MANDARIN LEARNING APPLICATION : EASYCHINESE

WANGYIFAN

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ABSTRAK

Pembangunan Aplikasi Mudah Alih EasyChinese bertujuan untuk membantu pelajar bukan penutur jati bahasa Cina mempelajari perkataan dan struktur ayat Mandarin dengan lebih mudah dan interaktif. Aplikasi ini dibina untuk peranti Android dengan antara muka yang mesra pengguna dan fungsi yang disusun secara modular, merangkumi pembelajaran asas, latihan interaktif dan kuiz ulangan. Pengguna boleh mendengar sebutan, mengenal gambar, dan memilih jawapan berdasarkan kefahaman mereka. Fungsi kuiz akhir membolehkan pengguna menyemak semula kemajuan mereka dalam bentuk kadar ketepatan dan masa. Teknologi Firebase digunakan sebagai backend untuk menyimpan data pengguna, rekod latihan dan kemajuan pembelajaran. Model pembangunan Inkremental membolehkan kemas kini dan penambahbaikan berdasarkan maklum balas pengguna. EasyChinese dibangunkan dengan Java dan Android Studio, dan direka bentuk agar mudah digunakan oleh pelajar pelbagai peringkat umur. Projek ini diharap dapat menjadi alternatif pembelajaran bahasa yang menyeronokkan dan berkesan dalam konteks pembelajaran kendiri melalui peranti mudah alih.

Kata Kunci: *Bahasa Mandarin, Aplikasi Mudah Alih, Latihan Interaktif, Pembelajaran Digital, Firebase*

ABSTRACT

The EasyChinese Mobile Application is developed to assist non-native learners in mastering Mandarin vocabulary and sentence structures through a simplified and interactive mobile learning experience. Designed for Android devices, the app offers a modular structure including core units, pronunciation guides, interactive practice, and review quizzes. Learners can hear accurate pronunciations, recognize meaning through images, and receive immediate feedback on their choices. The quiz module at the end of each session tracks accuracy and time, helping users reflect on their progress. Firebase technology serves as the backend for storing user data, learning records, and practice results. The Incremental Development Model ensures that the app evolves based on user input. Developed in Java with Android Studio, EasyChinese is designed to be intuitive for learners of all ages. This project aims to provide an effective and engaging alternative to traditional Mandarin learning methods, especially for independent learners using mobile platforms.

Keywords: Mental Math, Arithmetic, Gamification, Mobile Learning, Android Application

INTRODUCTION

Mandarin Chinese, spoken by more than one billion people worldwide, is increasingly regarded as a valuable asset in global communication, education, and business (MamaMandarin, 2024). Despite this, many English-speaking learners face significant difficulty mastering fundamental aspects of the language, particularly tone distinctions and character recognition—skills not inherent in non-tonal native languages (Pelzl, 2022). Tonal errors can lead to miscommunication, thereby reducing learner confidence and motivation (Cao, 2024).

To address these obstacles, gamified mobile applications that incorporate multimedia support and real-time feedback have shown strong efficacy in sustaining learner engagement and improving retention (Zolfaghari et al., 2025; Ratinho, 2023). Interactive quizzes, progress tracking, and immediate corrective response create a

structured learning experience that encourages continued use and concept reinforcement.

In response to learners' needs, the EasyChinese mobile application was developed for Android devices as a beginner-friendly Mandarin trainer tailored to English speakers. The app is built around three main modules: a Pinyin Training section to teach correct tone and pronunciation, an Interactive Practice module with multiple-choice and sentence-building quizzes, and a Review Quiz system to monitor accuracy and study duration. The use of native-speaker audio, pictorial cues, and simplified sentence structures helps reduce cognitive load while enhancing comprehension.

This application was developed using the Incremental Development Model, allowing phased delivery of functionality followed by iterative refinement based on user feedback during the usability testing stage (GeeksforGeeks, 2025). Early features were released for pilot testing, with further improvements implemented as usability data was gathered.

