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FULL LENGTH ARTICLE

Immersive Learning with the Metaverse's Environment to Increase Academic Success and Motivation in Learning Arabic as a Second Language for Non-Native Speakers

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ABSTRACT

The metaverse's environment offers a unique opportunity for immersive learning experiences that can enhance education in ways never before possible. By creating virtual environments that simulate real-world scenarios, students can actively engage with the material and practice their skills in a safe and controlled setting. This technology has the potential to revolutionize the way we learn, making education more interactive, engaging, and effective for students of all ages. The integration of the metaverse's environment into Arabic language learning can provide non-native speakers with a more engaging and interactive learning experience. By creating virtual environments that simulate real-life situations, students can practice their language skills in a more realistic and practical way. The participants were 60 learners from non-native speakers enrolled in an intermediate-level Arabic language course at the Arabic Language Center for Non-Native Speakers, Faculty of Education, Mansoura University. The findings showed that the immersive approach could help increase students' motivation to learn Arabic as a second language, leading to greater academic success in the subject. Additionally, the use of the metaverse can help bridge the gap between language learners and native speakers, providing opportunities for real-time communication and cultural exchange.

Keywords: Metaverse's environment ▪ Academic success ▪ Arabic language ▪ Non-native speakers

1. INTRODUCTION

Immersive learning refers to a learning approach that uses realistic and engaging learning methodologies to present learners with realistic scenarios. For example, immersive learning using virtual reality training technology provides learners with a sense of presence and immersion in a virtual environment where they can practice and apply skills during simulations. The metaverse's environment enables immersive learning experiences by offering new capabilities such as co-presence for group learning, coaching, and mentoring. Companies are already bringing their operations into the metaverse, creating digital twins of their offices and products. The Creator Economy is emerging for immersive learning content creators due to the increasing demand for immersive learning content [1, 2].

Metaverse technology capabilities provide potential features that can be developed for specific functionalities. These capabilities are dynamic and can change through interaction in the metaverse. Technology plays a key role in virtual teams, and existing classifications of technology capabilities do not yet account for metaverses and their unique characteristics. Metaverse technology capabilities support communication,

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rendering, interaction, and team processes [3, 4, 5].

1.1 Purpose of the Research

The aim of this research is to design an immersive learning environment with metaverse technology to increase academic success and motivation in learning Arabic as a second language for non-native speakers. The virtual world enables students to interact with native speakers, practice real-life scenarios, and receive instant feedback.

1.2 Research Questions

1. Does immersive learning with the metaverse's environment affect academic success in Arabic as a second language for non-native speakers compared with traditional learning methods?

2. To what extent can learning through the metaverse's immersive environment increase motivation to learn Arabic as a second language?

2. STUDY OF THE CONTEXT

2.1 Explanation of Immersive Learning

Immersive learning is facilitated by immersive technologies that induce a sense of presence, co-presence, and identity. It focuses on the impact of immersion on learning and perceptual processes rather than on technological features. Immersive learning involves using technological affordances to enhance learning experiences [6, 7].

2.2 The Role of Immersive Learning in Education

Immersive learning is a teaching and learning approach that integrates technology with traditional educational methods, providing a more realistic and stimulating environment for growth. It focuses more on the experience of learning than on whether a student's answers are right or wrong. It incorporates digital media, simulations, and other interactive tools to create immersive experiences for learners. This type of education can be used in both online and offline classes through simulations, role-playing, or other activities that allow students to experience firsthand what they are learning about. Immersive learning enables students to practice real-world skills in a safe environment and achieve mastery through guided rehearsals. It establishes an emotional connection with learners and allows for individualized instruction at their own pace. Immersive learning also provides a platform for geographically dispersed learners to interact and exchange knowledge [8, 9, 10].

2.3 The Character of Generation Z Students

Immersive learning experiences have been shown to improve participation and amplify engagement in education, particularly benefiting Generation Z students, who prefer learning from the internet. Various studies have highlighted the motivations, benefits, and design methods of immersive systems in education. The role of immersive technologies in educational inclusion has also been discussed, as have evaluation methods for immersive systems in education. Overall, immersive learning plays a significant role in enhancing learning outcomes and educational experiences [7].

