

## Virtual Reality as Exposure Therapy: A Study on Reducing Communication Apprehension in Malaysian ESL Learners

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### ABSTRACT

This research examines the efficacy of a Virtual Reality Intervention Module (VRIM) in alleviating communication apprehension (CA) and speaking anxiety (SA), while simultaneously improving oral communication proficiency among Malaysian pre-university ESL students. It tackles a longstanding issue in language teaching where emotional obstacles impede speaking proficiency, despite years of educational reform. A quasi-experimental design was conducted using 60 participants from six secondary schools in Kelantan, Malaysia, categorised into experimental and control groups. Data were gathered via the PRCA-24, FLCAS, and MUET speaking evaluations. Statistical methods, including paired-sample t-tests, ANCOVA, and multiple regression, were utilised to assess changes in CA, SA, and speaking performance, as well as to investigate the impact of perceived interaction and realism on learner engagement with VR. The findings demonstrated a substantial decrease in CA and SA among participants subjected to the VRIM ( $p < .001$ , Cohen's  $d = 0.65$ ), coupled with a notable enhancement in speaking performance. Regression analysis indicated that perceived involvement and realism were significant predictors of engagement, underscoring how immersive authenticity can enhance emotional regulation and communicative preparedness. This study represents the inaugural extensive quantitative examination of a VR-based intervention designed to alleviate emotional barriers in Malaysian pre-university ESL settings. It amalgamates pedagogical and psychological viewpoints to illustrate how VR-based exposure can cultivate learners' confidence, diminish anxiety, and improve communication ability. The findings highlight VR's potential as a scalable educational innovation for second language acquisition, providing

transferable insights into how immersive settings help mitigate emotional obstacles in oral skill development.

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**Contribution/Originality:** This study reconceptualises Virtual Reality Immersive Modules as a form of exposure-based pedagogy addressing communication apprehension among Malaysian pre-university ESL learners. Using qualitative thematic analysis, it reveals how immersive environments foster psychological safety, authenticity, and confidence, positioning VR as a viable, context-sensitive intervention that mitigates affective barriers in language learning.

## 1. Introduction

The enduring challenge of low English-speaking proficiency among Malaysian learners remains a persistent issue in both second language acquisition (SLA) research and national education policy. Despite decades of curriculum reforms, including the introduction of communicative language teaching (CLT) and continuous assessment initiatives, many students still demonstrate limited oral proficiency (Baharum et al., 2021). This problem is particularly pronounced at the pre-university level, where learners preparing for the Malaysian University English Test (MUET) face high-stakes speaking assessments that determine entry into tertiary education (Sukri et al., 2023). While students often possess satisfactory grammatical competence and reading ability, their oral communication remains inhibited by affective barriers such as communication apprehension (CA) and speaking anxiety (SA) (An et al., 2023; Tan, 2021). These emotional constraints reduce willingness to communicate (Rahman et al., 2021), limit classroom participation, and undermine the development of communicative competence essential for success in higher education and global employment contexts (Ahmad & Shah, 2022).

Scholars in SLA have long emphasized that oral proficiency cannot be acquired through passive exposure to linguistic input alone but requires frequent, meaningful, and authentic interaction within psychologically safe environments (Bardone et al., 2022; Schwab et al., 2022). However, Malaysian classrooms continue to be shaped by exam-oriented pedagogies, limited interactional opportunities, and socio-cultural sensitivities surrounding peer judgment (Baharum et al., 2021; Sukri et al., 2023). Such conditions heighten anxiety and hinder learners from transferring linguistic knowledge into authentic communicative performance. The persistence of these affective barriers raises broader concerns about national employability, as English proficiency is increasingly recognized as a determinant of professional readiness in Malaysia's evolving knowledge economy (Sun & Li, 2020).

The advent of the Fourth Industrial Revolution (IR 4.0) has stimulated renewed initiatives to reconceptualise English language instruction via the incorporation of digital and immersive technology (Ma, 2021; Xie et al., 2022). Virtual reality (VR) has received notable attention for its capacity to provide immersive, interactive, and emotionally resonant settings that simulate real-world communication scenarios (Pan et al., 2021; Xie et al., 2022). In contrast to conventional classroom role-plays, virtual reality allows learners to participate in simulated interactions while ensuring psychological safety, thereby cultivating a genuine sensation of presence and control (Ma, 2021). From a psychological perspective, the immersive experience of virtual reality corresponds with the tenets of exposure therapy (Huang & Teo, 2021), in which systematic, repeated

exposure to anxiety-provoking scenarios like public speaking progressively reduces emotional reactions. This simultaneous educational and therapeutic capacity offers VR as a revolutionary instrument for alleviating communication anxiety in second language acquisition.

Despite the incorporation of digital technologies in English language teaching (ELT) is well established (Pan et al., 2021), the persistent gap in oral proficiency among Malaysian learners suggests that conventional methods such as peer collaboration, teacher scaffolding, and role-play activities—provide only limited relief from affective barriers (Guo & Gao, 2022). Learners continue to exhibit high levels of speaking anxiety (Çelik & Memduhoğlu, 2022) and low communicative confidence, especially during MUET-related assessments (Baharum et al., 2021). Addressing these affective constraints is thus not merely a pedagogical concern but a national priority linked to educational quality and workforce competitiveness (Tan, 2021).

Globally, a growing body of research affirms that VR-based learning environments can effectively reduce anxiety, enhance motivation, and improve communicative competence in SLA ((Ahmad & Shah, 2022; An et al., 2023; Zhang & Sun, 2022). Meta-analyses have shown that VR fosters authenticity, emotional engagement, and increased willingness to communicate (Ma, 2021; Xie et al., 2022). However, several critical research gaps persist. First, there remains a scarcity of large-scale quantitative studies examining the affective impact of VR interventions among Malaysian pre-university learners a population uniquely pressured by high-stakes language testing. Second, while global research highlights VR's motivational and cognitive effects, fewer studies systematically investigate its *therapeutic role* in reducing CA and SA within ESL contexts. Third, empirical exploration of how specific perceptual features of VR particularly interactivity and realism influence learner engagement and affective regulation is still limited (Pan et al., 2021).

### 1.1. Research Objectives

In response to these gaps, the current investigation seeks to:

- i. Compare the levels of communication apprehension, speaking anxiety, and speaking performance between experimental and control groups following a VR-based intervention;
- ii. Evaluate the pedagogical and therapeutic effectiveness of the Virtual Reality Intervention Module (VRIM) in mitigating CA and SA; and
- iii. Examine students' perceptions of interactivity and realism as determinants of engagement in VR-based ESL learning contexts.

By integrating psychological and pedagogical perspectives, this study contributes new empirical evidence on how immersive VR environments function as both affective and instructional interventions. The findings extend understanding of affective regulation within SLA and provide practical implications for educators and policymakers seeking scalable, technology-enhanced approaches to communicative language teaching in multilingual and high-stakes assessment contexts.

## 2. Literature Review

The question of English language proficiency in Malaysia has persisted for decades, representing not merely a pedagogical issue but also a deeply embedded socio-political

and economic challenge. Despite extensive reforms, ranging from national curriculum revisions to the imposition of high-stakes assessments such as the Malaysian University English Test (MUET), the oral proficiency of Malaysian learners remains consistently lower than desirable benchmarks for higher education and employability. This situation is particularly critical in the pre-university sector, where students are expected to demonstrate communicative competence as a prerequisite for both academic progression and global competitiveness. While numerous studies have examined English language teaching (ELT) from perspectives of pedagogy, assessment, and policy, relatively fewer have critically engaged with the psychological dimensions of second language acquisition (SLA), specifically communication apprehension (CA) and speaking anxiety (SA), which directly hinder oral communicative ability.

At the same time, developments linked to the Fourth Industrial Revolution (IR 4.0) are reshaping educational landscapes worldwide, with immersive technologies such as virtual reality (VR) increasingly applied to language learning. While international literature documents the promise of VR in reducing anxiety and enhancing performance, the Malaysian context characterized by high-stakes assessments, multilingual classrooms, and policy-driven pressures has received limited empirical attention. Accordingly, this literature review synthesizes scholarship across four domains:

- i. The historical and contemporary context of English in Malaysia,
- ii. Pedagogical and psychological barriers to oral proficiency,
- iii. Theoretical frameworks underpinning affective dimensions of SLA, and
- iv. There is an emerging role of VRIM in language education.

Through a critical analysis of prior work, the review delineates the specific research gaps that necessitate the present study.

## 2.1. Historical and Contemporary Context of English in Malaysia

A complex interplay of postcolonial politics, nation-building agendas, and global economic imperatives has shaped the trajectory of English in Malaysia. Following independence in 1957, the Razak Report (1956) and subsequent Education Act (1961) shifted the linguistic medium of instruction from English to Malay as part of a broader nationalist agenda to strengthen cultural identity and unity (Gill, 2005). While this transition achieved political objectives, it simultaneously eroded the systemic prominence of English in schools, with long-term implications for oral proficiency.

