



The Effectiveness Of Interactive Arabic Language Learning Through Virtual Reality Among University Students At UNIKHAMS Jember

Hasyim Asy'ari^{1*}, Ramadhaniati Fitri², Evi Nurus Suroiyah³

¹Universitas Islam KH. Achmad Muzakki Syah, Indonesia

²STIT Hamzah Al Fansuri Sibolga Barus, Indonesia

³Universitas Islam Negeri Maulana Malik Ibrahim Malang, Indonesia

E-mail: iim.ba23@gmail.com*, ramadhaniatyfitri@gmail.com, evienurus@uin-malang.ac.id

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Abstract

Arabic classes in Indonesian Islamic higher education still rely heavily on lectures, and many students show low engagement and motivation. This study tested whether interactive Arabic instruction through virtual reality improves listening and speaking skills more than conventional instruction. It also examined how students responded to the medium. The study used a quantitative quasi-experimental design with a pretest, a posttest, and a control group. Sixty third-semester students of an Arabic Education study program took part. Thirty students formed the experimental group and learned through virtual reality, while thirty formed the control group and followed conventional lessons. Tests, a Likert-scale questionnaire, and observation sheets provided the data, and paired and independent samples t-tests served for the analysis. Both groups started at almost the same level (62.4 and 61.8). The experimental group reached a posttest mean of 84.3 and the control group 72.6, a gain of 21.9 against 10.8 points. The posttest difference between groups was significant at the 0.05 level. Most experimental students reported higher motivation (90%), easier understanding of conversational context (87%), and more enjoyable lessons (83%). Virtual reality serves as an effective complement to Arabic skills instruction when teachers embed it in a structured instructional design.

Keywords: Arabic language learning; virtual reality; listening skill; speaking skill; quasi-experimental design

Introduction

Arabic holds a strategic place in global education as a language of religion, scholarship, and cross-cultural communication. More than 313 million people speak it, and 25 countries and independent territories use it as a first language (D. Hess, 2021). Globalization affects Islamic higher education in two directions. It opens room for modern pedagogy, yet it also deepens a digital divide that reportedly affects 55% of rural Islamic institutions (Rahimadinullah & Kholisin, 2025). Technology has also changed Arabic teaching methods by widening access and simplifying instruction (Khan & Ahmad, 2024). Among these innovations, virtual reality (VR)

stands out because it creates immersive and contextual learning environments. A meta-analysis of 21 quantitative studies with 1,144 participants found that VR-assisted language learning produced a medium effect on linguistic gains (Hedges' $g = 0.662$, 95% CI [0.398, 0.925], $p < .001$) and on affective gains (Hedges' $g = 0.570$, 95% CI [0.309, 0.831], $p < .001$) compared with non-VR conditions (B. Chen et al., 2022). Another meta-analysis of 41 randomized controlled studies concluded that VR lowers anxiety and raises motivation, performance, satisfaction, and self-efficacy in language learning (Yu & Duan, 2024).

In Indonesia, Arabic is a required subject in madrasas, universities, and many secondary schools, so its development calls for technology-supported instruction (Ritonga et al., 2024). Classroom practice often lags behind this demand. Teachers repeat the same methods, and lectures, direct instruction, and teacher presentations dominate the lesson (Roslan & Sahrir, 2020). As a result, many students lose interest because they find the material difficult and the media unappealing (Ritonga et al., 2024). This study treats VR as the independent variable and Arabic listening (*maharah istima'*) and speaking (*maharah kalam*) skills as the dependent variables. Motivation and engagement form the affective dimension under observation. Two theories frame the study. A framework that combines constructivism with cognitive load theory holds that VR optimizes foreign language learning through meaningful experience (Song et al., 2023). The cognitive theory of multimedia learning states that words presented with pictures produce better understanding than words alone (Mayer & Moreno, 2002).

Empirical work on VR in language learning has grown quickly, but most of it concerns English as a foreign language. VR delivered through mobile head-mounted displays improved listening comprehension and retention (Tai & Chen, 2021), and VR supported speaking development through situated and authentic environments (Irons, 2023). A PRISMA systematic review reported a positive relationship between immersive VR and foreign language education, particularly against conventional teaching, along with gains in motivation and satisfaction (Peixoto et al., 2021). A meta-analysis of extended reality confirmed its benefits for language learning (J. Chen et al., 2022). In vocabulary learning, VR outperformed word-word association learning (Legault et al., 2019), increased vocabulary acquisition and motivation in problem-based learning (C.-H. Chen et al., 2021), and improved retention among adolescent learners (Tai et al., 2022).