Generation Z students are characterized as true digital natives, diverse, and experiencing high rates of depression and anxiety. They expect immediate feedback, crave autonomy in education, and are the most diverse generation yet. Teachers need to adapt by using technology in education, understanding differ-ent cultures, and being aware of mental health issues among students. It is important to provide support and create a safe learning environment for Generation Z students [11, 12].

2.4 Explanation of the Metaverse

The metaverse is a virtual platform that enables sociocultural interactions among individuals in a computer-generated environment where multiple users can interact simultaneously from remote physical locations. It is anticipated to be the next digital realm that can fundamentally change how people interact. The term "metaverse" refers to a three-dimensional virtual world inhabited by avatars of real people, creating a universe beyond the physical world. Metaverse platforms vary by immersiveness, fidelity, and sociability, offering dif-ferent experiences to users. Avatars play a key role in mediat-ing the virtual experience in the metaverse, enhancing social perception and interactions between individuals [13, 14, 15].

2.5 Metaverse Technologies

Metaverse technologies encompass immersive technologies such as virtual reality (VR) and augmented reality (AR), which enable multisensory interactions with virtual environments, digital objects, and people. These technologies offer unique communication channels, personalization, and vividness, allowing for immediate feedback and collaboration. Metaverse technologies can enhance team processes and improve virtual project outcomes by providing support for communication, rendering, and custom tools [16, 4].

Metaverse technologies encompass a range of technologies such as spatial computing, digital humans, virtual spaces, shared experiences, gaming, and tokenized assets. These technologies include extended reality, blockchain, artificial intelligence, 3D reconstruction, and gaming engines such as Unity and Unreal. The metaverse is expected to occupy a key place in Web 3.0, characterized by decentralization and interoperability. It needs 3D modeling, the Internet of Things, and other relevant areas for metaverse development [17, 18, 19].

2.6 Metaverse Tools

Metaverse tools and technology encompass a wide range of capabilities, including cognitive artificial intelligence al-gorithms, movement and behavior tracking tools, customer identification technology, immersive visualization systems, shopper engagement technologies, machine-learning-based product recognition tools, spatial computing technology, im-mersive remote collaboration tools, behavioral predictive an-alytics, extended reality technologies, 3D modeling, geospa-tial mapping, and event modeling and forecasting tools on blockchain-based metaverse platforms. These technologies play a crucial role in shaping consumer behavior, optimizing purchase journeys, and supporting communication, render-ing, interaction, and team processes in virtual environments. The metaverse provides a unique context for studying virtual projects due to its immersive nature and technology capabilities [20, 21, 4, 22].

Metaverse tools include immersive remote collaboration tools, augmented analytics tools, extended reality technologies, data visualization tools, customer behavior analytics, vir-tual work environments, sensory and tracking technologies, and image-processing computational and object-tracking al-gorithms. These tools are essential for optimizing operational workflows and enhancing customer engagement in virtual marketplaces within the metaverse [21, 23, 24, 25].

Some of the top professional metaverse tools that developers can use include Webaverse, a browser-based, open-source metaverse engine, and Blender, an open-source tool for cre-ating three-dimensional content. These tools can help build immersive virtual worlds and gaming experiences, as well as support the complete 3D pipeline for modeling, game cre-ation, rendering, and more. Metaverse development tools aim to provide developers with the resources needed to cre-ate innovative and engaging experiences within the meta-verse [26, 27].

2.7 Metaverse Platforms for Education

Metaverse technology has been explored for educational pur-poses, with the potential to enhance learning experiences in non-traditional classes. The concept of the metaverse involves a combination of the real world and virtual reality, where daily activities and economic life are conducted through avatars representing real individuals. The metaverse can be a plat-form for social, economic, and cultural activities that create value. Some metaverse applications have already been inte-grated into education, demonstrating the need to understand its concept and types for educational implementation. The ASF's metaverse roadmap outlines four types of metaverse based on augmentation versus simulation and intimate versus external axes [28, 29].