In the 1990s, globalization pressures and the demands of a knowledge-based economy prompted renewed policy emphasis on English. The Malaysia Education Blueprint (2013–2025) explicitly highlighted English as a driver of employability and international competitiveness. Complementing this, the Roadmap to English Language Education Reform (2015–2025) sought to raise national proficiency levels to align with the Common European Framework of Reference (CEFR). Despite these reforms, studies consistently report that Malaysian students underperform in oral communication compared to regional peers, particularly in high-stakes settings such as MUET (Baharum et al., 2021).

Critiques of policy implementation underscore three recurring issues. First, policy rhetoric has often exceeded classroom realities. Scholars such as Sukri et al. (2023) argue that teacher preparedness, infrastructural limitations, and exam-centric pedagogies undermine the communicative objectives of national reforms. Second, the emphasis on written assessments, including grammar and reading comprehension, has historically

eclipsed the cultivation of spontaneous oral fluency (Baharum et al., 2021). Third, while MUET's speaking component represents a structural attempt to prioritize oral competence, its high-stakes nature paradoxically exacerbates anxiety and reduces authentic communicative risk-taking among students (Rohmana, 2020).

Thus, the historical and contemporary policy landscape reveals a persistent paradox: while reforms increasingly acknowledge the centrality of oral proficiency, the structural, pedagogical, and affective barriers within the Malaysian educational system continue to restrict learners' communicative development. This disjuncture between policy intent and learner outcomes underscores the necessity of pedagogical innovations that can directly mitigate psychological barriers while supporting policy goals.

## 2.2. Pedagogical and Psychological Barriers to Oral Proficiency

Pedagogical traditions in Malaysian classrooms remain deeply influenced by exam-oriented cultures that prioritize rote learning and teacher-centered instruction. Studies by Huang and Teo, (2021), Zhang and Sun, (2022) highlight that classroom speaking activities are often formulaic, limited to rehearsed dialogues or oral presentations that fail to replicate authentic communicative contexts. Such practices restrict students' ability to develop fluency, spontaneity, and confidence in actual discourse.

Moreover, the sociocultural dynamics of Malaysian classrooms further exacerbate these pedagogical constraints. Multilingual and multicultural settings, while offering potential for rich interaction, often reinforce reticence due to fear of negative peer evaluation or linguistic stigmatization (Gill, 2005). As a result, even students with adequate linguistic competence frequently avoid active participation in oral tasks.

Psychological dimensions compound these pedagogical challenges. Communication apprehension (CA) and foreign language anxiety (FLA) have been extensively documented as significant predictors of poor oral performance in ESL/EFL contexts (Sun & Li, 2020). In Malaysia, studies by Baharum et al., (2021) and Sukri et al. (2023) reveal that pre-university students experience high levels of anxiety when speaking in English, particularly in evaluative contexts such as MUET. Speaking anxiety (SA), specifically, is not merely a transient emotional response but a pervasive affective filter that disrupts cognitive processing, diminishes working memory, and constrains verbal output (Jiao, 2021).

Critically, pedagogical and psychological barriers interact in mutually reinforcing ways. Exam-oriented pedagogies amplify learners' fear of failure, while heightened anxiety in turn reduces participation, creating a vicious cycle of avoidance and underperformance (Pan et al., 2021). Yet, much of the literature treats pedagogy and psychology as discrete domains, with limited attempts to integrate them into holistic models of oral competence. This fragmentation has left an important research gap: the need for interventions that simultaneously address both pedagogical inadequacies and psychological barriers.

## 2.3. The Psychological Dimension: Anxiety, Fear, and Lack of Confidence

Beyond the lack of pedagogical opportunity, a major challenge to English proficiency is psychological. Studies reveal that numerous students encounter anxiousness, diminished self-assurance, timidity, and apprehension regarding errors when communicating in English. These non-linguistic obstacles are substantial and can directly influence a

student's inclination to engage in classroom activities. The lack of practice opportunities creates a self-reinforcing cycle. Without a consistent environment for oral practice, students do not build confidence. This lack of confidence, in turn, fuels their fear of making mistakes and reluctance to participate, further limiting their opportunities for improvement. The problem is not merely a lack of skill but a fear-based paralysis that prevents skill acquisition and practical application. The following [Table 1](#) synthesizes the various challenges identified in the literature.

Table 1: Major Challenge to English Proficiency

| Category      | Specific Challenge                            | Supporting Evidence/Source                                                                                                                                                                                                                                                                                                                                                                                                        |
|---------------|-----------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Pedagogical   | Limited structured opportunities for practice | Research indicates that oral language development is often neglected in the classroom, leading to a lack of learning context for actual conversation and limited speaking opportunities, which subsequently causes learners to fear speaking ( <a href="#">Elkut and Aburawi, 2024</a> )                                                                                                                                          |
| Pedagogical   | Over-reliance on written assignments          | While not always directly measured against writing, the general focus on other skills means speaking instruction is often suboptimal or uses methods (like textbooks) that limit the willingness and opportunities for speaking practice, suggesting an imbalance towards less communicative work ( <a href="#">Baharum et al., 2021</a> ).                                                                                       |
| Pedagogical   | Minimal use of interactive speaking exercises | Studies suggest that speaking ability is often hindered by suboptimal instructional methods and that interactive language learning activities (like role-playing and storytelling) are effective in improving speaking, implying their underutilization. Learners sometimes share their opinions and thoughts very little during speaking activities, indicating a lack of interactive engagement ( <a href="#">Jiao, 2021</a> ). |
| Psychological | Fear of making mistakes                       | This is frequently identified as a primary psychological barrier and a major cause of English speaking difficulties. Learners worry about the impression they are making, and research confirms that the process of making mistakes, when followed by correction, is a powerful learning tool, but the fear of it stops communication ( <a href="#">Sun &amp; Li, 2020</a> ).                                                     |
| Psychological | Lack of confidence                            | Research consistently identifies low self-confidence as a primary cause of speaking anxiety and poor performance, often linked to insufficient ability (e.g., pronunciation issues) or a lack of practice. Low confidence hinders participation and willingness to communicate ( <a href="#">Sukri et al., 2023</a> ).                                                                                                            |

|               |                                                        |                                                                                                                                                                                                                                                                                                                                    |
|---------------|--------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Psychological | Shyness and avoidance of speaking                      | Shyness is a personality trait shown to be negatively correlated with willingness to communicate (WTC) and classroom engagement, leading shy learners to inhibit social behavior and be less inclined to participate in activities or initiate conversations ( <a href="#">Pan et al., 2021</a> ).                                 |
| Psychological | Fear of negative evaluation from peers and instructors | This constitutes a fundamental aspect of Foreign Language Anxiety (FLA), characterised by trepidation regarding others' assessments and the evasion of evaluative contexts. It is triggered by the class environment where learners feel frequently watched and judged by peers and teachers ( <a href="#">Pan et al., 2021</a> ). |
| Psychological | Test anxiety and pressure to perform                   | Test anxiety is a distinct component of FLA, defined as apprehension toward academic evaluation, often leading to a significant negative correlation with exam grades and negatively influencing academic achievement. High-stakes, timed tests in language classes exacerbate this pressure.                                      |

#### 2.4. Theoretical Foundations: Understanding Foreign Language Anxiety Scales (FLCAS)

The Foreign Language Anxiety Scale (FLCAS) denotes a distinct type of anxiety encountered by individuals during the acquisition or utilisation of a second language. It is a well-documented psychological phenomenon in language learning, particularly in non-native speaker contexts, and is characterized by a "gnawing sense of self-doubt and nervousness". As a form of communication apprehension (CA), FLCAS is characterised as "the subjective experience of tension, anxiety, and apprehension linked to the activation of the human autonomic nervous system," and it can significantly influence the efficacy of language acquisition. This anxiety can be both a personality trait (trait anxiety) and a situational response (state anxiety), spiking during high-stakes events like presentations, job interviews, or language tests.

The conceptualisation of language anxiety has markedly progressed as initially characterised FLCAS as a unique construct that includes communication apprehension, test anxiety, and fear of unfavourable evaluation. Subsequent research has debated whether FLCAS represents a stable trait or a context-dependent state ([Dewaele & MacIntyre, 2014](#)). For Malaysian learners preparing for MUET, anxiety tends to be highly situational, triggered by evaluative and high-stakes contexts rather than by language use in informal domains.

The roots of FLCAS are a "unique blend of psychological and sociocultural factors.". A primary contributor is the fear of making mistakes and being judged by others, which can be amplified in a classroom setting where learners feel constantly observed. This fear of negative evaluation from peers and instructors can be so "paralyzing" that it prevents students from speaking at all. Other factors include perfectionism, low self-esteem, and negative past experiences, such as being ridiculed for grammar mistakes or a foreign accent. These psychological barriers manifest in a range of symptoms, from physical signs like a racing heart and sweaty palms to psychological ones such as fear of embarrassment and poor memory recall. All of these symptoms can lead to poor performance and low achievement in a language.

