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Enhancing Mandarin Proficiency in Ethnic Minority Contexts: A Comparative Study of MALL and Traditional Teaching Methods

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Abstract

Background and Aims: Language education in ethnic minority regions faces challenges such as limited resources for Mandarin teaching and students' relatively weak language foundation. Mobile-Assisted Language Learning (MALL) has been proposed as a potential solution. This study aimed to investigate whether a MALL intervention—combining Automatic Speech Recognition (ASR) feedback with structured practice modules—could effectively improve the accuracy of Mandarin pronunciation and the fluency of oral expression among this area students.

Research Methodology: Using a post-test control experimental design, 90 students were divided into an experimental group (MALL intervention for 8 weeks) and a control group (traditional teaching). Their performance was evaluated using the National Mandarin Proficiency Test (PSC) indicators, and the results were analyzed with Jamovi.

Results: The experimental group significantly outperformed the control group in monosyllabic and polysyllabic reading accuracy ($p < .001$) and demonstrated moderate improvement in impromptu speaking ($p < .05$). No statistically significant differences were observed in extended text reading fluency, although the mean improvement on each proficiency test ranged from 3.04 to 4.13.

Conclusion: MALL technology can serve as an effective supplement to traditional instruction in resource-limited settings by improving students' Mandarin pronunciation and accuracy. Future research could provide a more comprehensive understanding of the impact of MALL by expanding the scope and duration of the survey to include variables such as motivation and self-efficacy.

Keywords: Mandarin; Ethnic Minority; Oral Ability; Mobile-assisted Language Learning

Introduction

Language plays a crucial role in human society, impacting individual communication, cognition, and societal development (Jeannin, 2020). In multilingual environments, language diversity enhances cross-cultural understanding and cooperation (Mackey, 1992), underpins social and economic interactions, and preserves cultural identity (Brunner, 2021). Proper language policy is vital for promoting social harmony and protecting minority rights (Rosiak, 2022). Thus, effective management and respect for linguistic diversity are key to social and cultural prosperity (Little, 2020).

Mobile-assisted Language Learning (MALL) has become integral in modern language education, significantly improving learning experiences and outcomes (Kamasak et al., 2021). Utilizing mobile devices like smartphones and tablets, MALL offers diverse educational tools, such as language learning apps, online courses, and multimedia resources (Yang et al., 2022), allowing personalized and optimized learning (Burston & Athanasiou, 2020). It enhances all language skills—speaking, listening, reading, writing, and grammar—through varied materials and exercises (Kamasak et al., 2021). The flexibility of MALL enables students to learn anytime and anywhere, fitting their schedules and increasing learning efficiency (Chen et al., 2020). Interactive features and gamification engage students, boosting motivation and effectiveness (Kukulska-Hulme & Viberg, 2017). Thus, MALL plays a crucial role in enhancing language abilities and academic achievements (Rogerson-Revell, 2021).

The global interest in learning Mandarin is increasing, but the complex grammar and a large number of Chinese characters require a lot of time and energy, making learning difficult (Yang, Chen, et al., 2022). Especially in ethnic minority areas in western China, teaching support is insufficient (McLellan et al., 2022). These remote areas also face inadequate access to modern educational technologies, further affecting learning outcomes (Weng, 2020). Although MALL provides a convenient and flexible way, over-dependence may affect traditional classroom adaptation (Tseng et al., 2022), and its isolation may

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also reduce teacher-student interaction and hinder the development of communication ability (Cavus, 2016). In addition, although gamification design is attractive, users may pay more attention to entertainment than learning, and the uneven application quality and privacy security risks should not be ignored (Kim, 2022). The integrated use of traditional teaching and MALL is expected to complement each other and enhance the overall learning experience (Pennington & Rogerson-Revell, 2021).