Studies on Arabic have started to appear. A needs analysis for an Arabic-VR application found strong demand and positive student responses for grammar learning (Ali & Ghalib, 2024). A VR medium built on the Delightex platform raised Arabic speaking scores from 66.1 to 85.5, with 28 of 30 students meeting the minimum mastery criterion and an N-Gain of 0.57 (Humayrah et al., 2025). A VR vocabulary application tested with 69 university students received high mean scores for motivation, engagement, and comprehension (Nordin et al., 2025). A VR vocabulary medium for Islamic primary schools obtained expert ratings of 100% for content and language and 97% for design (Yasmin et al., 2024). University students also rated augmented reality for Arabic vocabulary positively, with an overall mean of 4.48 (Sahrim et al., 2023).

The evidence is not uniform. In a between-subjects study ($N = 63$), learners who viewed annotated 360° pictures on a desktop monitor scored significantly higher than learners who used a VR headset or standard 2D pictures (Papin & Kaplan-Rakowski, 2024). A study of 91 learners found higher vocabulary scores under high-immersion VR, but the difference was not significant, and interaction with virtual objects did not change outcomes (Kaplan-Rakowski & Thrasher, 2025). Research with 30 Japanese students found no significant difference among voice, video, and VR modes in reducing language anxiety, even though students rated VR as the easiest and most enjoyable mode (York et al., 2021). Yu and Duan (2024) also observed the same benefits whether learners used immersive or non-immersive environments. These results indicate that VR effects depend on instructional design and context rather than on immersion alone. B. Chen et al. (2022) noted that most earlier studies were qualitative and offered little substantial evidence. Irons (2023) reported few studies on the strengths and weaknesses of VR for speaking

skills. Ali and Ghalib (2024) found that research on teaching Arabic with VR remains limited, especially from the perspective of university students. In Indonesia, Arabic VR studies mostly take the form of research and development, needs analysis, and design testing, and few measure learning outcomes through controlled experiments.

This study provides controlled experimental evidence on how VR affects Arabic learning outcomes in Indonesian Islamic higher education. It also considers real barriers to implementation, such as high device costs (Kumar, 2025), expensive headsets (Meccawy, 2023), and limited infrastructure and staff training in Indonesia (Rabani et al., 2023). Three questions guide the study. (1) Do Arabic learning outcomes differ significantly between students taught with VR and students taught conventionally? (2) How effective is VR in improving students' Arabic listening and speaking skills? (3) How do students respond to VR-based interactive Arabic learning? Accordingly, this study aims to test the effectiveness of VR-based interactive Arabic instruction on the listening and speaking skills of UNIKHAMS Jember students and to analyze their responses and motivation toward the medium.

Method

This study used a quantitative approach with a quasi-experimental pretest-posttest nonequivalent control group design (Creswell & Creswell, 2018). The design compared learning outcomes between an experimental group that learned Arabic through VR and a control group that followed conventional instruction. The pretest allowed the researchers to check initial equivalence between the groups. A quasi-experiment suits educational settings because students study in intact classes, and random assignment of individuals would disrupt academic administration (L. Cohen et al., 2018; Shadish et al., 2002). An untreated control group with pretest and posttest measures is the most widely used quasi-experimental design, because the pretest helps researchers estimate selection bias (Shadish et al., 2002). Earlier VR language studies used the same comparative logic. Tai and Chen (2021) assigned 72 seventh graders to VR and video groups to measure listening comprehension. Tai et al. (2022) compared intact experimental and control classes in vocabulary learning, and C.-H. Chen et al. (2021) applied a similar pattern with 84 university students. Table 1 presents the design.

Table 1. *Research Design*

Group	Pretest	Treatment	Posttest
Experimental	O ₁	X (VR-based instruction)	O ₂
Control	O ₁	Conventional instruction	O ₂

Note. O₁ = pretest; O₂ = posttest; X = treatment with VR learning media.