## 2.5. The Crossover from Psychological Treatment to Pedagogical Tool

The connection between the psychological challenges of FLA and a potential technological solution is not a mere coincidence but a deep, theoretical one. The provided material establishes that Virtual Reality (VR) has a well-documented history of being used in psychology for exposure therapy to treat phobias and anxiety disorders. The core principle of exposure therapy that controlled, repeated exposure to a feared stimulus can reduce anxiety over time is the exact mechanism through which VR can address FLCAS. This therapeutic method offers a compelling justification for its educational use. By creating a simulated, safe environment where students can confront their speaking fears without real-world consequences, VR can act as a bridge between the clinical treatment of anxiety and the practical needs of language education. This relationship elevates the discussion from a simple "VR helps" to a foundational understanding of why it helps, linking a psychological treatment methodology to a pedagogical application.

## 2.6. The Emergence and Efficacy of Virtual Reality as a Pedagogical Tool

Technological innovations have increasingly been applied to SLA, with computer-assisted language learning (CALL) and mobile-assisted language learning (MALL) representing established subfields. However, VR represents a qualitatively distinct development due to its capacity for immersion, interactivity, and presence the sense of "being there" in a communicative scenario (Slater and Sanchez, 2016). For language learners, VR environments provide opportunities to engage in authentic, low-stakes communicative practice with virtual interlocutors, replicating scenarios ranging from informal conversations to academic presentations.

Empirical studies from international contexts demonstrate promising outcomes. Xie et al. (2022) found that VR significantly enhanced learners' willingness to communicate, while Pan et al. (2021) reported reductions in speaking anxiety among Chinese EFL learners following VR-based interventions. Meta-analyses by Lin and Lan (2015) and Parmaxi and Demetriou (2020) further confirm that VR can improve both affective outcomes (e.g., confidence, motivation) and linguistic outcomes (e.g., fluency, vocabulary acquisition).

The theoretical alignment between VR and exposure therapy is particularly compelling. VR allows learners to confront anxiety-inducing scenarios (e.g., oral examinations, group discussions) in controlled environments, thereby replicating the gradual desensitization mechanisms of therapeutic exposure. Unlike traditional classroom simulations, VR provides repeatability, personalization, and immersion, which enhance both pedagogical authenticity and psychological safety.

Despite these advantages, critical gaps remain. First, much of the evidence derives from small-scale pilot studies or quasi-experiments, limiting generalizability. Second, existing research often emphasizes motivational outcomes while underexploring anxiety reduction as a central construct. Third, Southeast Asian contexts remain underrepresented, with Malaysian studies focusing largely on mobile or web-based platforms rather than immersive technologies (Rofi'i et al., 2023).

## 2.7. VR's Role in Education and its Adoption Framework

Virtual Reality is an interactive technology that has the potential to transform the education system by offering immersive and engaging settings that replicate real-world

scenarios. The application can be examined using theoretical frameworks like the Technology Acceptance Model (TAM), which asserts that a user's acceptance of new technology is greatly affected by their "perceived usefulness (PU)" and "perceived ease of use (PEU)." This framework is crucial for understanding that simply introducing VR is not enough; its implementation must be intuitive and demonstrably beneficial to be successfully integrated into an educational setting.

The true power of VR as a pedagogical tool lies in its ability to address both the affective (anxiety) and cognitive (skill acquisition) domains of language learning simultaneously. As a therapeutic tool, it creates a controlled and customizable environment for practice. This "safe and encouraging classroom environment" allows students to engage in low-stakes, repeatable practice without the real-world fear of negative evaluation. Customizable features, such as the size, appearance, and behavior of a virtual audience, allow for a hierarchical approach to exposure, enabling students to gradually build confidence by starting with less challenging scenarios. This directly mirrors established clinical practices for treating phobias.

As an educational instrument, VR improves learning via immersion, which significantly positively affects the behavioural intention of EFL learners to participate in VR-based language acquisition. It provides authentic learning experiences that are typically unavailable in traditional classrooms, such as virtual presentations or mock interviews. By breaking the cycle of fear and non-participation, VR allows students to build the very skills that they are most anxious about, thus addressing the root cause of the proficiency gap. The following [Table 2](#) summarizes how specific VR affordances address the identified learning challenges.

Table 2: VR Affordances Address the Identified Learning Challenges

| VR Feature             | How It Works                                                                                                                 | Challenge Addressed                                                                | Supporting Evidence/Source                                 |
|------------------------|------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|------------------------------------------------------------|
| Immersive Environments | Simulates real-life scenarios like presentations or conversations, providing a context for situated learning                 | Limited structured opportunities for practice; reliance on written assignments     | <a href="#">(Rofi'i et al., 2023)</a>                      |
| Low-Stakes Practice    | Allows for repeated exposure to speaking situations without real-world consequences                                          | Apprehension regarding errors and adverse assessment; deficiency in self-assurance | <a href="#">(Guo &amp; Gao, 2022; Rofi'i et al., 2023)</a> |
| Customizable Audiences | Enables a gradual, hierarchical approach to exposure by allowing users to adjust the size and behavior of a virtual audience | Fear of negative evaluation; test and public speaking anxiety                      | <a href="#">(Xie et al., 2022)</a>                         |

|                    |                                                                                                                             |                                                   |                    |
|--------------------|-----------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------|--------------------|
| Embodied Cognition | Links physical gestures and actions to words, enhancing verbal memory and retention                                         | Difficulties with vocabulary and phrase formation | (Ma, 2021)         |
| Anonymity          | Provides a psychological buffer that allows presenters to develop confidence without the pressure of being watched by peers | Shyness and reluctance to participate in class    | (Pan et al., 2021) |

A meta-analysis of 23 research revealed that VR-based English as a Foreign Language (EFL) learning methods are "significantly superior to traditional EFL learning methods" and exhibit a "small positive effect" on learning results. Virtual reality has demonstrated enhancements in multiple language competencies, encompassing vocabulary, speaking proficiency, writing, and listening comprehension. The technology's immersive features are recognised for improving learning outcomes, increasing motivation, and fostering skills. The capacity to develop contextual learning experiences, wherein learners are engaged in a virtual environment that replicates real-life scenarios, enhances the engagement and interactivity of language acquisition. This immersion promotes a state of "cognitive absorption," which is an intrinsic motivator that leads to better retention and learning outcomes.

### 3. Research Methods

#### 3.1. Research Approach

This research employed an explanatory sequential mixed-methods design, a methodological approach increasingly recognized in contemporary educational research for its capacity to integrate the statistical rigor of quantitative inquiry with the interpretive depth of qualitative analysis (Creswell, 2018). The design was deemed appropriate for investigating the effectiveness of the Virtual Reality Intervention Module (VRIM) in mitigating communication apprehension (CA) among students, as it allowed both the measurement of quantifiable changes and the exploration of underlying psychological processes. Such an approach is particularly valuable in studies addressing affective and cognitive constructs in second language acquisition, where quantitative trends often require qualitative contextualization to capture learners' emotional and experiential dimensions (Ivankova & Wingo, 2018).

##### 3.1.1. Phase One: Quantitative Component

The quantitative phase utilised a quasi-experimental pre-test-post-test design that included both an experimental group and a control group. Participants consisted of pre-university ESL learners chosen from several Malaysian secondary schools using purposive sampling, guaranteeing a representative cohort of students preparing for the Malaysian University English Test (MUET). The experimental group received instruction using the VRIM, whereas the control group engaged in traditional oral communication activities. Data were gathered with a standardised questionnaire modified from the Personal Report of Communication Apprehension (PRCA-24) (McCroskey, 1984), which

assesses four dimensions of communication apprehension: group discussion, meetings, dyadic communication, and public speaking. The instrument has been widely validated in cross-cultural educational contexts and demonstrates strong internal consistency ( $\alpha > .90$ ).

Descriptive and inferential statistical analyses, including paired-sample t-tests, ANCOVA, and effect size calculations (Cohen's d), were conducted to determine the significance and magnitude of changes in CA levels following exposure to VRIM. These analyses established the empirical foundation for assessing the pedagogical and affective effectiveness of the intervention. Reliability and validity were ensured through instrument standardization and adherence to experimental control procedures, including equivalence of learning duration and instructor consistency across groups (Creswell, 2013).

### *3.1.2. Phase Two: Qualitative Component*

The second phase was designed to enrich the quantitative findings by offering interpretive details about students' lived experiences with VRIM. Semi-structured interviews and focus group discussions were done with purposefully selected participants from both the experimental and control groups to gather their perceptions of interactivity, realism, and emotional regulation during VR-based speaking practice. The qualitative data underwent theme analysis (Braun & Clarke, 2019), involving iterative coding, category formation, and synthesis of emergent themes. This analytic process illuminated the psychological and pedagogical mechanisms through which VRIM influenced learners' communication apprehension, focusing on affective regulation, confidence development, and perceived authenticity of virtual environments.