Research on metaverse education describes interactive vir-tual learning environments that can combine VR, AR, AI, and social learning. Reviews report AR and VR among the commonly used technologies and identify implementation challenges, while educational frameworks propose adaptive learning and collaboration [30, 31].

2.8 Metaverse Platform Criteria Overview

To select the right metaverse platform, businesses should focus on personalization, decentralization, user experience, platforms and accessibility, and integrations. They should compare their requirements with the features of different platforms to make an informed decision [32].

Metaverse scholarship characterizes these environments through persistence, real-time interaction, and integrated dig-ital spaces, while identifying open technical and governance challenges [19]. McKinsey reports that 95% of surveyed busi-ness leaders expect the metaverse to have a positive impact on their industries within five to ten years, and 61% expect it to change how their industries operate [33]. Educational frameworks also propose adaptive learning based on student interaction and learning data [31, 34].

2.9 Ethical Concerns Surrounding Metaverse Technology

Ethical concerns surrounding metaverse technology include data privacy, user profiling, and digital personality mining for marketing purposes. Businesses must ensure transparency, user consent, and data control to maintain ethical standards. A utilitarian perspective and ethical decision-making are crucial to addressing privacy concerns and preventing data breaches. Stakeholders must consider various ethical theories and de-velop action plans to navigate ethical challenges in meta-verse usage. Transparency and user control over personal data are essential for ethical business practices in the meta-verse [35, 36].

2.10 Immersive Learning in the Metaverse

Immersive learning in the metaverse involves creating im-mersive and experiential learning environments through 2D and 3D platforms. Students can engage in learning activities, customize avatars, and express feelings through emojis, en-hancing social presence and reality. The use of 3D learning content and group work can lead to higher satisfaction levels among students. Experiential learning in the metaverse is be-lieved to positively influence learning outcomes by promoting active participation and involvement [37, 38].

2.11 Immersive Learning with the Metaverse for Teaching Languages

Immersive learning for teaching languages involves surround-ing oneself with the language being learned, whether through living in a country where the language is spoken or creating immersive experiences in everyday life. This method has been shown to be highly effective in language acquisition, as it puts learning in context and mimics the experience of native speakers. Blended learning, combining online and classroom environments, can also enhance the immersive learning experience for language learners [39, 40]. Immersive learning for teaching languages using fully immer-sive virtual learning environments is a promising approach, but systematic investigations into the incremental value of immersive technologies and different degrees of immersion are lacking. Studies show potential benefits of increased im-mersion, but there is a gap in research on how immersive technologies can enhance intercultural learning in language teaching. VR interventions for language learning are less studied compared with AR, and more research is needed on the impact of VR on language-learning outcomes [41].

3. METHODOLOGY

This research addressed the effects of immersive learning with the metaverse on academic success and motivation. The research was guided by the following questions:

1. Does immersive learning with the metaverse's environment affect academic success in Arabic as a second language for non-native speakers compared with traditional learning methods?
2. To what extent can learning through the metaverse's immersive environment increase motivation to learn Arabic as a second language?

3.1 Research Design

The researcher employed a quasi-experimental design with a convergent parallel mixed-method approach to explore the effects of immersive learning through the metaverse's environment on academic success and motivation in learning Arabic as a second language. The study aimed to compare two groups of learners: one group using the traditional Moodle Learning Management System (LMS) for instruction (control group), and the other using an immersive virtual environment (metaverse environment) for learning (experimental group). Both quantitative and qualitative data-collection methods were used simultaneously to assess academic achievement and learner motivation.

3.2 Participants and Sample Size

The participants were 60 non-native speakers enrolled in an intermediate-level Arabic language course at the Arabic Language Center for Non-Native Speakers, Faculty of Education, Mansoura University. All learners enrolled in the course had the opportunity to volunteer for participation in the research. The researcher randomly assigned all participants to either the control group, which learned Arabic lessons using traditional methods, or the experimental group, which learned Arabic lessons in the metaverse.

3.3 Learning Environments and Tools

To provide a balanced and well-structured learning experience, the researcher developed two parallel digital environments tailored to each group.