This document presents a comprehensive overview of the EasyChinese project, covering its objectives, architectural design, module implementation, interface layout, testing strategies, and evaluation results. It also identifies areas for future enhancements—such as expanding question formats, adding multilingual navigation, and improving accessibility features—to broaden the app's educational reach and usability.

LITERATURE REVIEW

Mandarin tone perception continues to challenge non-native learners, especially English speakers, who often confuse Tone 2 and Tone 3 due to acoustic similarities and perceptual biases (Hao, 2018). Machine-learning-based studies find that while

adult L2 learners often learn proper cue-weighting strategies for tonal classification, inter-speaker variability and atypical exemplars still lead to significant misidentification (Zhang, 2025). Perceptual training can help, but requires carefully designed auditory feedback and repetition to yield measurable improvements (Leung, 2025). Persistent confusion is frequently linked to cognitive features such as underdeveloped internal tone models (Sereno, 2007).

In addition to tone, learners also face high cognitive load from Mandarin's logographic characters and unfamiliar sentence structures. These demands can lead to slower progress, frustration, and reduced motivation without structured support (Wang, 2006). Early exposure to integrated multimodal scaffolds — combining audio, visual cues, and meaningful context — has been shown to reduce overwhelm and improve retention (Ling, 2021).

Gamification has emerged as an effective motivational tool in language learning. A systematic review of gamified English learning strategies found significant gains in attentional control, working memory, and learner engagement when features like feedback, levels, and progress bars were embedded (Al-Khresheh, 2025). Broader multilingual reviews further confirmed improved attitudes, emotional responses, and language ability (Shortt, 2023).

However, misuse of gamification is common. Qualitative analysis of Duolingo user experiences shows that overemphasis on leaderboards and points can distract learners from actual learning objectives, reducing educational effectiveness and increasing unethical practices like game-based shortcuts (Mogavi, 2022). Similarly, mapping studies note that badges and rankings when unbalanced with pedagogy can negatively impact learner motivation and performance (Almeida, 2023).

Based on these insights, EasyChinese was designed to balance pedagogical rigor with user engagement. Its Pinyin Training module employs native-speaker audio and explicit tone feedback aligned with perceptual training research. The Interactive Practice module uses varied question formats — image matching, sentence assembly,

and listening tasks — to support meaningful multimodal learning. The Review Quiz module tracks accuracy and study time to encourage focused revision rather than point chasing. By avoiding superficial gamification and emphasizing structured tone practice and content progression, EasyChinese aims to support sustained engagement and learning efficacy.
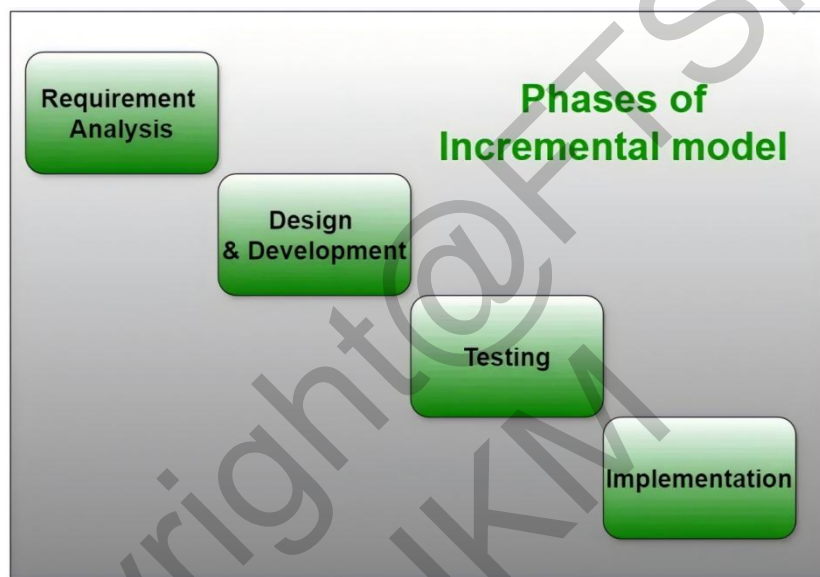
METHODOLOGY

Figure 1 Increment Development Model (GeeksforGeeks, 2018)

The development of the EasyChinese mobile application followed the Incremental Development Model to ensure iterative growth, structured planning, and adaptability to user feedback. This methodological approach allowed the design team to introduce features in manageable stages while continuously validating each component through testing and refinement. The model is particularly effective for educational applications, as it accommodates evolving pedagogical needs and usability improvements throughout the development cycle.