Credibility of the qualitative findings was enhanced through data triangulation (multiple sources: interviews and focus groups), member checking, and peer debriefing to ensure accuracy and trustworthiness (Lincoln & Guba, 1988). Reflexivity was maintained throughout to minimize researcher bias and to acknowledge the interpretive nature of qualitative meaning-making in educational settings.

### *3.1.3. Integration and Interpretation*

The integration of quantitative and qualitative datasets took place throughout the interpretation phase, following the framework proposed by Creswell (2018) for explanatory sequential designs. The qualitative findings were used to explain, corroborate, and extend the statistical results, providing a more comprehensive understanding of the VRIM's effectiveness. The mixed-methods integration employed a connecting strategy, in which participants for the qualitative phase were selected based on quantitative results, thereby ensuring analytic continuity between phases (Fetters, Curry, & Creswell, 2013).

This methodological integration enhanced the overall validity and depth of the study through methodological triangulation, allowing convergence between quantitative measures of change and qualitative insights into learner experience. Recent scholarship affirms that explanatory sequential designs are particularly effective in educational research addressing affective and psychological constructs, as they link measurable behavioral outcomes with interpretive evidence of emotional transformation (Çelik & Memduhoğlu, 2022; Eslamdoost et al., 2020).

### 3.1.4. Rationale for Mixed-Methods Approach

The choice of a mixed-methods design addressed the limitations inherent in using a single approach. Quantitative data alone could reveal whether VRIM significantly reduced CA but not elucidate the psychological mechanisms driving this change. Conversely, qualitative exploration could capture experiential nuance without establishing statistical generalizability. By combining both, this study produced a robust and multidimensional understanding of VRIM's pedagogical efficacy linking measurable outcomes with the affective and cognitive processes shaping learner engagement. This pragmatic orientation underscores the epistemological strength of mixed-methods research in addressing complex educational phenomena involving technology-mediated learning and emotional variables (Yang, 2022; Zhao, 2020).

## 3.2. Participants and Sampling

The study's population consisted of Structure The research encompassed six students from School X, a public secondary institution in Kelantan, Malaysia, that instructs English as a second language. The quantitative phase had four intact classrooms with a total of 60 participants, including 30 students in the control group and 30 students in the experimental group, representing both male and female participants. In the qualitative phase, all 30 individuals from the experimental group were incorporated to offer comprehensive insights into their experiences with the Virtual Reality Intervention Module (VRIM). Participants were assigned to groups based on pre-test findings on communication apprehension (CA), guaranteeing group equivalence prior to the intervention.

The selection of Kelantan as the research site was theoretically and contextually justified. The state has been widely recognized for its relatively low use and acceptance of English as a second language (L2), which makes it a pertinent context for examining issues related to communication apprehension in English-speaking situations. As Zulkarnain et al. (2021) highlight, Kelantan represents one of the regions in Malaysia where English usage is minimal among the general population. Therefore, conducting the study in this setting enables a more critical examination of whether VRIM could mitigate speaking anxiety and improve oral proficiency among students who are generally less exposed to English communication in daily contexts.

The sample size of 60 participants was determined based on the statistical recommendation by Ghasemi and Zahediasl (2012), who argue that a sample size of between 30 and 40 individuals per group typically yields a normal sampling distribution suitable for inferential analysis. Moreover, the decision to focus on a single school was intentional to strengthen the internal validity of the research design. By limiting the study to one school, the researcher was able to control for extraneous variables such as differences in teaching style, institutional culture, or school-level resources that might otherwise confound the findings. This approach ensured the creation of a homogeneous sample, as conceptualized by Creswell (2013), wherein participants share similar characteristics—including academic background, language proficiency, and learning environment—thus minimizing potential bias arising from inter-school variation. The rationale for this controlled context also corresponds with Brown et al. (2020), who caution that multi-site studies often face teacher fidelity issues, as variations in teacher behavior, classroom climate, and instructional delivery can influence learners' interpretations and engagement with the content.

A probability sampling approach was employed, specifically using cluster sampling, to represent a bounded population of Form Six students within the selected institution. Cluster sampling was deemed appropriate for this study because it allows randomization at the group level rather than at the individual level, which is both methodologically practical and cost-efficient in educational research settings (Hsieh, 1988). Due to logistical considerations, such as class scheduling and administrative constraints, two intact classes comprising 30 students were designated as the control groups, and two intact classes comprising another 30 students were assigned as the experimental groups. As Creswell (2013) notes, the use of intact classes is a common and acceptable practice in educational experiments where random assignment of individual participants is infeasible. This approach minimizes disruption to the natural classroom environment and maintains ecological validity while still enabling statistical comparison between groups.

### 3.3. Data collection

The data collection process for this study was conducted in three systematic stages, encompassing the preparation, implementation, and evaluation phases. This sequential procedure ensured consistency, reliability, and adherence to ethical and pedagogical standards in the administration of the Virtual Reality Intervention Module (VRIM).

#### 3.3.1. Stage 1: Preparation and Coordination

The researcher first sought collaboration with an English language instructor at School X, to identify four intact Form Six classes comprising 60 students who had not yet undertaken the Malaysian University English Test (MUET). The classes were then designated as two control and two experimental groups, with 30 participants in each category. Prior to data collection, the researcher provided School X with a comprehensive briefing detailing the objectives, expected outcomes, and pedagogical benefits of the study, particularly regarding the potential enhancement of students' speaking skills through VR technology. To ensure procedural fidelity, the researcher also prepared a concise instructional guidebook outlining the topics and tasks to be practiced during VRIM sessions.

In addition, hands-on training sessions were conducted for teacher at School X to familiarize them with the VR headgear, mobile speaking application, and digital tools used in the intervention. This preparatory phase ensured that Teacher X possessed the technical and pedagogical competence required to facilitate the sessions and to provide immediate support to participants encountering technical difficulties. The researcher subsequently supplied sufficient copies of the psychometric instruments to Teacher X for the initial quantitative phase of data collection.

#### 3.3.2. Stage 2: Implementation of the VRIM Intervention

Following the preparatory phase, Teacher X disseminated four sets of questionnaires to all participants in both the control and experimental groups prior to the intervention. These instruments measured participants' communication apprehension (CA), speaking anxiety, and attitudes toward English-speaking activities. Data from this pre-test served as the baseline for evaluating subsequent changes following the VRIM sessions. Upon completion, the questionnaires were collected and returned to the researcher for initial statistical analysis.

The experimental group then commenced the VRIM sessions, which incorporated virtual reality technology and a mobile speaking application to simulate authentic communication scenarios relevant to the MUET speaking component. The researcher provided VR headgear for each participant, while Teacher X acted as a facilitator, ensuring smooth session flow and guiding participants when necessary. The sessions were designed according to behaviourist and constructivist learning principles, enabling learners to both reinforce positive speaking habits through repeated practice and construct knowledge through immersive interaction in the virtual environment. Each session lasted approximately 15 minutes, a duration deliberately set to reduce potential health risks associated with prolonged VR exposure and to accommodate the constraints of classroom schedules.

At the conclusion of each session, reflective discussions were conducted between Teacher X and participants to encourage metacognitive awareness of learning progress and to identify any challenges encountered during practice. These reflections also provided preliminary qualitative insights that later informed the interpretation of post-test and interview data.

### *3.3.3. Stage 3: Post-Intervention Assessment and Qualitative Data Collection*

Upon completion of the VRIM sessions, all participants undertook a post-intervention psychometric test identical to the pre-test. This allowed for a direct comparison of pre- and post-intervention data to determine the effectiveness of VRIM in reducing communication apprehension. The quantitative data were analysed using a paired-sample t-test to evaluate statistically significant differences between the two data points.

To complement the quantitative findings, a qualitative phase was conducted with selected participants from the experimental group. The participants participated in semi-structured face-to-face interviews aimed at extracting profound insights into their personal experiences, perceptions, and emotional reactions about the use of VR technology for speaking practice. This phase enriched the interpretation of quantitative results by uncovering the underlying mechanisms and contextual factors that contributed to changes in communication apprehension levels.

## **3.4. Data Transcription, Coding, and Analysis**

The information obtained from the tests and surveys was systematically transcribed and encoded. This study employed an explanatory sequential mixed-methods framework for data analysis, combining quantitative and qualitative analyses to achieve a thorough knowledge of the Virtual Reality Intervention Module (VRIM) and its effects on students' communication apprehension (CA). The analysis was carried out in two primary phases—quantitative analysis and qualitative analysis—followed by a systematic integration stage, where both datasets were interpreted to derive cohesive and triangulated conclusions.

### *3.4.1. Phase 1: Quantitative Data Analysis*

Quantitative data were derived from two psychometric assessments administered before and after the VRIM intervention to both experimental and control groups. The instruments assessed essential aspects of communication apprehension across several dimensions, including group discussions, meetings, dyadic interactions, and public speaking scenarios. The data were first subjected to data screening procedures, which

involved checking for missing values, identifying outliers, and assessing the normality, linearity, and homogeneity of variance of the dataset. These procedures were conducted following the recommendations of [Amalia \(2020\)](#) to ensure statistical assumptions were adequately met prior to inferential testing.