Objective of Research

The purpose of this study is to verify the teaching effect of the MALL-based Mandarin teaching method, to achieve that by improving and optimizing Mandarin teaching methods in remote areas, it can provide students with a better learning experience and help promote the development of digital education. Two research objectives were established for this purpose:

1. To identify the role of the Mandarin teaching mode of MALL in improving the Mandarin level of students in minority areas.
2. To determine the ability of the Mandarin teaching mode of MALL to improve the Mandarin proficiency of students in minority areas.

Literature Review

MALL and Traditional Teaching

MALL has gained attention as an alternative to traditional classroom instruction because of its flexibility and accessibility (Tseng et al., 2022; Cavus, 2016). Several studies have assessed the impact of MALL compared to traditional methods. Zhang et al. (2019) explored the motivations of Chinese graduate students for self-directed mobile learning, but the study lacked direct comparisons with traditional instruction. Shadiev et al. (2020) reviewed MALL methods in authentic environments but did not specifically focus on Mandarin learning in ethnic minority contexts. Despite Burston et al.'s (2021) historical overview of the achievements of MALL, direct comparative analysis between MALL and traditional classroom instruction remains limited. This highlights a research gap in evaluating the effectiveness of MALL on minority students' Mandarin language learning.

Impact of MALL on Different Language Skills

Pronunciation is an important part of Mandarin learning and requires precise pitch control (Lee et al., 2014; Martin, 2020). Several studies have shown that real-time feedback enhances pronunciation (Baker et al., 2016). Apps such as Elsa Speak, which utilizes AI for pronunciation training, have shown promising results in English language learning (Kholis, 2021; Anggraini, 2022). However, research on MALL-driven Mandarin pronunciation improvement for ethnic minority students remains scarce.

Fluency, which refers to the ability to express language smoothly and without unnecessary pauses, is another important aspect of language acquisition (Kantithammakorn et al., 2022; Sammit et al., 2022). Task-based instruction has been found to improve language fluency (Masuram et al., 2020), and interactive learning tools have been found to have significant benefits in promoting phonological organization (Popescu et al., 2021). However, there is a dearth of research directly comparing MALL-based fluency training with traditional classroom instruction in minority contexts.

Accuracy includes grammatical correctness and syntactic precision (Derwing et al., 2022; Yu & Lowie, 2020). Studies have shown that corrective feedback and self-assessment can improve linguistic accuracy (Pereira et al., 2018; Krejčí, 2020). Rokoszewska (2021) found that structured training can improve linguistic accuracy. However, whether MALL-based grammar training is as effective as traditional teaching for minority Mandarin learners, research in this area is not yet sufficient.

Socio-cultural factors in MALL learning

The socio-cultural context of language learning plays a crucial role, especially in ethnic minority areas. Vygotsky's sociocultural theory emphasizes interaction and context-based learning (Almazyed, 2021; Chong et al., 2022). The interaction hypothesis suggests that meaningful interaction contributes to language acquisition (Levinson, 2023; Namaziandost & Nasri, 2019). However, few studies have

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explored how ethnic background, gender, and prior language proficiency interact with MALL-based Mandarin learning. Given that traditional methods may be more in line with the cultural learning preferences of these communities, further investigation is needed to determine whether MALL can effectively accommodate these differences.

Conceptual Framework

By reviewing the social attributes of language, language teaching in minority areas, and the application of MALL technology in language teaching, this paper provides a sufficient theoretical framework for the application of MALL in remote areas with limited traditional education resources. The literature in the field of dependent variables, including language fluency, language pronunciation, and language accuracy, was also reviewed to determine the validity of this research method.