To initiate the project, a requirement analysis phase was conducted by distributing structured surveys to a focused group of ten participants. These individuals were selected from first-year university students enrolled in basic Mandarin courses and

were representative of the application's target user base: English-speaking beginners with little or no exposure to tonal languages. The survey was designed using Google Forms and included both quantitative and open-ended questions on learners' preferences, challenges, and expectations. Respondents consistently identified tone differentiation, pronunciation feedback, and vocabulary recognition as their main difficulties when learning Mandarin. They also expressed a preference for interactive exercises over passive memorization, as well as a desire for flexible, user-friendly app interfaces. This feedback was essential in guiding the identification of core functional and non-functional requirements.

In addition to survey analysis, the team conducted a comparative study of existing Mandarin learning applications such as Duolingo, LingoDeer, and HelloChinese. These platforms, while widely used, were often criticized by survey respondents for being either too gamified or lacking in direct tone-specific feedback. As a result, the design of EasyChinese aimed to bridge this gap by integrating scaffolded learning modules, audio-visual support, and personalized progress tracking. Three primary learning functions were conceptualized: a Pinyin Training module featuring native-speaker audio and tonal explanations; an Interactive Practice module with varied question types including tone selection, image association, and sentence building; and a Review Quiz module that tracks individual performance and adapts question sets based on previous errors. Additional functions, such as user profiles, study reminders, and customizable interface settings, were introduced later as feedback accumulated through testing.

The system was developed using a modular, layered architecture to ensure maintainability and responsiveness. The interface followed Material Design principles to support clarity and ease of use, particularly on smaller Android devices. Firebase was chosen as the backend platform to handle real-time synchronization, user authentication, and data storage. The Pinyin Training module was designed with finite-state logic to guide users step-by-step through tonal learning, while the Practice module incorporated basic gamification features such as visual badges and streak counters to maintain motivation. However, these elements were carefully balanced to avoid overwhelming the user or distracting from pedagogical goals.

During the testing phase, both technical and educational effectiveness were evaluated. Unit and integration testing were conducted on multiple Android devices to ensure consistent functionality and fast loading times. Usability testing was carried out with the same ten initial survey respondents over a two-week period. Participants were asked to complete pre-set learning tasks, report bugs, and offer feedback through structured forms. The results highlighted several usability improvements, including the need for clearer tone markers, slower audio playback speeds, and simplified quiz prompts. These enhancements were incorporated into subsequent iterations to improve learning flow and reduce cognitive load.

The final implementation phase followed a staged rollout strategy. The application was first deployed in beta mode to the test group, allowing for performance monitoring and rapid bug resolution. Firebase Crashlytics and Analytics were used to gather backend data on user engagement, module usage frequency, and system stability. Weekly updates were scheduled during the rollout phase to incorporate feature requests such as dark mode, hint buttons, and session summaries. Post-rollout data indicated strong user retention and repeated module usage, particularly among those who favored the structured tone quizzes and audio-supported sentence tasks.

Through the use of the Incremental Development Model, EasyChinese successfully evolved from a simple prototype into a structured, scalable, and pedagogically sound mobile application. The methodology not only supported systematic feature development and risk management, but also ensured that every phase of the project remained closely aligned with the actual needs of beginner-level Mandarin learners. By combining technical rigor with educational responsiveness, the application was able to deliver an experience that supports both engagement and meaningful language acquisition.