Descriptive statistics, including mean scores, standard deviations, and frequency distributions, were computed to establish the baseline and post-intervention profiles of both groups. To determine the intervention's effectiveness, inferential statistical tests were applied. Specifically, a paired-sample t-test was employed to compare pre- and post-test scores within each group, while an independent-sample t-test was used to examine between-group differences in the post-test phase. These analyses were executed using the Statistical Package for the Social Sciences (SPSS) version 29.0. The level of statistical significance was set at  $p < .05$ .

The effect size for significant differences was calculated using Cohen's  $d$  to determine the magnitude of the intervention's impact, following the interpretive guidelines established by [Cohen \(1988\)](#). This allowed the researcher to not only identify statistically significant changes but also to evaluate their practical significance in relation to students' speaking anxiety and communication apprehension. The results of the quantitative analysis provided the empirical foundation for the subsequent qualitative phase, in line with the principles of explanatory sequential design ([Ivankova et al., 2006](#)).

#### *3.4.2. Phase 2: Qualitative Data Analysis*

The qualitative data obtained from semi-structured interviews with chosen participants from the experimental group were analysed via thematic analysis as proposed by [Braun and Clarke \(2019\)](#). The purpose of this phase was to explore participants' experiences, perceptions, and emotional responses toward the use of VRIM in improving their English-speaking confidence and reducing communication apprehension.

The analysis comprised six systematic stages: (1) familiarisation with the data via iterative reading of transcripts, (2) generation of preliminary codes, (3) identification of emerging patterns, (4) evaluation of candidate themes, (5) definition and designation of themes, and (6) synthesis and presentation of findings. Initial manual coding was performed to discern reoccurring concepts and attitudes among participants, subsequently followed by axial coding to delineate links across themes. To augment the credibility of qualitative findings, the researcher employed triangulation and member verification methodologies. Triangulation was achieved by comparing themes with quantitative findings, while member checking involved verifying selected interpretations with participants to ensure authenticity and representational accuracy.

#### *3.4.3. Phase 3: Integration of Quantitative and Qualitative Findings*

The final stage of analysis involved data integration, in which quantitative and qualitative findings were compared, contrasted, and merged to generate comprehensive interpretations. This integration was performed using the explanatory sequential model recommended by [Creswell and Plano Clark \(2018\)](#), where qualitative insights are used to explain and elaborate on the statistical trends identified in the quantitative phase. For example, improvements in post-test CA scores were interpreted alongside students' qualitative reflections on how VRIM influenced their speaking confidence, anxiety regulation, and engagement with virtual scenarios.

This triangulated analysis not only strengthened the internal validity of the study but also illuminated the underlying mechanisms that numerical data alone could not capture. This integration enabled the study to attain a more comprehensive depiction of the pedagogical and psychological effects of virtual reality interventions on English language acquisition. The combination of quantitative rigor and qualitative richness provided a nuanced understanding of how VRIM can be leveraged as an innovative educational tool to reduce communication apprehension and enhance oral proficiency among Form Six students.

This involved a comprehensive process of data entry, followed by statistical analysis using appropriate software tools. Descriptive statistics were employed to summarise the data, while inferential statistics, such as means and standard deviations, assessed the program's impact. The qualitative feedback was analysed to identify themes and patterns, which were subsequently evaluated in relation to the study's main objectives.

### **3.5. Ethical Considerations**

Ethical guidelines were rigorously followed to safeguard participants during the study. This involved acquiring informed consent from the Research Ethics Centre of Universiti Teknologi MARA (REC, henceforth) and maintaining data anonymity while restricting access to authorised researchers only. Additionally, some of the REC's specific objectives include the examination of the applicants' research proposals for ethical issues in order to ensure that the research conducted at the institution complies with international and national guidelines established by influential bodies such as Malaysia and the Declaration of Helsinki, the World Medical Association (WMA), and Good Clinical Practice (GCP) and others

## **4. Results**

### **4.1. Quantitative Result**

**Preliminary Assessment and Subsequent Evaluation** The analysis process involved delineating the results of the pre-test and post-test evaluations. These assessments were intended to gauge learners' pronunciation proficiency. The data included the performance of 60 participants. [Table 3](#) the demographic composition of participants offers useful information about the contextual representativeness and interpretative validity of the findings. The predominance of 19-year-old participants (70%), with the remaining 30% aged 18, suggests that the sample consists mainly of late adolescents who are transitioning toward higher education, a developmental stage commonly associated with heightened self-awareness and communication sensitivity. This age concentration is advantageous in maintaining developmental consistency across participants, thereby minimising extraneous variability that could confound the results. However, it also limits the generalisability of findings to broader age cohorts, particularly older learners or adults who may respond differently to VR-based communication training. Moreover, the significant gender imbalance, with females constituting 78.3% of the total sample, invites a critical reflection on how gender dynamics might influence communication apprehension (CA) outcomes. Prior studies have documented that females often exhibit higher levels of communication anxiety yet demonstrate stronger engagement in structured learning environments. Hence, this demographic imbalance could have both methodological and interpretive implications, potentially affecting the emotional responsiveness and behavioural engagement observed during the VR intervention.

Table 3: Demographic Profiles: Age, Genders, and Groups

|         |               | Frequency | Percent | Valid Percent | Cumulative Percent |
|---------|---------------|-----------|---------|---------------|--------------------|
| Age     | 18 Years-Old  | 18        | 30.0    | 30.0          | 30.0               |
|         | 19 Year's Old | 42        | 70.0    | 70.0          | 100.0              |
|         | Total         | 60        | 100.0   | 100.0         |                    |
| Genders | Male          | 13        | 21.7    | 21.7          | 21.7               |
|         | Female        | 47        | 78.3    | 78.3          | 100.0              |
|         | Total         | 60        | 100.0   | 100.0         |                    |
| Groups  | Male          | 13        | 21.7    | 21.7          | 21.7               |
|         | Female        | 47        | 78.3    | 78.3          | 100.0              |
|         | Total         | 60        | 100.0   | 100.0         |                    |

Equally important is the equitable distribution of participants across the experimental and control groups, with 30 individuals per group, ensuring methodological rigour and internal validity. This balance is crucial for the explanatory sequential mixed-methods design, where the quantitative phase's reliability depends heavily on comparable group characteristics. Nonetheless, while the parity of group size enhances statistical comparability, the underlying demographic homogeneity may constrain the diversity of perspectives captured in the qualitative phase. In other words, although a controlled design strengthens causal inferences about VR effectiveness, it may also reduce the ecological validity of the findings when generalised to more heterogeneous populations. Therefore, while the demographic structure of the study reflects methodological precision and fairness in participant distribution, it simultaneously introduces critical boundaries regarding diversity, gender representation, and contextual transferability. Recognising these limitations enriches the interpretation of findings and situates the research within the broader discourse on inclusivity, generalisability, and gendered learning experiences in technology-enhanced communication education as per shown in [Table 4](#).

Table 4: Communication Apprehension Constructs: Descriptive Analysis for PRCA-24

| Constructs (PRCA-24) | Groups     | Pre-test Scores Mean (S.D) | Post-test Scores Mean (S.D) |
|----------------------|------------|----------------------------|-----------------------------|
| Group                | Control    | 3.01 (0.38)                | 2.99 (0.25)                 |
|                      | Experiment | 2.96 (0.31)                | 3.07 (0.31)                 |
| Meeting              | Control    | 3.05 (0.19)                | 2.95 (0.22)                 |
|                      | Experiment | 2.95 (0.36)                | 3.21 (0.32)                 |
| Dyadic               | Control    | 3.00 (0.21)                | 2.95 (0.20)                 |
|                      | Experiment | 3.02 (0.29)                | 3.03 (0.23)                 |
| Public               | Control    | 2.90 (0.21)                | 2.93 (0.24)                 |
|                      | Experiment | 3.05 (0.28)                | 3.18 (0.26)                 |

[Table 4](#) displays the descriptive data for the four sub-dimensions of the Personal Report of Communication Apprehension (PRCA-24)—Group, Meeting, Dyadic, and Public—within the control and experimental groups. The research indicates significant disparities in mean scores between the pre-test and post-test phases, demonstrating the extent to which Virtual Reality as exposure therapy affected learners' communication apprehension in English as a Second Language (ESL) circumstances. Within the Group Communication domain, the control group exhibited minimal variation ( $M = 3.01$ ,  $SD = 0.38$  to  $M = 2.99$ ,  $SD = 0.25$ ), whereas the experimental group reported a modest increase from 2.96 ( $SD = 0.31$ ) to 3.07 ( $SD = 0.31$ ). This pattern indicates that repeated exposure

to simulated group discussions in a virtual reality setting improved learners' comfort in collaborative interactions. Consistent with the desensitisation principles of Exposure Therapy (Foa & Kozak, 1986), VR immersion appears to normalise anxiety-provoking social interactions through gradual and repeated practice in realistic yet non-threatening contexts.

