for intensive, one-on-one practice—a pedagogical scenario that is logistically impossible to replicate in a standard classroom setting.

The pedagogical implications of these findings are significant. They suggest that, for ESP instruction in technical fields, a paradigm shift from purely text-and-image-based methods to experiential, simulation-based learning is warranted. The development of VR simulations, while requiring an initial investment, offers a scalable and highly effective solution for bridging the persistent gap between academic knowledge and professional practice. Such tools can provide students with consistent, standardized, and repeatable training experiences that prepare them not only for exams but for the actual communicative demands of their future careers. This study advocates for a blended learning approach, where VR simulations serve as a core component for practical skill development, complemented by instructor-led sessions focusing on nuanced aspects of communication, such as intercultural pragmatics and advanced negotiation strategies. However, practical implementation and scalability of such a bespoke solution warrant careful consideration. Developing a custom application like the VRTF-Sim requires significant upfront investment—not only financially, but also in time and interdisciplinary expertise, demanding collaboration among faculty, instructional designers, and software developers. For many institutions, these resource requirements may present a substantial barrier to adoption. As VR hardware becomes more affordable and development platforms more accessible, these barriers may diminish. Nevertheless, future research should explore scalable models, such as modular or adaptable VR platforms customizable for different specific purposes, thereby distributing development costs and effort across multiple institutions.

Despite its contributions, the study has limitations. The sample size of 60, while sufficient for statistical analysis, was drawn from a single university, which may limit generalizability. The intervention lasted six weeks; a longitudinal study would better assess long-term retention of acquired skills. Additionally, the results must be interpreted with consideration for the "novelty effect." It is plausible that heightened motivation and engagement in the VR group were partly attributable to the excitement of using new technology, independent of the simulation's intrinsic pedagogical value. The current study's eight-week design cannot fully disentangle these motivational factors from the cognitive benefits of the immersive intervention. Thus, longitudinal research is needed to determine whether the significant performance gains observed are sustained over time, once the initial novelty of the technology diminishes. Future studies should incorporate follow-up assessments or integrate the VR tool over a longer period, such as a full academic year, to provide a more definitive measure of its lasting impact. Furthermore, while the discussion suggests that a reduced affective filter may have contributed to the VR group's success, student anxiety levels were not directly measured. Future research could incorporate psychological metrics to empirically test the hypothesis that immersive environments reduce communication apprehension. Finally, the AI NPC, while functional, has limitations in conversational range compared to a human interlocutor. Future iterations could integrate more advanced, generative AI models to provide an even more dynamic and challenging interactive experience. Moreover, the assessment of lexical sophistication was limited to a pre-compiled list of target terms taught to both groups. While this directly measured acquisition of core professional vocabulary, a key objective of the course, it did not capture the extent to which learners could transfer their knowledge to related but non-instructed terms (i.e., evidence of near or far transfer). Future research should incorporate analysis of such vocabulary migration to investigate whether immersive learning environments promote more flexible and generalizable lexical competence.

V. CONCLUSION

This study quantitatively measured the effectiveness of a VR trade fair simulation in enhancing the oral proficiency of Textile English learners. The results unequivocally demonstrate the superiority of the immersive VR intervention over traditional classroom role-playing. While both methods led to significant improvements in oral proficiency, participants in the VR group achieved substantially greater gains in all measured aspects. They spoke more fluently, with greater grammatical accuracy, and, most importantly, demonstrated superior ability to apply specialized technical vocabulary in a professionally relevant context. The findings strongly suggest that the unique affordances of VR—specifically its ability to induce a sense of presence, provide a safe and private practice space, and facilitate embodied, situated learning—are powerful catalysts for language acquisition in ESP settings. By allowing students to actively inhabit and interact within a simulation of their future professional environment, VR technology effectively bridges the gap between theoretical knowledge and practical application. It transforms language learning from a passive, academic exercise into an active, goal-oriented, and professionally meaningful endeavor. As immersive technologies become increasingly accessible, their strategic integration into language curricula for specialized domains holds the key to better preparing the next generation of professionals for the communicative challenges of the globalized industrial landscape.

AUTHOR CONTRIBUTIONS

Conceptualization – Yingying Yang and Yeming Gai; methodology – Yingying Yang and Yeming Gai; formal analysis – Yingying Yang and Yeming Gai; investigation – Yingying Yang; resources – Yingying Yang and Yeming Gai; writing – Yingying Yang and Yeming Gai. All authors have read and agreed to the published version of the manuscript.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

FUNDING

This research was funded by Youth Project Of Science And Technology Research Of Chongqing Municipal Education Commission: "The Application Of Intelligent Technology In Mixed Teaching Of Higher Vocational English Under Digital Vision" (Project No.: Kjqn202202903).