This study adopts the National Mandarin Proficiency Test (PSC) standard and content. Language fluency, language pronunciation, and language accuracy are measured using Reading monosyllabic characters (RMC), Reading polysyllabic expressions (RPE), Passage recitation (PR), and Impromptu speech (IS) in the standard. Language pronunciation is considered from the two dimensions of the monosyllabic word and two-syllable words, respectively using language pronunciation-a and language pronunciation-b, the variable relationship is as follows:

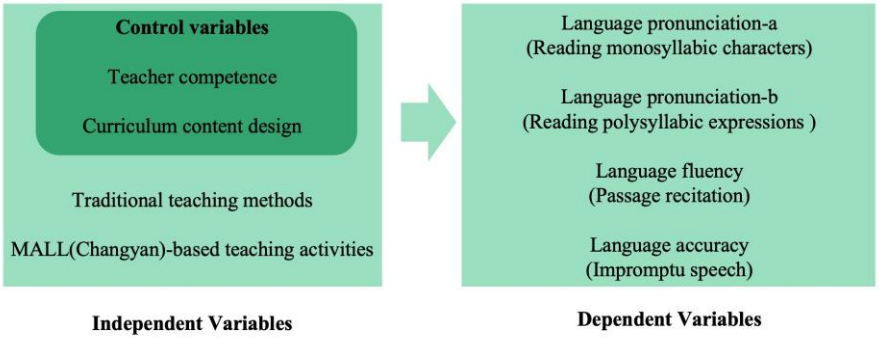

Figure 1 The Relationships Between Variables.
Note: Constructed by the Author

Under the background of sociocultural theory and interactive hypothesis teaching, this study focuses on using the Changyan app to participate in the teaching of the experimental group, comprehensively understanding the effectiveness of MALL in Mandarin teaching, and identifying strategies to optimize the learning outcomes of students. During the first week of preparation for instruction, the students were tested on their language baseline skills while the experimental group was taught about technology use. In the subsequent courses, the experimental group adopted the Mall-based teaching method, while the control group adopted the traditional teaching method with the same teaching content. The students in the two groups were tested after the eighth week of the experiment. The entire experiment lasted for eight weeks, and the researchers proposed the following research framework:

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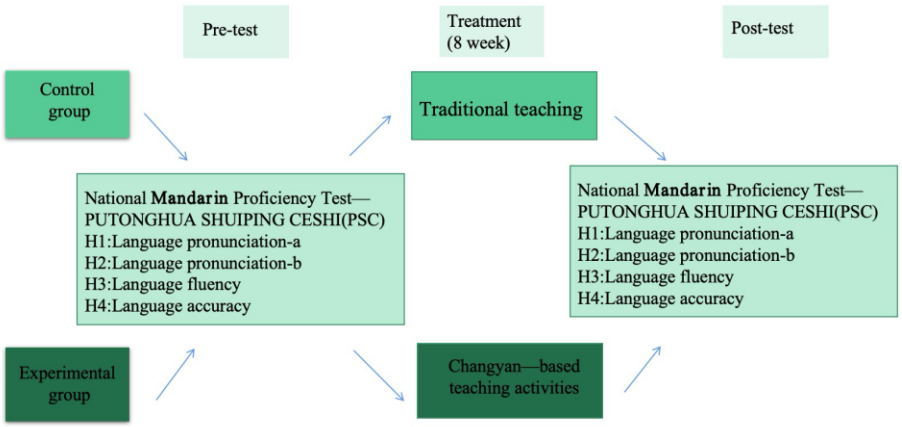

Figure 2 The Conceptual Framework of the Study.
Note: Constructed by the Author

The purpose of this study was to explore the effectiveness of the Putonghua teaching method based on MALL technology among students in ethnic minority areas of Qinghai Province and to find out whether it can provide different effects on the learning improvement in language pronunciation (H1 and H2), language fluency(H3), and language accuracy(H4).

Methodology

The experiment is a quantitative study using quasi-experimental research methods designed to answer the research questions raised, test the relevant variables, and thus confirm or refute the hypothesis (Mohajan, 2020). The subjects were freshmen students from the School of Journalism of a university in Qinghai Province, China, who had passed the Unified Examination for Higher Education Arts in China, and who were enrolled in an eight-week course on Mandarin pronunciation and vocal methods in the second semester. During this period, the students were divided into two groups for pre-tests and post-tests to collect and analyze quantitative data to measure the students' Mandarin speaking ability. Due to enrollment constraints, all students at that grade level will be included in the experiment. An analysis of sensitivity efficacy was conducted before the experiment to ensure a sound experimental design.