3.3.1 Moodle LMS for the Control Group

The control group received instruction through a course delivered on the Moodle LMS. This platform was selected for its user-friendliness and widespread use in educational institutions. Moodle enabled the researcher to upload Arabic learning resources, assign activities, and administer pre- and post-tests. Learner progress data were automatically stored and organized within the system, simplifying data collection and analysis. The content included six lessons focused on Arabic language topics: Homeland, Village, Sea, Commerce, Ministries, and Promotion.

3.3.2 Metaverse Environment for the Experimental Group

The experimental group participated in the same six Arabic lessons, but within a virtual 3D immersive environment known as the metaverse environment. This environment was custom-built by the researcher using a combination of technologies and development tools:

- **Microverse Builder (Croquet.io):** A browser-based platform used to create collaborative 3D spaces with real-time synchronization, enabling multiple learners to interact simultaneously within the same virtual environment.
- **Unity Game Engine:** Used to design and develop the 3D models, environment interactions, and user-interface elements that made the virtual space engaging and interactive.
- **WebXR and WebGL:** Web standards used to enable cross-platform compatibility and browser-based access to the metaverse environment, allowing learners to participate without high-end hardware.
- **Real-time collaboration software:** Integrated tools allowed learners to engage in group activities, discussions, and shared exploration of the virtual content.
- **Blockchain-based decentralized finance tools (optional):** Explored as part of the platform infrastructure to support secure, decentralized interactions and data integrity within the environment, although they were not central to content delivery.

The six Arabic lessons—Homeland, Village, Sea, Commerce, Ministries, and Promotion—were embedded directly into the metaverse environment through interactive objects, guided narration, virtual scenarios, and quizzes integrated into the 3D scenes.

3.4 Procedure

Two separate instructional sessions were conducted. The control group completed its learning session using the Moodle LMS. The experimental group experienced the same instructional content inside the metaverse environment. Before the session, all learners completed a pre-test to assess their existing knowledge. After completing the lesson, they were given a post-test to evaluate their learning outcomes.

The control group engaged with lesson resources, activities, and assessments using traditional LMS tools. Meanwhile, the experimental group navigated through virtual lessons, interacted with 3D environments, and completed activities integrated into the metaverse space.

3.5 Data Collection Instruments

3.5.1 Content Test

The research tested the effects of immersive learning with the metaverse's environment on academic success by comparing participant learning in the Moodle LMS and metaverse groups. A pre- and post-test model was used to measure participant learning. The pre- and post-tests each consisted of 30 questions, drawn from existing assessments of student understanding of the designed Arabic lessons.

3.5.2 Survey of Motivation in Learning Arabic as a Second Language

The survey used a five-point Likert-type scale (1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree) to measure five dimensions: intrinsic motivation, extrinsic motivation, social interaction and communication, presence and engagement, and perceived usefulness and value. Overall, higher scores represented a greater response and a greater likelihood of using the metaverse's environment to increase academic success and motivation.

3.6 Data Analysis

To address both research questions, the researcher used quantitative data from pre- and post-tests to evaluate academic performance, as well as survey responses to assess learner motivation. The data were analyzed using appropriate statistical techniques. A mixed ANOVA (repeated measures) was employed to examine within-group differences over time, while independent-samples t-tests were used to compare outcomes between the experimental and control groups. These analyses enabled the researcher to determine whether immersive learning through the metaverse environment had a statistically significant effect on academic achievement and motivation in learning Arabic as a second language.

3.7 Research Question 1

Research Question 1 was the following: Does immersive learning with the metaverse's environment affect academic success in Arabic as a second language for non-native speakers compared with traditional learning methods?

To address this question, the researcher performed statistical analyses on pre- and post-test scores from both the control group (which used the Moodle LMS) and the experimental group (which engaged with the metaverse environment). Descriptive statistics (mean and standard deviation) summarized learners' performance, and a mixed ANOVA (repeated measures) examined within-group and between-group differences over time. This analysis allowed the researcher to assess whether the immersive learning environment had a statistically significant impact on academic success compared with traditional learning methods.

3.8 Research Question 2

Research Question 2 was the following: To what extent can learning through the metaverse's immersive environment increase motivation to learn Arabic as a second language?