The study took place in the Arabic Education Study Program at UNIKHAMS Jember. The program has an educational technology laboratory and VR devices. Students used the Meta Quest 2 headset with the Mondly VR application during the VR sessions. Participants were 60 third-semester students enrolled in Arabic skills courses (*maharah kalam* and *maharah istima*). The researchers used purposive sampling, which selects participants whose characteristics match the research focus (Etikan et al., 2016). Here, all participants were taking skills courses at the same level. Nordin et al. (2025) applied the same sampling technique in a VR study of Arabic learning. The participants came from two existing classes. One class of 30 students formed the experimental group, and the other class of 30 students formed the control group. Both groups covered the same material and received the same instructional time.

The study used three instruments. First, a pretest and a posttest measured listening and speaking skills, including supporting vocabulary. Pre- and post-intervention tests are standard in VR language research, as in studies of listening comprehension (Tai & Chen, 2021) and vocabulary acquisition (Tai et al., 2022). Second, a closed Likert-scale questionnaire captured

students' responses, motivation, and engagement with VR (Joshi et al., 2015). The researchers checked its internal consistency with Cronbach's alpha (Tavakol & Dennick, 2011), following an earlier Arabic augmented reality study (Sahrim et al., 2023). Third, an observation sheet recorded student engagement during the lessons. A panel of experts reviewed all instruments for content, language, and design before use (Lynn, 1986). Yasmin et al. (2024) used the same expert validation procedure when they developed VR media for Arabic vocabulary.

Data collection ran in three stages. In the first stage, both groups took an identical pretest. In the second stage, each group received its treatment with the same material and the same number of sessions. The treatment ran for eight weeks, with two sessions per week, for a total of 16 sessions. Each session lasted 90 minutes. The experimental group learned Arabic with VR, while the control group followed conventional lessons without VR. The researchers observed the experimental lessons with the observation sheet. In the third stage, both groups took the posttest, and the experimental group completed the response questionnaire on their perceptions, motivation, and learning experience.

Data analysis had two layers. Descriptive analysis reported frequencies, percentages, means, and standard deviations, mainly for the questionnaire data (Field, 2018). Inferential analysis used parametric tests. Before hypothesis testing, the researchers ran normality and homogeneity of variance tests to confirm the assumptions of parametric procedures (Field, 2018; Ghasemi & Zahediasl, 2012). A paired samples t-test compared pretest and posttest scores within each group, and an independent samples t-test compared posttest scores between the experimental and control groups (Field, 2018). The significance level was set at .05, and all computations ran in SPSS.

The study followed the ethical principles of educational research (L. Cohen et al., 2018). The researchers explained the aims, procedures, and possible effects of the study before participants gave informed consent. Participation was voluntary, and students could withdraw without any effect on their academic grades. The researchers protected participants' identities by reporting only aggregated data and used the data solely for this study.

Result

This section reports the pretest, posttest, and questionnaire data from 60 third-semester students, with 30 students in the experimental group and 30 in the control group. The results cover descriptive statistics, the paired samples t-test, the independent samples t-test, and student responses to VR. All analyses used $\alpha = .05$.

Descriptive Statistics of Learning Outcomes

Table 2 summarizes the mean pretest and posttest scores and the gain in each group.

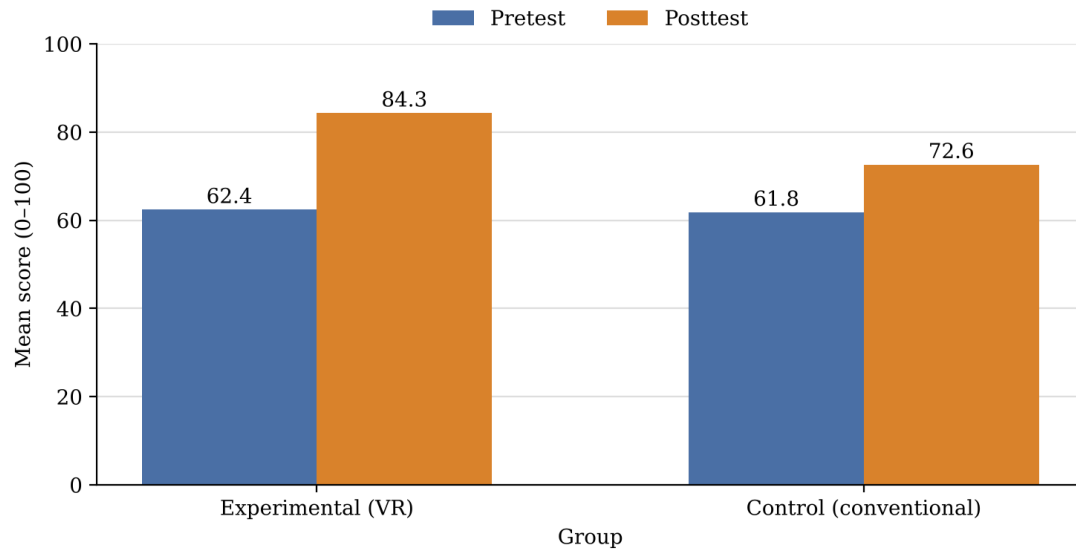
Table 2. *Descriptive Statistics of Arabic Learning Outcomes*