RESULTS

This section presents the implementation outcomes of the EasyChinese mobile application, with a focus on how key functionalities were translated from design concepts into working features. The purpose of the application is to improve Mandarin

tone recognition, vocabulary retention, and sentence construction skills among English-speaking learners through an engaging, gamified interface. Throughout development, attention was paid not only to pedagogical validity but also to performance, responsiveness, and user accessibility across devices.

The system architecture was implemented using Android Studio in combination with Firebase, ensuring secure user authentication, dynamic data synchronization, and persistent storage of user progress. Firebase Authentication and Firestore Database were integrated to provide secure login, real-time data management, and seamless performance tracking. Each module was iteratively tested and refined based on usability feedback from target users. The interface was designed with the goal of minimizing cognitive overload while reinforcing Mandarin language structures. Visual cues, Pinyin, and native audio were embedded throughout the app to scaffold user understanding and support multimodal learning.

The implementation logic behind key functionalities—including user registration, English-to-Mandarin question generation, score tracking, and weekly review quizzes—was carefully developed to maintain consistency and ease of use. Special attention was given to the user interface, ensuring cross-linguistic accessibility and clean navigation across modules. Unlike traditional language learning apps that rely heavily on level progression, EasyChinese adopts a level-free structure, emphasizing thematic reinforcement. Users are free to navigate between Learn, Review, and My Profile sections based on their own pace and learning goals.

As shown in Figure 2, the Review tab's main interface introduces the practice section with a bright, engaging layout that combines Chinese motivational text ("抓紧复习") with playful cartoon imagery. This visual design helps lower performance anxiety and promotes a friendly atmosphere, especially for beginner learners. The bottom navigation bar clearly separates learning modes, improving flow and accessibility throughout the application.

Figure 2 Review & Quiz

As shown in Figure 3, during a review session, users are presented with image-based multiple-choice questions designed to test vocabulary comprehension in context. Learners are prompted to select the correct image corresponding to the Mandarin term for "foggy," with each option labeled in both Pinyin and Chinese characters. The countdown timer encourages timely responses, while instant feedback on submission reinforces memory and builds user confidence in tone and word recognition.

Figure 3 Quiz Questions

As shown in Figure 4, EasyChinese also features an interactive sentence construction module, which advances the learner's grammatical and syntactic understanding. Users receive an English prompt and are asked to form a complete Mandarin sentence by selecting and arranging vocabulary cards. This activity not only reinforces word order and structure but also provides contextual usage practice, which is essential for meaningful language acquisition.
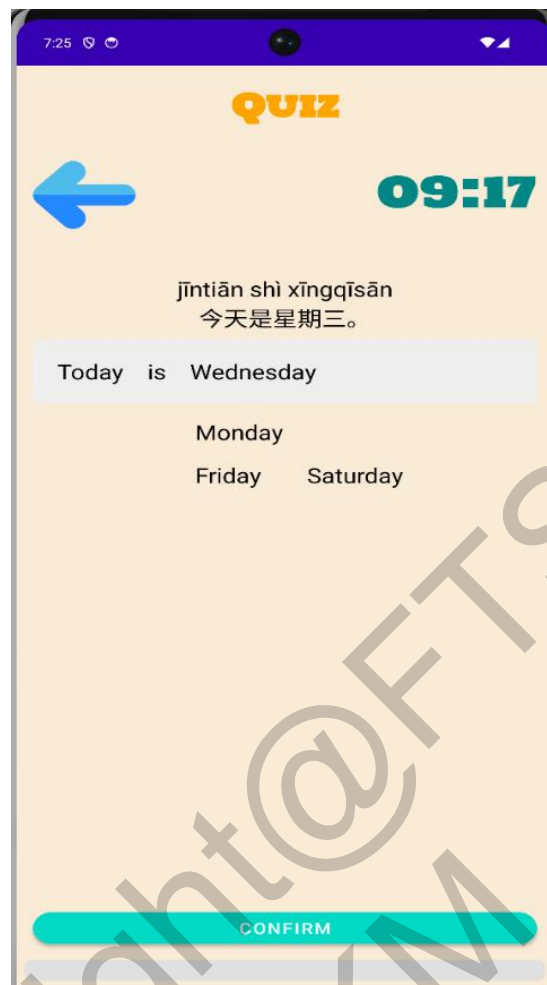
Figure 4 Sentence Construction Quiz