Research Treatment: The study, which used the Changyan App as an intervention technique, was conducted over eight weeks with a total of 90 students, twice a week for four sessions (45 minutes per session). The experiment was divided into three phases:

Preparation phase (week1)

Teachers and students familiarized themselves with each other and determined the course content and teaching methods. The experimental group receives training on the functions of the “Common Word APP”. Both groups underwent pre-experimental assessments including PSC tests and baseline data collection such as RMC, RPE, PR, and IS.

Intervention phase (weeks 2-8)

The instructor and course content were kept the same for both groups to control for instructor bias. The control group received traditional offline multimedia instruction combined with online homework feedback. The experimental group, on the other hand, received group learning through the “Changyan” app, which provided real-time feedback on students' test scores and errors. This enabled teachers to provide immediate, targeted instruction. The intervention ensured that the experimental group remained technologically and functionally consistent.

Data collection stage: Data from each phase were integrated to assess the instructional effectiveness of the two methods.

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Research Instruments : The National Mandarin Proficiency Test (PSC), also known as PUTONGHUA SHUIPING CESHI, is a standardized test set up by the State Language Commission and the Ministry of Education of China (Wang et al., 2006). The main goal is to assess the candidate's standardization and proficiency in Mandarin pronunciation, pronunciation, vocabulary, grammar, and practical communication skills (Li & Li, 2013). The test is especially important for educators, broadcasters, public service workers, and students who require Chinese proficiency certification (Lee, 2007). After passing the exam, the examinees can obtain the "National Putonghua Proficiency Test Registration Certificate" produced and issued by the State Language Commission. This test has been used for nearly 30 years, the PSC through rigorous design and scientific implementation methods to ensure its efficiency and high reliability (Li & Li, 2013), therefore, the validity and reliability of the performance tests in this study do not need to be tested.

Data Collection and Analysis: The research data in this study are mainly related to quantitative analysis of performance testing. To make an in-depth analysis of MALL's improvement of students' Mandarin proficiency and identify the factors that affect their learning effect from the perspective of pre-test and post-test comparison, the researcher mainly used the independent sample T-test method in Jamovi software to make a comparative analysis of the data before and after the test in the quantitative analysis of performance test. In short, the researchers combined standardized test scores to make the final assessment.

Population and Sample Size: Students majoring in broadcasting and hosting art in a journalism school of a university in the Qinghai region are the focus of this study. They come from different ethnic groups and are usually between 19 and 20 years old and are admitted through the art entrance examination of ordinary Chinese colleges and universities. A total of 90 people were included in the experiment. Their participation provided a representative sample with basic characteristics to investigate the effectiveness and applicability of Mall-based Putonghua teaching methods in the region.

Results

Demographic Information

The gender distribution of the control and experimental groups is a crucial aspect of this study. The control group consisted of 13 males and 32 females, totaling 45 participants. The participants in this study ranged in age from 18 to 20 years old. Many of the students were 19 years old, totaling 72 participants (80%).

Descriptive Statistics of Variables

Descriptive statistical methods, focusing on measures of central tendency and variation, were employed to analyze the pre-test and post-test scores of RMC, RPE, PR, and IS in the PSC for both the experimental and control groups. The following section presents the detailed results of this data analysis.

Table 1 Means Summary for Students' Reading Monosyllabic Characters Score in the Control Group and the Experimental Group.