Group	n	Mean Pretest	Mean Posttest	Gain
Experimental (VR)	30	62.4	84.3	21.9
Control (conventional)	30	61.8	72.6	10.8

Note. Maximum score = 100. Gain = mean posttest minus mean pretest.

Both groups started from almost the same point, with a pretest difference of only 0.6 points. After the treatment, the experimental group scored 84.3 on the posttest and the control group scored 72.6, a difference of 11.7 points. Figure 1 shows a steeper rise in the experimental group.

Figure 1. *Mean Pretest and Posttest Scores of the Experimental (VR) and Control (Conventional) Groups*



Paired Samples *t*-Test

Table 3 reports the paired samples *t*-test that compared pretest and posttest scores within each group.

Table 3. Paired Samples *t*-Test of Pretest and Posttest Scores by Group

Group	Sig. (2-tailed)	α	Decision
Experimental (VR)	0.000	0.05	H ₀ rejected
Control (conventional)	0.004	0.05	H ₀ rejected

Note. H₀ = no difference between pretest and posttest scores within the group.

Both groups showed significance values below .05, so scores changed significantly from pretest to posttest in each group. The size of the change differed. The experimental group gained 21.9 points, while the control group gained 10.8 points, about half as much.

Independent Samples *t*-Test

Table 4 reports the independent samples *t*-test that compared posttest scores between the two groups.

Table 4. Independent Samples *t*-Test of Posttest Scores

Comparison	Sig. (2-tailed)	α	Decision
Posttest (experimental vs. control)	0.001	0.05	H ₀ rejected

Note. H₀ = no difference in posttest scores between the experimental and control groups.

The significance value fell below .05, so the posttest scores of the two groups differed significantly after the treatment. This result matches the descriptive pattern in Table 2 and Figure 1: students who learned with VR achieved higher final scores than students who learned conventionally.

Student Responses to VR

The 30 students in the experimental group completed a closed questionnaire after the treatment. Table 5 presents the percentage of agreement for three response indicators.

Table 5. Experimental Group Responses to VR-Based Arabic Learning (*n* = 30)

No.	Response Indicator	Agreement (%)
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No.	Response Indicator	Agreement (%)
1	Felt more motivated to learn Arabic with VR	90
2	Found it easier to understand Arabic conversational context	87
3	Found the lessons more enjoyable and less boring	83

Note. Percentages show the proportion of students who agreed with each indicator.

All three indicators fell between 83% and 90%. Motivation received the highest agreement, followed by understanding of conversational context and enjoyment of the lessons. Overall, the experimental group gained more (21.9 points) than the control group (10.8 points), the posttest difference was significant ($p = .001$), and most experimental students responded positively to VR.

Discussion

This study tested the effectiveness of VR-based interactive Arabic instruction on the listening and speaking skills of UNIKHAMS Jember students and examined their responses to the medium. VR proved more effective than conventional instruction. Both groups began with nearly identical pretest means (62.4 and 61.8). After the treatment, the experimental group reached 84.3 and the control group 72.6, so the experimental gain was about twice the control gain. The paired samples t-test confirmed significant change within each group, and the independent samples t-test on posttest scores yielded a significance value of .001. The null hypothesis of no difference between groups is therefore rejected. The questionnaire supports this result: 90% of experimental students felt more motivated, 87% found conversational context easier to understand, and 83% found the lessons more enjoyable.

Mechanisms behind the Effect of VR

Three related pathways explain the advantage of the experimental group. The first pathway is contextual. VR lets students practice Arabic in communicative settings that resemble real situations instead of memorizing words and patterns out of context. This mechanism agrees with evidence that VR supports speaking development through situated and authentic environments (Irons, 2023) and with the use of situated learning in VR-enhanced language instruction (Yan et al., 2024). The capacity to supply context likely explains why 87% of students reported easier understanding of conversational context, the indicator most closely tied to the strength of VR.