As shown in Figure 5, after completing a quiz session, learners are redirected to a comprehensive performance summary screen. This interface displays overall accuracy, total time spent, and detailed feedback for each question. Correct answers are confirmed, and incorrect ones are paired with the right answer, encouraging immediate reflection and correction. This data is stored for longitudinal tracking, allowing learners to monitor their progress over time and revisit areas that need reinforcement.

Figure 5 Result Summary Screen

These implemented features work in tandem to ensure that learning remains active, reflective, and user-centered. Functional testing confirmed that all major modules—including vocabulary review, sentence construction, real-time feedback, and result visualization—operate smoothly and consistently across different devices. The application's design supports focused, efficient language learning sessions with high retention value, making it a strong example of mobile-assisted Mandarin instruction grounded in pedagogical best practices.

Functional testing was conducted to validate that all implemented features perform as intended under expected usage conditions. To systematically evaluate the application's behavior, a use case testing approach was employed. This allowed for verification of core functionalities in relation to user actions and system responses.

Table 5.1 Use Case Testing for Registration

Test Case ID: TC-01			
Function ID: FN-01			
Objective: To guarantee valid and successful account creation			
Input	Expected Result	Requirement	Procedure
Enter email	No error	Required for registration	None
Enter password	No error	Required for registration	None
Confirm password	No error	Must match password	None
Click Register	Redirect to login page	Valid input provided	TC-02

Table 5.2 Use Case Testing for Login

Test Case ID: TC-02			
Function ID: FN-02			
Objective: To ensure login works with correct credentials			
Input	Expected Result	Requirement	Procedure
Enter valid email	No error	Email exists	None
Enter valid password	No error	Password correct	None
Click Login	Redirect to home page	Credentials correct	HomeActivity loaded

Table 5.3 Use Case Testing for Learning Module

Test Case ID: TC-03			
Function ID: FN-03			
Objective: To ensure pinyin/lesson content loads correctly and plays audio			
Input	Expected Result	Requirement	Procedure
Click lesson card	Navigate to lesson screen	Card exists	Load intent
Click pinyin card	Audio plays	Card is enabled	Trigger playPinyinAudio()
Click next button	Show next lesson page	Lesson not last	Update UI content

Table 5.4 Use Case Testing for Quiz Practice

Test Case ID: TC-04			
Function ID: FN-04			
Objective: To ensure quiz questions load and results are stored			
Input	Expected Result	Requirement	Procedure
Open quiz module	Questions loaded	Firebase data available	loadQuizQuestions()
Select answer	Answer saved	Answer not empty	saveCurrentAnswer()
Submit all	Navigate to MainActivity	All questions done	Finish Activity

Table 5.5 Use Case Testing for Progress Tracking

Test Case ID: TC-05			
Function ID: FN-05			
Objective: To ensure study time and lesson completion display properly			
Input	Expected Result	Requirement	Procedure
Complete a quiz	Progress updated	Firebase connected	Update score node
View profile	See completed count	Valid login	refreshUserData()
Check today's time	Show study time	User active today	time_today retrieved

Usability testing is a critical component in determining whether the EasyChinese mobile application fulfills user expectations in terms of interface design, ease of navigation, learning support, and overall satisfaction. This phase plays a vital role in verifying that the application's educational objectives — particularly in supporting Mandarin tone recognition and vocabulary acquisition — are effectively realized through a user-friendly and accessible interface.

To assess the app's usability, a Google Form questionnaire was distributed alongside the APK installation file and a concise user manual. Participants were encouraged to explore all key modules — namely the Pinyin Training, Interactive Practice, and Review Quiz components—before responding to 10 items designed to evaluate various aspects of their user experience. Each item was rated on a five-point Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree), reflecting the degree to which users agreed with each usability statement.