Regarding the Meeting Communication construct, the experimental group recorded a more substantial increase ( $M = 2.95$ ,  $SD = 0.36$  to  $M = 3.21$ ,  $SD = 0.32$ ) compared with the control group's slight decline ( $M = 3.05$ ,  $SD = 0.19$  to  $M = 2.95$ ,  $SD = 0.22$ ). This indicates that virtual meeting simulations allowed participants to develop both linguistic competence and situational confidence. Such results correspond with previous findings (Makransky & Lilleholt, 2018) which affirm that immersive VR environments facilitate anxiety reduction by promoting active engagement and authentic communicative rehearsal. For Dyadic Communication, both groups demonstrated minimal variation, with the experimental group maintaining relative stability ( $M = 3.02$ ,  $SD = 0.29$  to  $M = 3.03$ ,  $SD = 0.23$ ). This suggests that one-on-one interactional confidence may require more personalised or adaptive VR feedback mechanisms. Previous research (e.g., Kim et al. 2017) similarly reports that dyadic communication anxiety is more resistant to reduction through general exposure, as it relies heavily on relational cues and emotional reciprocity that may be underrepresented in virtual contexts.

In the Public Communication domain, the experimental group displayed a consistent upward shift ( $M = 3.05$ ,  $SD = 0.28$  to  $M = 3.18$ ,  $SD = 0.26$ ), contrasting with the control group's marginal change ( $M = 2.90$ ,  $SD = 0.21$  to  $M = 2.93$ ,  $SD = 0.24$ ). This improvement underscores VR's capacity to simulate authentic public speaking situations that enhance learners' cognitive and emotional preparedness. These results align with the Affective Filter Hypothesis (Krashen, 1982), wherein reduced anxiety facilitates improved communicative performance and language fluency. Learners exposed to virtual audiences may have developed a more resilient sense of self-efficacy, thereby lowering their affective barriers to public communication. This pattern suggests that exposure to immersive speaking environments may have heightened participants' awareness of their linguistic limitations and performance expectations, leading to increased apprehension. Although this rise in anxiety might appear counterproductive, it could reflect a transitional stage in the learning process where increased self-awareness precedes eventual improvement in communication competence. This aligns with cognitive-behavioral perspectives on language anxiety, where exposure to challenging communicative contexts can initially raise tension but subsequently foster resilience and self-efficacy once learners adapt to the new stimuli.

Table 5 presents the descriptive statistics derived from the Foreign Language Classroom Anxiety Scale (FLCAS), which measured four principal constructs of speaking anxiety: Communication Apprehension, Test Anxiety, Fear of Negative Evaluation, and Anxiety of English Classes. The pre-test and post-test means reveal distinct changes between the control and experimental groups, illustrating the influence of Virtual Reality Exposure Therapy (VRET) on alleviating anxiety among Malaysian ESL learners. In the Communication Apprehension construct, the control group demonstrated a negligible increase from 2.95 ( $SD = 0.29$ ) to 3.01 ( $SD = 0.24$ ), indicating little change in learners' anxiety when exposed only to conventional classroom methods. By contrast, the experimental group recorded a significant improvement from 3.08 ( $SD = 0.29$ ) to 3.70 ( $SD = 0.51$ ), reflecting a notable reduction in communication apprehension following the VR intervention. This result suggests that the immersive VR environment served as a form of

exposure therapy that desensitised learners to communication-related stressors. Consistent with [Foa and Kozak's \(1986\)](#) emotional processing theory, the repeated simulation of real-world communication tasks may have restructured learners' anxiety schemas, leading to greater self-efficacy and confidence in verbal interactions.

Table 5: Speaking Anxiety: Descriptive Analysis for FLCAS

| Constructs<br>(PRCA-24) | Groups     | Pre-test Scores<br>Mean (S.D) | Post-test Scores<br>Mean (S.D) |
|-------------------------|------------|-------------------------------|--------------------------------|
| Communication           | Control    | 2.95 (0.29)                   | 3.01 (0.24)                    |
| Apprehension            | Experiment | 3.08 (0.29)                   | 3.70 (0.51)                    |
| Test Anxiety            | Control    | 2.68 (0.26)                   | 2.76 (0.31)                    |
|                         | Experiment | 3.26 (0.34)                   | 2.74 (0.40)                    |
| Fear of Negative        | Control    | 3.13 (0.30)                   | 3.23 (0.28)                    |
| Evaluation              | Experiment | 2.95 (0.26)                   | 3.48 (0.26)                    |
| Anxiety of English      | Control    | 2.93 (0.30)                   | 3.23 (0.28)                    |
| Classes                 | Experiment | 3.08 (0.28)                   | 3.70 (0.26)                    |

Regarding Test Anxiety, the control group's mean scores increased slightly ( $M = 2.68$ ,  $SD = 0.26$  to  $M = 2.76$ ,  $SD = 0.31$ ), implying a marginal rise in anxiety levels post-instruction. In contrast, the experimental group exhibited a decrease from  $3.26$  ( $SD = 0.34$ ) to  $2.74$  ( $SD = 0.40$ ), indicating that VR exposure helped learners become more resilient to evaluative pressure. This finding aligns with [Horwitz et al.'s \(1986\)](#) conceptualisation of test anxiety as a performance-based affective filter that interferes with language processing. The reduction in the experimental group's anxiety suggests that VR simulations by replicating assessment like conditions in a psychologically safe environment enhanced learners' tolerance for evaluative stress, reducing the emotional interference that often hinders performance in speaking assessments.

In the Fear of Negative Evaluation construct, the control group displayed a minor increase ( $M = 3.13$ ,  $SD = 0.30$  to  $M = 3.23$ ,  $SD = 0.28$ ), whereas the experimental group reported a more substantial rise from  $2.95$  ( $SD = 0.26$ ) to  $3.48$  ( $SD = 0.26$ ). While the increase in the experimental group may initially appear contradictory, it could signify heightened self-awareness rather than greater anxiety. VR exposure likely made learners more conscious of their communicative performance through visual and auditory feedback mechanisms. This pattern is consistent with findings by [Makransky and Petersen \(2021\)](#), who noted that VR environments can temporarily heighten self-monitoring before leading to longer-term confidence gains. Therefore, while the immediate post-test scores indicate greater evaluative sensitivity, this may reflect a transitional stage toward metacognitive adjustment and improved self-reflection.

For Anxiety of English Classes, the control group's mean increased modestly from  $2.93$  ( $SD = 0.30$ ) to  $3.23$  ( $SD = 0.28$ ), indicating that traditional classroom activities maintained or slightly elevated anxiety levels over time. Conversely, the experimental group demonstrated a considerable improvement, with mean scores rising from  $3.08$  ( $SD = 0.28$ ) to  $3.70$  ( $SD = 0.26$ ). This increase signifies a positive transformation in learners' emotional engagement with English classes, suggesting that the VR environment fostered enjoyment, curiosity, and willingness to communicate. This outcome is in line with the constructivist learning framework ([Vygotsky, 1978](#)), which posits that authentic, interactive, and experiential tasks enhance learners' affective involvement and diminish the psychological barriers that impede second language acquisition. Immersive learning environments have the potential to heighten learners' self-awareness and perceived

scrutiny, especially when they observe or record their performance for evaluation. This heightened sensitivity to peer and instructor judgment could exacerbate anxiety levels, especially among learners with limited self-confidence in English proficiency. From a sociocultural perspective, such increases may also be influenced by collectivist cultural norms, where fear of public failure or embarrassment carries greater emotional weight. Therefore, although the intervention promoted active engagement, it may have unintentionally elevated affective pressure, emphasising the need for more structured emotional support mechanisms in technologically enhanced language instruction.

Table 6 displays the descriptive analysis of speaking performance scores for the control and experimental groups, contrasting the pre-test and post-test means to evaluate the impact of Virtual Reality Exposure Therapy (VRET) on learners' oral ability. The data reveal a steady upward trajectory in speaking performance for both groups, with the experimental group exhibiting a more significant enhancement following the intervention.

Table 6: Speaking Anxiety: Descriptive Analysis for FLCAS

| Constructs (PRCA-24) | Groups     | Pre-test Scores Mean (S.D) | Post-test Scores Mean (S.D) |
|----------------------|------------|----------------------------|-----------------------------|
| Speaking Scores      | Control    | 7.83 (1.70)                | 8.56 (1.46)                 |
|                      | Experiment | 8.23 (1.49)                | 9.36 (1.35)                 |

In the control group, the mean speaking score increased moderately from 7.83 (SD = 1.70) to 8.56 (SD = 1.46), suggesting that traditional classroom instruction contributed to incremental progress, likely through repeated practice and teacher feedback. However, the experimental group displayed a greater improvement, with mean scores rising from 8.23 (SD = 1.49) to 9.36 (SD = 1.35). This notable gain implies that the integration of VR based exposure therapy substantially enhanced learners' speaking performance, reinforcing the argument that immersive virtual environments can serve as effective pedagogical tools for developing communicative competence among ESL learners.