To answer this question, data from the post-intervention Survey of Motivation in Learning Arabic as a Second Language were analyzed. The survey used a five-point Likert scale and measured five motivation dimensions: intrinsic motivation, extrinsic motivation, social interaction and communication, presence and engagement, and perceived usefulness and value. Descriptive statistics summarized participant responses across these dimensions. Comparative analyses, such as independent-samples t-tests, were conducted to examine significant differences in motivation between the experimental and control groups.

4. RESULTS

This section presents the findings in response to the two research questions. The study investigated the effects of immersive learning with the metaverse environment on academic success and motivation for learning Arabic as a second language, comparing it with traditional learning methods via the Moodle LMS. Data from pre- and post-tests and a motivation survey were analyzed to address these questions.

4.1 Research Question 1

Does immersive learning with the metaverse's environment affect academic success in Arabic as a second language for non-native speakers compared with traditional learning methods?

The data for Research Question 1 were collected through pre- and post-test scores administered to both the control group (which learned via Moodle LMS) and the experimental group (which learned via the metaverse environment). The independent variable was the learning environment (traditional via Moodle LMS versus immersive via the metaverse), and the dependent variable was learners' academic achievement as reflected in their test scores. The pre- and post-tests were identical and aimed to assess learners' understanding of Arabic as a second language. A mixed ANOVA (repeated measures) analyzed within-group and between-group differences across the two testing points, as presented in Tables 1 and 2.

Table 1. Repeated-measures ANOVA summary for academic achievement.

Partial η^2	Sig.	F value	Effect
.935	.000	840.43	Between groups
.327	.000	28.21	Within groups

Table 1 indicates that the main effect of academic success was significant: participants improved from pre- to post-test overall, $F(1,58) = 840.43$, $p < .001$, $\eta^2 = .935$, a very large effect size. The interaction between academic success and group was also significant: $F(1,58) = 28.21$, $p < .001$, $\eta^2 = .327$, indicating that the experimental group improved more than the control group.

There was a significant difference between groups overall, with the experimental group showing higher scores than the control group across both time points, $F(1,58) = 12.11$, $p = .001$, $\eta^2 = .173$. Overall, a 2 (Group: Experimental versus Control) $\times$ 2 (Time: Pre-test versus Post-test) mixed ANOVA revealed a significant main effect of Time, $F(1,58) = 840.43$, $p < .001$, $\eta^2 = .935$, indicating that scores improved from pre- to post-test across all participants. There was also a significant Group $\times$ Time interaction, $F(1,58) = 28.21$, $p < .001$, $\eta^2 = .327$, suggesting that the experimental group showed significantly greater improvement than the control group. This is supported by the between-subjects effect of Group, $F(1,58) = 12.11$, $p = .001$, $\eta^2 = .173$. Together, these results indicate that the intervention applied to the experimental group was more effective in enhancing post-test scores.

4.2 Research Question 2

To what extent can learning through the metaverse's immersive environment increase motivation to learn Arabic as a second language?

The independent variable for Research Question 2 was the type of learning environment (traditional Moodle LMS versus immersive metaverse environment), and the dependent variable was the total score on the motivation survey, which measured five key dimensions: intrinsic motivation, extrinsic motivation, social interaction and communication, presence and engagement, and perceived usefulness and value. The survey was administered after the learning experience to both groups. An independent-samples t-test analyzed the differences in motivation scores between the groups. The results are presented in Table 3.

An independent-samples t-test compared survey scores between the two groups. Levene's test showed that equal variances could be assumed ($F = .256$, $p = .615$). There was a

Table 2. Tests of between-subject effects for academic achievement.

Source	Statistic	Value
Intercept	Type III Sum of Squares	49654.008
	Degrees of freedom	1
	Mean square	49654.008
	F	27740.560
	Significance	.000
	Partial eta squared	.998
Group	Type III Sum of Squares	21.675
	Degrees of freedom	1
	Mean square	21.675
	F	12.109
	Significance	.001
	Partial eta squared	.173
Error	Type III Sum of Squares	103.817
	Degrees of freedom	58
	Mean square	1.790

Table 3. Independent-samples t-test for motivation survey scores.