Although the questionnaire used a five-point scale, rather than relying on external benchmarks for interpretation, the analysis adopted a simplified internal classification: responses averaging below 3.5 were considered "moderate," while those above 3.5 were interpreted as "positive" indications of system usability. Higher mean scores represented stronger affirmation of successful design, navigation, and learning impact.

A total of 10 English-speaking learners participated in the testing, and Table 6 summarizes the average scores for each usability item:

Table 6 Usability Testing Results for EasyChinese

No.	Items	Mean
1	The app interface was easy to understand and navigate.	4.7

2	The layout and screen design were clean and visually clear.	4.7
3	I could easily find and access different lessons and quizzes.	4.5
4	The pinyin audio playback feature was helpful and worked as expected.	4.6
5	It was easy to track my learning progress in the profile section.	4.8
6	I was able to complete a quiz without needing external help.	5.0
7	The app responded quickly and didn't freeze or crash.	4.8
8	I felt motivated to continue learning after using the app.	4.6
9	I would recommend this app to other beginners learning Mandarin.	4.3
10	Overall, I am satisfied with the experience of using EasyChinese.	4.8

The results from this usability test demonstrate an overwhelmingly positive user experience across all measured dimensions. All items received average scores above 4.3, indicating high satisfaction with the application's design, technical stability, and motivational impact. The highest-rated items were related to technical responsiveness (4.8), learning independence (5.0), and satisfaction with the overall experience (4.8). These findings strongly support the app's success in delivering an intuitive, functional, and educationally supportive experience for Mandarin learners.

User comments provided additional qualitative insights, suggesting that users appreciated the app's minimalist structure, seamless audio support, and visual clarity. Some feedback also indicated potential improvements for future releases, such as enhanced font adaptability for different screen sizes and the inclusion of tutorial prompts for first-time users.

Overall, the usability testing process has validated the app's core design principles while offering clear direction for further optimization. The consistently high scores reflect the application's effectiveness in meeting user expectations and confirm its readiness for broader deployment among beginner Mandarin learners.

CONCLUSION

The EasyChinese mobile application developed in this project offers a targeted and innovative solution for Mandarin beginners, particularly those from English-speaking backgrounds who struggle with tone recognition, pronunciation, and sentence construction. By combining structured linguistic instruction with game-based interaction, the application successfully delivers a learning experience that is both educationally meaningful and engaging. The integration of modules such as Pinyin Training, Sentence Building, and Vocabulary Review ensures that users are supported across the foundational aspects of Mandarin acquisition.

The app's core functionalities—real-time feedback, dynamic difficulty scaling, and visual reinforcement—have demonstrated effectiveness in supporting learning

retention and maintaining user motivation. Usability testing results further confirmed the clarity of the interface, the ease of navigation, and the high level of satisfaction among users. Through Firebase-based architecture and adaptive UI design, the app maintains robust performance and accessibility, making it well-suited for use in diverse learning environments.

Despite these strengths, several enhancements remain necessary. Expanding the app's capabilities to include additional language support, increased content variety, and user customization features would further improve its inclusivity and pedagogical range. Implementing these refinements could better accommodate learners with different needs and provide a more personalized experience.

EasyChinese exemplifies how mobile-assisted language learning can be optimized through thoughtful design and iterative development. The project contributes to the growing intersection of educational technology and second-language acquisition by demonstrating how gamification, structured progression, and real-time monitoring can be effectively combined. With continued updates driven by user feedback and research-based practice, the app holds promising potential to support long-term learning outcomes in Mandarin education.

In conclusion, the EasyChinese project has achieved its objectives by delivering a reliable, learner-centered mobile platform that promotes linguistic confidence and cognitive engagement. It stands as a practical and scalable model for future developments in mobile language education, with the capacity to make a meaningful impact on learners' progress in mastering Mandarin Chinese.

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