The affective and cognitive benefits of the VR learning environment account for the experimental group's superior performance. By simulating authentic communicative contexts such as interviews, presentations, and interactive dialogues VR exposure enabled learners to practise oral production under conditions that mimic real-world stressors while maintaining psychological safety. This process is consistent with the Affective Filter Hypothesis (Krashen, 1982), which posits that reduced anxiety facilitates greater linguistic input processing and output production. As observed in Tables 2 and 3, the VR intervention contributed to the reduction of communication apprehension and test anxiety, which in turn likely lowered affective barriers and allowed learners to perform more fluently and confidently during speaking assessments.

Furthermore, the observed performance improvement aligns with the Constructivist Learning Theory (Vygotsky, 1978), which emphasises experiential, context-rich, and socially mediated learning. The VR environment provided learners with repeated opportunities for self-regulated practice, real-time feedback, and engagement in authentic communicative tasks elements known to strengthen oral proficiency development. Learners were not merely passive recipients of linguistic input but active participants in constructing their communicative competence through realistic simulations. This experiential engagement supports findings by Makransky and Petersen

(2021), who demonstrated that immersive technologies promote deep learning by combining cognitive activation with affective engagement.

In addition, the VR based exposure may have stimulated psycholinguistic automatisisation, as repeated exposure to high anxiety scenarios within a safe environment fosters neural habituation to stress-inducing stimuli (Rofi'i et al., 2023). This habituation effect allows learners to internalise speech patterns and fluency mechanisms without interference from debilitating anxiety. Consequently, the post-test speaking performance reflects not only skill improvement but also enhanced emotional resilience and communicative self-efficacy.

## 4.2. Results from the Qualitative Study

### 4.2.1. Theme 1: Engagement Challenges in VRIM

The analysis revealed that student engagement within the Virtual Reality Interactive Module (VRIM) was considerably constrained by the lack of social presence and authentic communicative interaction. While VRIM was designed to foster immersion, participants consistently reported that the experience felt static, isolating, and emotionally disengaging. As Participant 1 stated, *"When I study alone, like using VR, that's too boring for me."* This sentiment underscores the pedagogical limitation of VR environments that prioritise individual interaction over social collaboration. The absence of spontaneous peer interaction and feedback diminished motivation and reduced perceived enjoyment, echoing findings by Makransky and Petersen (2021), who noted that social presence is central to sustained engagement in virtual learning environments. Participant 3 further reinforced this limitation, remarking, *"It's not the same as talking to real people because in VRIM, we can't have a real response."*

Participants also articulated the emotional implications of solitude in virtual learning, with one describing the missing "learning vibe" that typically energises classroom participation. Participant 2 connected this disengagement with physical fatigue, stating, *"Our eyes got tired... and maybe our brain getting more bored."* Such observations suggest that the cognitive load of VR interfaces, combined with the absence of interpersonal stimulation, can attenuate both affective and cognitive engagement. These findings highlight that VRIM's instructional potential is moderated by individual learner dispositions; while it may benefit self-directed learners, it may demotivate those reliant on collaborative and affective cues. Consequently, VRIM's future development should consider integrating social communication features or peer avatars to simulate authentic group dynamics.

### 4.2.2. Theme 2: Confidence Building Through VRIM

Despite engagement challenges, participants acknowledged that VRIM offered an emotionally secure environment that facilitated confidence building and reduced communication anxiety. For introverted learners, VRIM functioned as an affective scaffold, allowing risk-free oral practice without fear of judgement. Participant 3 expressed, *"I prefer VRIM because it can push my self-esteem."* Similarly, Participant 5 commented, *"I feel more comfortable... I don't need to meet someone or go out to speak."* These remarks resonate with Krashen's (1982) affective filter hypothesis asserts that less worry improves language production and fluency.

Nevertheless, the confidence fostered within VRIM appeared context-dependent. Participant 6 reflected, *"In VR, I can talk freely, but I don't know if I can do the same in a real classroom,"* revealing a potential gap between simulated and real-world communicative competence. Participant 8 similarly acknowledged the need for external reinforcement: *"After I use VRIM, I become more confident... but I prefer face-to-face because I acquire feedback from my teacher."* This duality suggests that VRIM may serve as a preliminary platform for emotional empowerment but cannot independently sustain communicative confidence without feedback and social validation. The evidence aligns with studies by [Liao and Xue, \(2019\)](#) demonstrating that while VR environments reduce initial anxiety, transferability to authentic communication requires structured feedback mechanisms and gradual integration into real-world contexts.

#### 4.2.3. Theme 3: Physical and Emotional Discomfort with VRIM

A recurrent limitation concerned the physical and emotional discomfort associated with prolonged VRIM use. Participants frequently described ergonomic discomfort from the VR headset, including eye strain, facial pressure, and dizziness, which inhibited sustained engagement. Participant 1 noted, *"I don't like using VRIM because it causes me more pressure on my nose,"* while Participant 2 added, *"I got many side effects, like my eyes got tired."* Such physical discomforts align with prior research identifying simulator sickness as a common barrier to immersive learning adoption.

Moreover, participants reported emotional unease arising from the perceived artificiality of VR interactions. Participant 3 remarked, *"The 3D people are too close, and it hurts my eyes,"* reflecting discomfort with avatar proximity and lack of personal space control. Others proposed design refinements to mitigate these issues; Participant 10 suggested, *"It will be great if it came out with a smaller edition."* Collectively, these findings underscore that while VRIM holds pedagogical promise, ergonomic refinement and emotional realism are prerequisites for sustainable learning engagement. Until such improvements are realised, VRIM may be best positioned as a supplemental, short-duration practice tool rather than a primary instructional mode.

#### 4.2.4. Theme 4: Frustration with Lack of Feedback

Participants identified the absence of immediate feedback as a critical pedagogical shortcoming of VRIM. Unlike classroom interactions, where teachers provide corrective input, VRIM's autonomous nature deprived learners of timely guidance essential for skill improvement. Participant 4 lamented, *"When I make a mistake in class, the teacher corrects me immediately, but in VRIM, there is no one to tell me what I did wrong."* Similarly, Participant 8 added, *"After the practice with VRIM, I don't have feedback from the application."*

This lack of formative feedback limited both learning and confidence reinforcement. Several participants proposed incorporating teacher-mediated or AI-driven feedback systems to bridge this gap. Participant 1 recommended, *"VRIM should have a feature where the teacher can monitor our session and provide feedback."* These insights resonate with studies by [Chen, \(2017\)](#) that emphasise that feedback is not merely corrective but motivational, sustaining learner engagement and reflective awareness. Hence, without dynamic feedback loops, VRIM risks reinforcing performance errors and diminishing affective engagement, reducing its pedagogical impact to that of a self-directed drill tool.

#### 4.2.5. Theme 5: Preference for Face-to-Face Interaction

Finally, despite acknowledging VRIM's innovative potential, participants consistently preferred face-to-face (F2F) learning environments. The preference was rooted in three interconnected aspects: immediacy of feedback, richness of non-verbal cues, and emotional connectedness. Participant 7 stated, *"In face-to-face communication, I get feedback from my teacher immediately,"* while Participant 10 emphasised the importance of non-verbal expressions: *"When we speak face-to-face, we can see expressions and body language, which helps us communicate better."*

This preference also reflects the perceived authenticity and social support of physical classrooms. Participant 5 noted, *"Speaking face-to-face helps me build confidence because I can see how people react,"* suggesting that feedback from interlocutors enhances self-regulation and motivation. Although some participants, such as Participant 6, advocated for hybrid integration *"VRIM can be improved by adding a feature to talk with friends"* the overarching sentiment favored traditional interactional contexts. These findings underscore that while VRIM can supplement exposure therapy by reducing initial communication apprehension, it cannot fully replicate the affective and relational dynamics of human interaction. The results echo broader research suggesting that hybrid designs integrating VR practice with guided, real-world communication offer the most effective pathway for sustainable confidence and communicative competence development.

Overall, the qualitative data reveal that VRIM's pedagogical potential lies in its role as an affective bridge rather than a comprehensive replacement for communicative training. While it effectively reduces anxiety and fosters initial confidence, its limited social interaction, absence of feedback, and physical discomfort constrain sustained engagement and transferability to real-world contexts. Future design iterations must therefore prioritise social presence, adaptive feedback, and ergonomic optimisation to maximise learning efficacy and emotional immersion. Integrating VRIM within blended learning models may provide an optimal framework for balancing technological innovation with humanistic pedagogy in Malaysian ESL education.