The second pathway is cognitive. The cognitive theory of multimedia learning holds that words and pictures presented together produce better understanding than words alone (Mayer & Moreno, 2002). This principle underpins a framework that combines constructivism and cognitive load theory to optimize foreign language learning in immersive environments (Song et al., 2023). Instructional design practice applies the same principle and recommends words with graphics rather than words alone in digital learning (A. N. Hess & Greer, 2016). In this view, VR works because it packages linguistic input into meaningful visual and contextual representations, not because the device is new.

The third pathway is affective. Higher motivation and lower affective barriers probably mediated the score gains. Meta-analytic evidence shows that VR benefits both linguistic and affective outcomes (Yu & Duan, 2024). Speaking practice in immersive VR produced lower foreign language anxiety scores than practice through video conferencing (Kaplan-Rakowski & Gruber, 2023). Repeated VR public speaking practice reduced anxiety and improved clarity, fluency, and confidence (Park et al., 2025), and an AI-integrated VR oral training application improved speaking and reduced anxiety (Huang et al., 2025). These results fit the high agreement on motivation (90%) and enjoyment (83%) in the present study.

Consistency with Previous Studies

The direction of the present results agrees with meta-analytic estimates of medium effects of VR on linguistic and affective gains (B. Chen et al., 2022). The present study therefore follows the general trend in the literature and extends it to a context that few experiments have examined. The skill-level results also agree with earlier work. The listening improvement mirrors reports that head-mounted VR raises listening comprehension and retention (Tai & Chen, 2021). For vocabulary, which supports both skills, VR outperformed association learning (Legault et al., 2019), raised acquisition and motivation in problem-based learning (C.-H. Chen et al., 2021), and improved retention among adolescents (Tai et al., 2022). A PRISMA review (Peixoto et al., 2021) and an extended reality meta-analysis (J. Chen et al., 2022) reached similar positive conclusions.

The findings also add to the small body of research on VR for Arabic. The Delightex study reported a rise in speaking scores from 66.1 to 85.5 (Humayrah et al., 2025), a pattern similar to the rise from 62.4 to 84.3 in the present experimental group. Studies of an Arabic VR vocabulary application (Nordin et al., 2025), VR media for madrasa vocabulary (Yasmin et al., 2024), augmented reality for Arabic vocabulary (Sahrim et al., 2023), and an Arabic-VR needs analysis (Ali & Ghalib, 2024) all reported positive responses. The present study complements this work with controlled experimental evidence on learning outcomes rather than on perceptions, needs, or product quality alone.

Inconsistencies with Previous Studies

Not all studies agree with these results. Desktop viewing of 360° pictures produced higher vocabulary scores than headset VR in one between-subjects study (Papin & Kaplan-Rakowski, 2024). High-immersion VR produced higher but not significantly different vocabulary scores, and interactivity with virtual objects had no significant effect (Kaplan-Rakowski & Thrasher, 2025). Voice, video, and VR modes did not differ significantly in reducing language anxiety among Japanese students (York et al., 2021). A ten-week longitudinal study of Spanish classes found that anxiety rose in both conditions, though less in the experimental group, while motivation and willingness to communicate did not differ between groups (Thrasher et al., 2026). A study of foreign language speaking anxiety found no significant effect of immersive VR on anxiety in real-life situations, because learners struggled to transfer the calm they felt in VR to actual communication (Ding, 2024).

Three explanations reconcile these differences. First, instructional design inside the virtual environment matters more than the degree of immersion. The superiority of desktop media in one study (Papin & Kaplan-Rakowski, 2024) and the null effect of interactivity in another (Kaplan-Rakowski & Thrasher, 2025) show that the advantage of VR is conditional. The present study embedded VR in lessons with structured content and fixed duration, so the measured effect reflects the medium combined with the design. Second, intervention length and the novelty effect may explain why short studies find large effects while others do not. A three-wave longitudinal study showed that the novelty of a virtual environment first hindered learning, and encoding improved as learners became familiar with it (Lee et al., 2025). Users also tend to rate satisfaction and perceived learning higher without real gains in learning (Miguel-Alonso et al., 2024). In contrast, a seven-week longitudinal study found no fading of the effect (Keller et al., 2024). The present results should therefore count as promising short-term evidence, not as proof of lasting effects. Third, the type of outcome shapes the conclusion. Effects weaken when studies measure transfer to real communication or changes in everyday anxiety (Ding, 2024). Effects appear clearly when studies measure performance on structured tasks and self-reported affect. This study measured skills with tests aligned to the course material, which places it in the second category.