Statistic	Assumed	Not assumed
Sig. (2-tailed)	.000	.000
t	11.0	11.0
Degrees of freedom	58	57.4
Mean difference	5.23333	5.23333
Standard error difference	.47468	.47468
Levene *F*	.256	
Levene significance	.615	
N	30	30

significant difference in survey scores between the groups, $t(58) = 11.025$, $p < .001$. The mean difference of 5.23 (95% CI [4.28, 6.18]) indicates that one group scored significantly higher on the survey than the other.

5. DISCUSSION

The primary aim of this research was to investigate the impact of immersive learning through the metaverse environment on academic success and motivation in learning Arabic as a second language, comparing it with traditional learning methods using Moodle LMS. The results indicated significant improvements in both academic performance and learner motivation in the experimental group exposed to the metaverse environment.

5.1 Research Question 1

Does immersive learning with the metaverse's environment affect academic success in Arabic as a second language for non-native speakers compared with traditional learning methods?

The first research question explored whether immersive learning with the metaverse environment affects academic success in Arabic language acquisition compared with traditional learning methods. The results showed that the experimental group, which engaged with Arabic lessons in the metaverse, exhibited significantly higher post-test scores than the control group, which used Moodle LMS. This difference suggests that immersive learning environments can enhance learners' ability to acquire new knowledge and skills, particularly in a second-language context.

The positive impact of the metaverse on academic success is consistent with previous research highlighting the effectiveness of immersive technologies in promoting engagement and deeper learning. For example, studies have shown that virtual environments enable learners to interact with content dynamically, which can improve comprehension and retention [42, 43]. By providing learners with a 3D interactive environment, the metaverse may offer richer, more engaging experiences than traditional e-learning platforms such as Moodle, which primarily rely on text-based and multimedia content.

5.2 Research Question 2

To what extent can learning through the metaverse's immersive environment increase motivation to learn Arabic as a second language?

The second research question aimed to determine whether immersive learning with the metaverse increases motivation to learn Arabic as a second language. The findings revealed that the experimental group reported significantly higher motivation scores across all five dimensions measured in the motivation survey: intrinsic motivation, extrinsic motivation, social interaction and communication, presence and engagement, and perceived usefulness and value. These results suggest that the immersive experience offered by the metaverse not only enhanced academic performance but also boosted learners' motivation to engage with and continue learning Arabic.

The increase in motivation observed in the experimental group is in line with prior research on the role of virtual environments in fostering learner engagement and motivation [44, 45]. Immersive learning environments are often designed to be interactive and dynamic, which can heighten students' sense of presence and engagement [46]. The high scores in the presence and engagement and social interaction and communication dimensions suggest that learners in the experimental group felt more connected to the learning experience and to their peers, potentially due to the collaborative and interactive nature of the metaverse.

5.3 Limitations of the Research

While the results are promising, several limitations must be acknowledged. First, the research was conducted over a relatively short period, with only one learning session for each group. Longer-term research would be beneficial for understanding the sustained effects of immersive learning on academic performance and motivation. Additionally, the sample size was limited, which may affect the generalizability of the findings. Future research should include larger, more diverse participant pools to confirm the results and explore potential differences based on demographic factors such as age, prior language proficiency, and familiarity with digital technologies.

Another limitation is the lack of qualitative data in the research. While the motivation survey provided useful insights into learners' attitudes, further research incorporating qualitative methods such as interviews or focus groups would provide a deeper understanding of learners' experiences in the metaverse environment. This could help identify specific features of the virtual learning environment that contribute to motivation and engagement.

6. CONCLUSION

Overall, the comparison of academic performance before and after implementing immersive learning in the metaverse for teaching Arabic showed promising results. Non-native-speaking students demonstrated significant improvements in their understanding and proficiency in the language, as well as increased motivation and engagement. The benefits of using immersive learning in the metaverse for teaching Arabic were evident, but there were also limitations such as access to technology and resources. As metaverse technology continues to evolve and expand, the availability of professional tools such as Webaverse and Blender will be crucial for developers looking to create cutting-edge virtual experiences. By using these tools, developers can bring their creative visions to life and push the boundaries of what is possible within the metaverse. With the support of these tools, the future of virtual reality and immersive learning experiences within the metaverse looks promising and exciting.