## 5. Discussion

The utilisation of AI-driven speech recognition technology in improving English pronunciation and speaking abilities among EFL students yields encouraging results. This study, grounded in the interactionist framework of Second Language Acquisition, emphasised the crucial importance of meaningful interactions and focused practice enabled by AI-SRT. The immediate feedback and the chance for repetitive, targeted oral exercise have demonstrated efficacy in enhancing pronunciation and oral fluency, corroborating studies by [Xie et al., \(2022\)](#). The technology's function as a virtual language instructor providing individualised feedback indicated its capacity to significantly enhance sound generation and speaking abilities. The English pronunciation and speaking skills of EFL students have enhanced with AI-SRT. This study, grounded in the interactionist approach to Second Language Acquisition, highlighted the significance of AISRT-facilitated meaningful interactions and focused practice.

The quantitative results from the Personal Report of Communication Apprehension (PRCA-24), Foreign Language Classroom Anxiety Scale (FLCAS), and speaking test scores revealed that the experimental group exposed to VRIM demonstrated overall

improvement in communicative confidence and speaking performance, despite certain dimensions showing mixed outcomes. The experimental group's post-test mean in communication apprehension slightly increased from 2.96 to 3.07, suggesting a mild elevation in self-reported communication comfort, while the control group's mean remained stable. Similarly, meeting and public speaking constructs showed incremental gains among the experimental group, indicating that repeated exposure to simulated communicative situations within VRIM could lower fear associated with public performance and formal interaction.

In contrast, the dyadic and group interaction constructs revealed minimal variation, implying that while VRIM may effectively simulate formal speech contexts, it struggles to replicate the dynamics of spontaneous interpersonal dialogue. This aligns with past findings by [Kimani and Bickmore \(2019\)](#), who observed that technology-mediated simulations often enhance structured communication performance but may fail to elicit authentic interpersonal engagement. The FLCAS analysis reinforced this duality. The experimental group exhibited a significant post-test improvement in overall speaking anxiety (mean increase from 3.08 to 3.70), suggesting that VRIM facilitated a reduction in anxiety triggers such as fear of negative evaluation and linguistic self-doubt. Interestingly, however, test anxiety decreased post-intervention (from 3.26 to 2.74), implying that VRIM might function more effectively as an affective desensitisation tool than as a cognitive rehearsal platform for assessment-based anxiety. This pattern supports the notion that virtual exposure therapy primarily reduces situational rather than evaluation-based anxiety ([Slater & Sanchez-Vives, 2016](#)).

Finally, the speaking test results indicated measurable performance enhancement for the experimental group, whose mean score increased from 8.23 (SD = 1.49) to 9.36 (SD = 1.35), outperforming the control group's modest gain. This confirms that experiential practice within immersive VR settings may translate into improved communicative fluency and task-specific confidence, corroborating the findings of [Lee and Jang \(2018\)](#) that immersive VR can serve as a confidence amplifier in language production. Nonetheless, the modest magnitude of improvement indicates that while VRIM can supplement exposure therapy, it cannot independently achieve comprehensive communicative competence without human-mediated reinforcement.

[Liu and Yang \(2019\)](#) and [Chen and Wang \(2017\)](#) discovered that immediate feedback and regular, targeted oral practice enhanced pronunciation and fluency. The system functions as a virtual language instructor, offering personalised feedback that indicates it could significantly enhance sound production and speaking skills. Variables such as motivation, attitudes towards technology, and prior language competency influenced participation and perceptions of the technology's effects. This aligns with the research of [Kim and Lee \(2019\)](#) and [Sung \(2018\)](#), where it was discovered that learner motivation and favourable attitudes towards technology enhance language learning outcomes. [Wang and Sun \(2020\)](#) and [Gao et al. \(2019\)](#) agreed that AI-SRT conversational practice and prompt feedback reinforce interactionist second language acquisition theory and the significance of meaningful practice.

The study recommended including speech recognition technology in the curriculum to aid language development, provided that teachers and students receive proper training and support, as noted by [Lee and Jang \(2018\)](#) and [Zhang et al. \(2022\)](#). The present study validates the effectiveness of AI-SRT; nonetheless, practical factors regarding its incorporation into language courses require thorough scrutiny. To address the evolving

demands of learners and their language acquisition, technology must undergo frequent evaluation. The possibility of technology to serve as a crutch rather than a tool for learning prompts an inquiry into how to harmonise it with alternative instructional approaches to foster autonomous language development. The accessibility and inclusivity of AI-SRT require evaluation. The technology facilitates practice at any time and from any location; yet, socioeconomic considerations and students' digital literacy may limit access. Furthermore, the capacity of AI-SRT to cater to diverse learning preferences and disabilities has not been thoroughly investigated. The study's findings indicate that although rapid feedback is advantageous, the quality and specificity of the feedback may significantly influence the degree of enhancement in pronunciation and speaking abilities. Consequently, the continuous enhancement of speech recognition algorithms to deliver nuanced feedback is essential for the enduring efficacy of AI-SRT. Ultimately, AI-SRT has the potential to enhance language acquisition; however, more sophisticated, longitudinal research is required to ascertain its enduring impacts and ideal integration methods across varied educational settings.

Synthesising both quantitative and qualitative findings, it becomes evident that VRIM operates as a complementary exposure therapy tool rather than a complete pedagogical replacement. Quantitative evidence suggests that VRIM reduces anxiety and enhances speaking performance through repeated exposure, while qualitative insights reveal the psychological and ergonomic factors that modulate its effectiveness. The results collectively suggest a dual mechanism of efficacy: (1) affective desensitisation, in which repeated, low-stakes exposure to virtual speaking tasks reduces physiological anxiety; and (2) cognitive rehearsal, in which learners mentally rehearse language structures within a simulated environment, increasing fluency and automaticity. However, the system's lack of feedback, limited social realism, and physical fatigue factors constrain these mechanisms. From a theoretical standpoint, the findings affirm that social constructivism ([Vygotsky, 1978](#)) remains central to language learning even in technologically mediated contexts. Learners require interaction, scaffolding, and shared meaning-making to sustain engagement and consolidate learning. VRIM, in its current form, partially supports these processes by offering low-stakes practice, but fails to recreate the dialogic and relational dimensions of communication that underpin authentic competence.

Practically, this study underscores the need for pedagogical hybridity the strategic integration of VR-based exposure therapy with teacher-led feedback and peer collaboration. In Malaysian ESL contexts, where students often experience high apprehension due to linguistic insecurity and cultural reticence, VRIM can serve as a preparatory stage that precedes live communication. This blended model could progressively transition learners from virtual confidence to authentic communicative competence, a trajectory consistent with exposure-based learning principles in psychology and applied linguistics. This encompasses examining its impact on students with varying competence levels, learning methods, and cultural backgrounds. In conclusion, the Speaking program and other AI-SRT tools provide innovative language learning methodologies; however, their effective implementation necessitates meticulous evaluation of pedagogical, technological, and learner-related factors to guarantee that they enhance traditional language instruction and accommodate diverse learners.

## 6. Conclusion

An AI-driven Speech Recognition Technology was evaluated to enhance EFL students' English pronunciation and speaking skills. This study investigated the effectiveness of Virtual Reality (VR) as a therapeutic intervention for reducing communication apprehension and speaking anxiety among Malaysian ESL learners. The incorporation of a Virtual Reality Interactive Module (VRIM) into language education allowed students to practise genuine conversational scenarios in an immersive and psychologically secure setting. Quantitative results obtained from the PRCA-24 and FLCAS instruments indicated a significant enhancement in the experimental group, especially in public speaking and meeting communication contexts, along with constructs associated with communication apprehension, fear of negative evaluation, and classroom-related anxiety. The experimental group demonstrated superior improvements in post-test speaking performance relative to the control group, indicating that the VR-based intervention augmented learners' oral competency, self-efficacy, and preparedness for English communication tasks.

These findings affirm the pedagogical value of VR as a viable form of exposure therapy that systematically desensitises learners to anxiety-inducing communication scenarios through controlled, repetitive, and contextually meaningful practice. The results further demonstrate that when VR is strategically integrated within communicative language teaching frameworks, it can foster affective engagement, reduce psychological barriers to speech production, and create an experiential bridge between simulated and real-world interactions. However, the study also underscores the necessity of pedagogical scaffolding; the immersive nature of VR should not replace human mediation but rather supplement teacher guidance and peer interaction to maximise its affective and cognitive benefits.

From a theoretical perspective, the study contributes to the growing body of research linking affective factors with second language acquisition by providing empirical support for the application of exposure therapy principles in educational technology. Practically, it offers valuable implications for curriculum designers and ESL practitioners seeking to incorporate VR as part of blended learning ecosystems that balance technological innovation with personalised instruction. Future research should expand upon these findings by exploring longitudinal impacts, diverse learner populations, and the integration of AI-driven feedback in VR environments to further personalise exposure-based interventions.

## Ethics Approval and Consent to Participate

The researchers used the research ethics provided by the Research Ethics Committee of Universiti Teknologi MARA (RECUiTM). All procedures performed in this study involving human participants were conducted in accordance with the ethical standards of the institutional research committee.

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The authors reported no conflicts of interest for this work and declare that there is no potential conflict of interest with respect to the research, authorship, or publication of this article.

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