The context of this study also differs from most comparison studies. Indonesian Islamic universities teach Arabic with limited communicative exposure, and lectures still dominate many classes (Roslan & Sahrir, 2020). Technology use in Indonesian Arabic teaching has grown,

including support for listening and speaking (Febriani & Anasruddin, 2020). Indonesian programs tend to stress productive skills such as speaking and writing, yet access to technology and curriculum standards remain uneven (Siregar et al., 2025). Under these conditions, an immersive environment can produce larger gains than in settings already rich in target-language input. This point explains the advantage of the experimental group and shows that VR should complement, not replace, existing instruction.

Implications

Theoretically, this study extends constructivism, cognitive load theory, and the cognitive theory of multimedia learning (Mayer & Moreno, 2002; Song et al., 2023) to Arabic instruction in Indonesian Islamic higher education. Earlier work in this context relied mainly on product development and needs analysis (Ali & Ghalib, 2024; Nordin et al., 2025; Yasmin et al., 2024). The results also support the proposition, drawn from inconsistent findings across studies, that the value of VR lies in its integration into meaningful instructional design rather than in immersion alone (Kaplan-Rakowski & Thrasher, 2025; Papin & Kaplan-Rakowski, 2024). The study thus reframes the question from whether VR works to the learning conditions under which VR outperforms conventional methods.

Practically, the results give lecturers, curriculum developers, and program managers an evidence base for adding immersive media to Arabic skills courses. Consistent gains in listening and speaking, together with positive responses on motivation, context, and enjoyment, show that VR can address the common complaints of boredom and lecture-dominated Arabic classes (Roslan & Sahrir, 2020). This recommendation agrees with other digital media that improved engagement and competence in Arabic listening and speaking (Fitriani et al., 2025) and with a messaging-based communicative approach that strengthened students' speaking confidence (Miswari et al., 2025).

Implementation still faces real barriers. Teachers describe classroom VR as complicated because of technical failures, costs, heavy initial effort, health concerns, and limited technological awareness (Rodríguez, 2024). The costs of devices and software licenses usually exceed institutional budgets (Hamash et al., 2026). Teachers also cite the lack of software, equipment, training, and infrastructure as the main barrier (Taggart et al., 2023). Most staff have received little or no VR training (Prieto et al., 2024). These conditions echo earlier reports on limited infrastructure and training in Indonesia (Rabani et al., 2023). A phased strategy therefore fits this context best. Programs can start with low-cost mobile VR, apply it to selected topics, and train lecturers before full adoption.

Conclusion

This study answered its three research questions. The posttest scores of students who learned Arabic with VR differed significantly from those of students who learned conventionally, although both groups started at the same level. The experimental group gained about twice as much as the control group in listening and speaking. Most students in the experimental group responded positively to VR, with the strongest agreement on motivation, followed by understanding of conversational context and enjoyment of the lessons. The study therefore met its aim: VR-based interactive instruction improved Arabic listening and speaking more than conventional instruction and strengthened the affective side of learning.

The study advances the field in three ways. Methodologically, it supplies controlled experimental evidence on VR in Arabic learning, where Indonesian research has relied mostly on product development, needs analysis, and design testing. Contextually, it extends testing to Indonesian Islamic higher education, where communicative exposure to Arabic is limited and teacher-centred classes persist. Theoretically, it supports the multimedia and constructivist accounts of VR learning and shows that the advantage of VR depends on instructional design and context rather than on immersion alone.

This study has several limitations that point to directions for future research. The quasi-experimental design without random assignment leaves room for selection bias, and the short intervention without a delayed posttest exposes the results to the novelty effect. Future studies should use random assignment across several institutions and run longer interventions with delayed posttests. The response data came from self-reports in the experimental group only, and the statistical report covers significance values only. Further work should add objective measures such as speaking anxiety scales and cognitive load indicators and report *t* values, degrees of freedom, effect sizes, and confidence intervals. The sample of 60 students from one program and two skills also limits generalization, so later studies should cover reading (*qira'ah*) and writing (*kitabab*) and compare headset VR with desktop 360° media. Finally, the study did not measure motion sickness, headset comfort, or other health and safety aspects. Future research should examine these aspects and involve lecturers in testing training models and VR content aligned with local Arabic curricula.

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