Educators must recognize the unique characteristics of Generation Z students and adapt their teaching methods to meet the needs of this diverse and tech-savvy generation. By embracing technology, promoting cultural understanding, and prioritizing mental health, teachers can create a more inclusive and supportive learning environment. Ultimately, by catering to the needs of Generation Z, educators can help ensure that these students reach their full potential and achieve academic success.

In conclusion, immersive learning is a powerful tool that enhances student engagement and retention of information. By creating a dynamic and interactive learning experience, students can develop a deeper understanding of complex concepts and apply them in practical settings. As technology continues to advance, the potential for immersive learning to revolutionize education is limitless. It can transform traditional teaching methods and create meaningful, personalized learning experiences for students of all ages and backgrounds.

7. RECOMMENDATIONS

The research recommends that educational institutions integrate immersive learning environments such as the metaverse into language curricula to enhance academic success and learner motivation. Educators should design engaging and interactive content that fosters intrinsic and extrinsic motivation, with opportunities for social interaction in virtual environments. Long-term studies are needed to assess the lasting impact of immersive learning, and content should be tailored to the specific needs of language learners. Future research should also focus on ensuring that immersive environments are inclusive, accessible, and ethically designed, with attention to data privacy and the digital divide. Collaboration between educators and technologists is crucial to creating effective and pedagogically sound virtual learning experiences.

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A. SURVEY OF MOTIVATION IN LEARNING ARABIC AS A SECOND LANGUAGE

The survey used the following five-point scale: 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, and 5 = Strongly Agree.

Table 4. Survey of motivation in learning Arabic as a second language.

Element	Indicator	1	2	3	4	5
Intrinsic Motivation	I find learning Arabic in a metaverse environment enjoyable.					
Intrinsic Motivation	I feel curious to explore Arabic culture in the virtual world.					
Intrinsic Motivation	I enjoy interacting with virtual characters who speak Arabic.					
Intrinsic Motivation	The immersive setting makes Arabic learning more exciting than traditional methods.					
Intrinsic Motivation	I look forward to using the metaverse to practice Arabic.					
Extrinsic Motivation	I am more motivated to learn Arabic when achievements or rewards are part of the metaverse platform.					
Extrinsic Motivation	I feel a sense of accomplishment after completing Arabic language tasks in the virtual world.					
Extrinsic Motivation	Using the metaverse makes me want to reach higher levels in Arabic proficiency.					
Extrinsic Motivation	I would be more committed to learning Arabic if virtual progress badges or points were given.					
Extrinsic Motivation	External rewards in the metaverse (e.g., unlocking new content) keep me motivated to practice Arabic.					
Social Interaction & Communication	I feel more comfortable practicing Arabic with avatars than with real people.					
Social Interaction & Communication	Interacting with others in the metaverse improves my confidence in speaking Arabic.					
Social Interaction & Communication	Group tasks in virtual Arabic environments make language learning more engaging.					
Social Interaction & Communication	I enjoy practicing Arabic with other learners in immersive virtual settings.					
Social Interaction & Communication	The social features of the metaverse help me stay committed to learning Arabic.					
Presence & Engagement	I feel like I am “inside” an Arabic-speaking environment while learning in the metaverse.					
Presence & Engagement	I lose track of time while learning Arabic in immersive virtual settings.					
Presence & Engagement	I pay more attention to Arabic lessons in the metaverse than in traditional platforms.					
Presence & Engagement	The immersive experience keeps me focused on learning.					
Presence & Engagement	I feel more involved and emotionally connected when learning Arabic through virtual environments.					
Perceived Usefulness & Value	I believe learning Arabic in the metaverse is more effective than traditional methods.					
Perceived Usefulness & Value	I feel my Arabic language skills improve faster using immersive tools.					
Perceived Usefulness & Value	The metaverse offers more opportunities for practical language use.					
Perceived Usefulness & Value	I consider the immersive method a valuable supplement to language classes.					
Perceived Usefulness & Value	I am more motivated to continue learning Arabic because of the immersive experience.					