	Group	N	Mean	SD
RMC-Pre	Experimental	45	89.0	2.93
	Control	45	88.7	2.67
RMC-Post	Experimental	45	92.9	2.37
	Control	45	90.5	2.10

In terms of central tendency, the control group's mean RMC score increased modestly from 88.7 before the experiment to 90.5 after the experiment. In contrast, the experimental group showed a more notable improvement, with the mean score rising from 89.0 in the pre-test to 92.9 in the post-test.

To further assess the data dispersion, a comparison of the standard deviation (SD) between the pre- and post-tests was conducted. In the control group, the SD decreased from 2.67 to 2.10, indicating that the

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scores became more concentrated around the mean after the intervention. Similarly, the experimental group's SD dropped from 2.93 to 2.37, reflecting a reduction in score variability and a tighter clustering of data.

Both group's RMC scores showed improvement after the intervention. However, the experimental group experienced a more substantial gain, with an increase of 3.9 points, compared to the 1.8-point increase in the control group. This suggests that the experimental intervention had a more pronounced positive effect on students' RMC performance.

Table 2 Means Summary for Students' Reading Polysyllabic Expressions Score in the Control Group and the Experimental Group.

	Group	N	Mean	SD
RPE-Pre	Experimental	45	88.6	1.99
	Control	45	89.0	1.76
RPE-Post	Experimental	45	92.8	1.82
	Control	45	90.7	2.07

In the control group, the average RPE score increased from 89.0 before the trial to 90.7 after the intervention, reflecting a modest improvement. Meanwhile, the experimental group demonstrated a more significant enhancement, with the average score rising from 88.6 to 92.8 post-intervention. Examining the variability of scores, the control group's standard deviation increased from 1.76 to 2.07, suggesting greater dispersion and uneven effects of the intervention. In contrast, the experimental group's standard deviation decreased slightly, from 1.99 to 1.82, indicating that the intervention led to more consistent and concentrated score improvements.

Both groups' RPE scores exhibited improvement in average scores; however, the experimental group achieved a more substantial increase of 4.2 points, compared to the control group's 1.7-point gain. The reduced variability in the experimental group further underscores that the intervention was not only more effective but also better suited to a broader range of students. These findings highlight the superiority of the MALL-based approach, which facilitated greater progress in RPE skills while maintaining consistency in student performance.

Table 3 Means Summary for Students' Passage Recitation Score in the Control Group and the Experimental Group.

	Group	N	Mean	SD
PR-Pre	Experimental	45	87.9	2.09
	Control	45	88.2	1.58
PR-Post	Experimental	45	91.2	1.77
	Control	45	91.1	1.91

The data highlights notable differences in PR scores between the two groups of students before and after the intervention in the PR. In the control group, the average PR score increased from 88.2 in the pre-test to 91.1 in the post-test, reflecting steady progress. Similarly, the experimental group demonstrated an improvement, with the average PR score rising from 87.9 before the intervention to 91.2 afterward. In terms of score variability, the standard deviation in the control group increased from 1.58 to 1.91, indicating a more dispersed distribution of scores post-intervention. Conversely, the experimental group's standard deviation decreased from 2.09 to 1.77, suggesting a more consistent and concentrated performance following the intervention. Both groups showed improvement in PR scores; however, the experimental group achieved a slightly greater increase of 3.3 points compared to the control group's 2.9 points.

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Additionally, the reduction in score variability within the experimental group highlights the effectiveness of the intervention in producing more uniform improvements among students. These findings underscore the potential of MALL-based methods in enhancing PR skills, providing not only greater overall progress but also ensuring that the benefits are more evenly distributed among learners.

Table 4 Means Summary for Students' Impromptu Speech Score in the Control Group and the Experimental Group.