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This survey was conducted in compliance with Ethics Committee of Chongqing Preschool Education College. All participants provided written informed consent and responses were collected anonymously. No personally identifiable information was stored.

ACKNOWLEDGEMENTS

Not applicable.

REFERENCES

[1] G. Gereffi, S. Frederick, and G. Gereffi, "The global apparel value chain, trade and the crisis: challenges and opportunities for developing countries," Washington, DC, USA: The World Bank; 2010.

[2] T. Neeley, "Global business speaks English," Harvard Business Review, vol. 90, no. 5, pp. 116-124, 2012.

[3] T. Neeley, "The language of global success: How a common tongue transforms multinational organizations," Princeton, NJ, Princeton: Princeton University Press; 2017, [Online]. Available: https://www.hbs.edu/faculty/Pages/item.aspx?num=52266.

[4] T. Chi, H. Liu, C. Salusso, V. McCracken, and editors, "Understanding the essential employability knowledge and skills needed for textile and apparel college graduates: A triangular design approach," International Textile and Apparel Association Annual Conference Proceedings; 2018; Pullman, WA, USA: Iowa State University Digital Press, 2018, [Online]. Available: https://www.iastatedigitalpress.com/itaa/article/id/1203/download/pdf/.

[5] S. Zemelman, H. Daniels, and A. Hyde, "Best practice: Bringing standards to life in America's classrooms," (No Title), 2012, [Online]. Available: https://lccn.loc.gov/2011047860.

[6] J. Pfeffer and R. I. Sutton, "The knowing-doing gap: How smart companies turn knowledge into action," Cambridge, MA: Harvard Business Press; 1999, doi: 10.1108/scm.2001.6.3.142.1.

[7] P. Hubbard, "Computer assisted language learning: Critical concepts in linguistics," London, UK: Routledge; 2009, [Online]. Available: https://web.stanford.edu/~efs/callcc/.

[8] G. Stockwell, "Mobile-assisted language learning," Contemporary computer-assisted language learning. London, UK: Bloomsbury Publishing; 2013. p. 201-216, [Online]. Available: https://www.torrossa.com/en/resources/an/5203393#page=226.

[9] M. Slater, "Place illusion and plausibility can lead to realistic behaviour in immersive virtual environments," Philosophical Transactions of the Royal Society B: Biological Sciences, vol. 364, no. 1535, pp. 3549-3557, 2009, doi: 10.1098/rstb.2009.0138.

[10] A. Parmaxi, "Virtual reality in language learning: A systematic review and implications for research and practice," Interactive Learning Environments, vol. 31, no. 1, pp. 172-184, 2023, doi: 10.1080/10494820.2020.1765392.

[11] B. Dalgarno and M. J. Lee, "What are the learning affordances of 3-D virtual environments? British Journal of Educational Technology," 2010; 41(1):10-32, doi: 10.1111/j.1467-8535.2009.01038.x.

[12] L. Ortega, M. González-Lloret, and T. B. L. T. Technology-mediated, "Amsterdam, The Netherlands: John Benjamins Publishing Company; 2014,", [Online]. Available: https://www.torrossa.com/en/resources/an/5016729.

[13] J. Bailenson, "Experience on demand: What virtual reality is, how it works, and what it can do," New York, NY, USA: WW Norton & Company; 2018.

[14] Z. Merchant, E. T. Goetz, L. Cifuentes, W. Keeney-Kennicutt, and T. J. Davis, "Effectiveness of virtual reality-based instruction on students' learning outcomes in K-12 and higher education: A meta-analysis," Computers & Education, vol. 70, pp. 29-40, 2014, doi: 10.1016/j.compedu.2013.07.033.

[15] H. Tom and W. Alan, “English for specific purposes: A learning-centred approach,” Cambridge, CA, USA: Cambridge University Press; 1987, [Online]. Available: https://www.cambridge.org/core/journals/studiesin-second-language-acquisition/article/abs/english-for-specific-purposes-a-learningcentred-approachhutchinsontom-and-watersalan-cambridge-cambridge-university-press-1987-pp-viii-183/94F1EF6932AB5BB00A73E13C73478C65.