	Group	N	Mean	SD
IS-Pre	Experimental	45	88.4	2.05
	Control	45	88.5	1.83
IS-Post	Experimental	45	91.4	1.71
	Control	45	90.8	1.82

In the control group, the average IS score increased from 88.5 in the pre-test to 90.8 in the post-test, reflecting a moderate improvement. Similarly, the experimental group demonstrated progress, with the average score rising from 88.4 before the intervention to 91.4 afterward. Examining score variability, the control group maintained a consistent standard deviation, with 1.83 in the pre-test and 1.82 in the post-test. In contrast, the experimental group experienced a notable decrease in standard deviation, from 2.05 before the intervention to 1.71 after, indicating that scores became more concentrated and less dispersed following the intervention.

Both groups showed improvement in IS performance after the test. However, the experimental group achieved a greater increase, with the average score rising by 3 points, compared to the 2.3-point improvement in the control group. This suggests that the intervention was more effective for the experimental group, leading to not only higher average scores but also a more uniform distribution of performance among students.

Hypotheses Testing

This study explores the effect of Mall-based teaching activities on improving students' Mandarin proficiency. To assess the impact, the average score of the project's improved performance was obtained after subtracting the pre-test and post-test of RMC, RPE, PR, and IS. The following assumptions guide this analysis:

Hypotheses 1

$H_0$1: There is no improvement between students who have been taught traditionally (Control group) and those who have been taught using the Changyan App (Experimental group) in language pronunciation-a(RMC) of post-test.

Ha1: There is improvement between students who have been taught traditionally (Control group) and those who have been taught using the Changyan App (Experimental group) in language pronunciation-a(RMC) of post-test.

Table 5 Means Summary for Students' RMC Score Improvement.

Group	N	Mean	SD
Experimental	45	3.89	2.66
Control	45	1.76	1.76

Table 6 T-tests for Students' RMC Score Improvement Between the Control Group and Experimental Group.

Group	Mean difference	p
Experimental and Control	2.13	< .001

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The independent samples t-test was conducted to compare the improvement in language pronunciation-a(RMC) scores between the control group and the experimental group. The results showed a significant difference, t (88) = 4.49, $p < 0.001$. Therefore, the null hypothesis was rejected. This indicates that there was a significant difference in the improvement of language pronunciation-a(RMC) scores between the control group and the experimental group.

Hypotheses 2

$H_0$2: There is no improvement between students who have been taught traditionally (Control group) and those who have been taught using the Changyan App (Experimental group) in language pronunciation-b(RPE) of post-test.

Ha2: There is improvement between students who have been taught traditionally (Control group) and who have been taught using Changyan App (Experimental group) in language pronunciation-b(RPE) of post-test.

Table 7 Means Summary for Students' RPE Score Improvement.

Group	N	Mean	SD
Experimental	45	4.13	1.83
Control	45	1.73	1.81

Table 8 T-tests for Students' RPE Score Improvement Between the Control Group and Experimental Group.

Group	Mean difference	p
Experimental and Control	2.40	< .001

The independent samples t-test was conducted to compare the improvement in language pronunciation-b(RPE) scores between the control group and the experimental group. The results showed a significant difference, $t(88) = 6.25$, $p < 0.001$. Therefore, the null hypothesis was rejected. This indicates that there was a significant difference in the improvement of language pronunciation-b(RPE) scores between the control group and the experimental group.

Hypotheses 3

$H_0$3: There is no improvement between students who have been taught traditionally (Control group) and those who have been taught using the Changyan App (Experimental group) in passage language fluency (PR) of the post-test.

Ha3: There is improvement between students who have been taught traditionally (Control group) and those who have been taught using the Changyan App (Experimental group) in language fluency (PR) of post-test.

Table 9 Means Summary for Students' PR Score Improvement.

Group	N	Mean	SD
Experimental	45	3.29	1.97
Control	45	2.91	1.43

Table 10 T-tests for Students' PR Score Improvement Between the Control Group and Experimental Group.

Group	Mean difference	p
Experimental and Control	0.378	0.301

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The independent samples t-test was conducted to compare the improvement in language fluency (PR) scores between the control group and the experimental group. The results showed a significant difference, $t(88) = 1.04$, $p = 0.301$. Therefore, the null hypothesis was retained. This suggests that there was no significant difference in the language fluency (PR) score improvement between the two groups.

Hypotheses 4

$H_0$4: There is no improvement between students who have been taught traditionally (Control group) and those who have been taught using the Changyan App (Experimental group) in language accuracy (IS) of post-test.

Ha4: There is improvement between students who have been taught traditionally (Control group) and who have been taught using Changyan App (Experimental group) in language accuracy (IS) of post-test.

Table 11 Means Summary for Students' IS Score Improvement.

Group	N	Mean	SD
Experimental	45	3.04	1.86
Control	45	2.27	1.47

Table 12 T-tests for Students' IS Score Improvement Between the Control Group and Experimental Group.

Group	Mean difference	p
Experimental and Control	0.778	0.03

The independent samples t-test was conducted to compare the improvement in language accuracy (IS) scores between the control group and the experimental group. The results showed a significant difference, $t(88) = 2.20$, $p = 0.03$. Therefore, the null hypothesis was rejected. This indicates that there was a significant difference in the improvement of language accuracy (IS) scores between the control group and the experimental group.

Discussion

This study explores the specific aspects of Mandarin proficiency that the MALL-based teaching model has improved for students in minority areas. The results indicate that the MALL teaching approach significantly enhances students' Mandarin skills, particularly in language pronunciation and accuracy and overall language abilities.

The study findings reinforce prior research indicating that MALL significantly enhances pronunciation and accuracy (Li, 2022). However, the lack of statistically significant improvement in fluency suggests that short-term interventions may not be sufficient to develop sustained oral proficiency (Darmawati, 2018; Rajendran et al., 2021). The study also highlights individual variation in adaptability to MALL-based instruction, a factor aligned with prior findings on language learning motivation and external intervention (Kuroda et al., 2021).

The limitations of the study should be acknowledged, particularly the quasi-experimental design and small sample size, which restrict the generalizability of findings. The absence of random assignment may introduce selection bias, while the eight-week intervention period may be too short to measure fluency development effectively (Meilasari et al., 2023). Future research should incorporate longitudinal studies to observe the sustained impact of MALL over extended periods.

Moreover, fluency development requires continuous language exposure and task-based interactive designs, which were limited in this study (Alashban et al., 2023). Future studies could implement extended intervention periods with increased task-based interactions and adaptive learning strategies to better support language fluency (Shadiev et al., 2023; Hu et al., 2022). Additionally, integrating psychological support mechanisms may help address language anxiety and motivation issues, thereby improving fluency outcomes.

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Existing studies predominantly focus on MALL's general effectiveness rather than its comparative impact with traditional methods in ethnic minority settings. There is limited research evaluating how MALL affects pronunciation, fluency, and accuracy specifically in Mandarin learning for diverse linguistic and cultural backgrounds. Furthermore, the interaction between socio-cultural factors and MALL adoption remains underexplored. This study aims to fill these gaps by conducting a controlled comparative analysis between MALL and traditional Mandarin teaching among ethnic minority students, incorporating linguistic performance metrics and socio-cultural influences.

Conclusion

This study provides significant evidence of the effectiveness of MALL in improving Mandarin proficiency among students in ethnic minority areas. The findings highlight the significant improvement in Mandarin language skills from the MALL intervention, particularly in terms of language pronunciation and accuracy. Especially when it comes to language pronunciation, MALL technology provides students with personalized feedback and correction mechanisms to help them effectively overcome language barriers in Mandarin learning. Minority students in the experimental group showed the most significant improvement. The PSC test score of the experimental group increased by up to 6.6 points, and the pronunciation accuracy improved by up to 10 points. The average improvement in each ability test ranged from 3.04 to 4.13, while the control group's score fluctuated from 1.73 to 2.91. These results highlight the potential of MALL to bridge the language gap and improve Mandarin proficiency among students from diverse linguistic and cultural backgrounds.

Although this study found the positive effect of MALL technology in improving Mandarin proficiency, the conclusions of the study may not apply to all ethnic groups due to the small sample size of students in the experimental group and the relatively single ethnic background. In addition, the research mainly focuses on the short-term effect, and the long-term application effect of MALL technology is not investigated. Therefore, future research could be conducted in a broader ethnic context, and the effects of MALL technology in long-term learning could be explored in depth.

In addition, this study provides valuable insights into the variability of learning outcomes. Although the experimental group made significant progress overall, the significant differences in individual performance suggest that further research is still needed into the factors influencing these differences. It is critical to explore the role of individual student characteristics, such as prior language ability, sociocultural background, and learning preferences, in the effects of MALL interventions. Tailoring MALL interventions to these factors will be key to maximizing their impact. At the same time, when MALL is combined with effective teaching strategies, innovative methods, and appropriate platform technology, it may significantly affect the oral learning effect of language learners.

The study also emphasizes the importance of integrating MALL with traditional teaching methods. While MALL has also been significantly successful in improving pronunciation standardization and language fluency, combining it with instructor-led classroom instruction may provide a more balanced and effective learning experience. Future research should explore the best blended learning models to take full advantage of MALL technology and traditional classroom instruction, especially in minority areas, where social, cultural and linguistic diversity must be considered.

This study contributes to the accumulation of important knowledge for the application of mobile-assisted language learning in language education, especially in the context of ethnic minority areas. By continuing to optimize the use of MALL technology, combined with personalized learning paths and designing culturally relevant content, educators can further improve student learning outcomes. Future research should continue to explore the long-term effects of MALL on language fluency, its integration with other teaching methods, and its potential to sustain and extend its influence in diverse contexts.

Recommendation

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Based on the research results and their practical implications for Mandarin teaching in ethnic minority areas, future research directions can be explored in the following areas to enhance their foresight, innovation, scientific rigor, and operability:

Exploring the Integration of MALL with Traditional Teaching Methods

Although MALL technology has achieved significant results in language learning, its integration with traditional teaching methods still requires further exploration. Future research could investigate the hybrid learning model combining MALL and traditional classroom teaching, especially in terms of standardizing pronunciation and improving oral fluency. Experimental studies and data analysis could verify the effectiveness of the blended teaching model and explore its potential application in Mandarin teaching in ethnic minority areas. The research could explore how MALL technology supplements areas where traditional teaching may fall short, such as pronunciation standardization and oral training, and create effective teaching strategies.

Investigating the Impact of MALL Technology on Students' Language Learning Motivation

Language learning motivation is a key factor affecting learning outcomes, especially in ethnic minority areas, and students' learning motivation may be affected by various factors. This study only conducted a quantitative analysis, and future research could explore how MALL technology can motivate students to learn, especially in terms of improving Mandarin proficiency. Empirical research can examine how different types of learning activities and interaction patterns affect student motivation, providing insights into future teaching strategies. Research should combine quantitative and qualitative methods to explore how feedback and reward mechanisms provided by the MALL platform affect students' motivation to continue learning.

Studying the Long-term Impact of MALL Technology on Improving Language Fluency

While MALL technology has improved students' pronunciation standardization and verbal accuracy in the short term, its impact on language fluency has been more limited. Future research could explore the long-term impact of MALL technology on improving Mandarin fluency and how personalized, ongoing training can further improve students' language fluency. Longitudinal studies can track the long-term impact of MALL technology on students' language fluency and explore the impact of continued use of the MALL platform. Research can also investigate how personalized speech training and dialogue simulation capabilities can further improve students' oral fluency, especially in real-life communication.

Through these research directions, future studies will not only deepen the understanding of the specific applications of MALL technology in Mandarin teaching in ethnic minority areas but also explore its cross-cultural adaptability and long-term benefits, driving the innovative application and practical development of MALL technology in the field of language education.

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