Interface Design and Functional Optimization of Chinese Learning Apps Based on User Experience

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Abstract: This research paper investigates the interface design and functional optimization of Chinese learning apps through the lens of user experience. With the increasing popularity of Chinese language learning apps in the era of rapid mobile internet development, users' demands for enhanced interface design and interaction experience have grown significantly. The study aims to explore the influence of user feedback on the design and functionality of Chinese learning apps, proposing optimization strategies to improve user experience and learning outcomes. By conducting a comprehensive literature review, utilizing methods such as surveys and user interviews for data collection, and analyzing user feedback, this research identifies existing issues in the interface design and interaction experience of Chinese learning apps. The results present user opinions, feedback analysis, identified problems, improvement directions, and specific optimization strategies. The study discusses the potential impact of these optimization strategies on enhancing user experience and learning outcomes, compares findings with previous research, addresses limitations, and suggests future research directions. In conclusion, this research contributes to enriching the design theory of Chinese learning apps, offering practical optimization recommendations for developers, and supporting the continuous advancement of Chinese language learning apps.

Keywords: Chinese Learning Apps; User Experience; Interface Design; Functional Optimization

DOI: https://doi.org/10.61414/jeti.v6i2.187

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1. Introduction

In recent years, the unparalleled momentum of technological development has pushed more researchers to pay attention to the application of technologies in education. Teaching Chinese as a foreign language as an emerging discipline, its digital development process has also become an important part of the construction of this discipline. Numerous researchers have paid great attention to the online learning of Chinese learners, among which various kinds of Chinese learning applications used by Chinese learners are significant contents of their researches. As these apps continue to emerge, user expectations for a smooth and engaging learning experience are also increasing. However, at present, there is a lack of research on the interface design and function optimization of Chinese language learning applications based on user experience, and relevant suggestions have been given.

Empirical studies on educational applications have increasingly emphasized the importance of user experience (UX) in the design and development process. However, when it comes to apps dedicated to language learning, particularly Chinese, there is a noticeable gap in research that specifically addresses the intricacies of user experience from the learners' perspective. Previous research has predominantly concentrated on the general aspects of app design or on the universal issues faced by learning apps across various fields. While there is extensive literature on the functionality, content, and pedagogical methods of Chinese learning apps, such as the studies conducted by Li and Zheng (2018), these often provide a theoretical foundation and practical experience without delving into the depth of user experience. This gap is particularly evident in the context of international students who may require more culturally attuned and engaging content (Zhao & Wang, 2020). This oversight extends to the analytical depth of user feedback within Chinese learning apps. Current research often lacks a rigorous quantitative approach to user feedback, relying instead on qualitative assessments that fail to capture the full spectrum of user dissatisfaction or delight (Liu & Zhang, 2021). By not adequately leveraging data analytics, previous studies have produced optimization strategies that are overly generic—thus not practically useful for specific app improvements.

In addition to the user experience perspective, our research extends into the realm of second language acquisition (SLA) theory to refine the evaluation of Chinese learning apps. Current evaluation practices predominantly cover aspects such as functionality, content, interface design, and maintenance, yet they often fail to incorporate foundational SLA theories into their assessment methods (Ahern et al.,2023). This omission results in an evaluation process that is limited to comparing existing app content rather than systematically analyzing the strengths and weaknesses of the apps in question. By integrating SLA theories into our evaluation criteria, as suggested by Hu (2022), this paper aim to provide a more nuanced and comprehensive approach to app assessment. For instance, SLA principles suggest that language learning should be iterative and contextual, with a strong emphasis on real-world application (Thompson, 2019). By incorporating these principles, the study will evaluate Chinese learning apps not just on their ability to present language content but on their effectiveness in fostering sustainable language acquisition.

In this study, based on the user experience of Chinese language learners, we focus on users' satisfaction with a certain part of these Chinese learning applications and their evaluations of the its importance from the perspectives of three major theories related to second language acquisition, namely, constructivism, behaviorism, and humanism. This study hopes to find out the evaluation and opinions on improvements of Chinese learning applications from learners through questionnaires

and interviews, and analyze the relevant data through SPSS Statistics 25 to put forward feasible suggestions for the optimization of Chinese learning applications. The resulting insights will inform targeted design and functionality enhancements, making the apps not only more effective in delivering educational content but also more engaging and responsive to user needs. There are three main research questions in this study:

1. What are the current issues in the interface design and functionality experience of Chinese learning apps?

2. What are the specific interface design and functionality needs and expectations of users?

3. How can user experience be leveraged to optimize the interface design and functionality of Chinese learning apps?

E-era has fostered a community of E-learning learners who have become accustomed to the freedom of the virtual environment and have learned to utilize the variety of learning resources available through hyperlinks (Cui, 2010). Nowadays, the development of teaching Chinese as a foreign language and the continuous progress of technology put forward higher requirements for Chinese learning apps. Whether or not an APP brings high value and a good user experience has a direct impact on the success of the APP (Shi & Hu, 2019). This research combines the user experience theory with the design practice of Chinese learning apps, which has the following two aspects of significance. Firstly, in theory. Starting from the perspective of user experience, this paper enriches the application of user experience research in the field of Chinese learning APP design. It provides new ideas and methods for research in related fields. Secondly, in practice. Through empirical research and case analysis, this paper reveals the existing problems and deficiencies in interface design and functional experience of current Chinese learning apps, provides the direction and motivation for developers to improve, and helps promote the continuous optimization and innovative development of Chinese learning apps.

The paper is structured as follows: the literature review section describes previous research related to the current status and challenges of the Chinese language learning apps and user experience in mobile app design. Also, the evaluation criteria for language learning apps based on Second Language Acquisition are described. The next sections are methodology, results, discussion, and conclusion.

2. Literature Review

2.1 Chinese Language Learning Apps: Current Status and Challenges

The proliferation of mobile technology has significantly impacted the field of language learning, with a marked shift towards the use of applications designed to facilitate the acquisition of new languages (Wilson, 2022). Among these, Chinese language learning apps have emerged as a prominent category, given the growing global interest in Mandarin Chinese due to its economic and cultural significance (Odinye, 2015). These apps offer a range of functionalities, from basic vocabulary drills to interactive lessons and cultural immersion experiences. However, despite their potential, several challenges hinder their effectiveness and user satisfaction.

Firstly, the current market is saturated with a plethora of apps, but a considerable number lack pedagogical soundness. Many are designed with a focus on gamification and user engagement, often at the expense of educational value (Li & Zheng, 2019). This raises questions about the efficacy of these apps in providing a comprehensive learning experience that goes beyond mere vocabulary acquisition to include grammatical understanding and language usage in real-life contexts.

Secondly, the issue of user retention is significant. Initial enthusiasm frequently wanes due to a variety of factors, including the monotony of content, lack of personalized learning paths, and

insufficient feedback mechanisms (Chen, 2020). Apps that fail to incorporate adaptive learning technologies or sophisticated algorithms to tailor the learning experience to individual user needs struggle to maintain user interest over time.

Furthermore, cultural content integration poses another challenge. Language learning is inextricably linked with cultural understanding (Kidwell & Triyoko, 2024), yet many apps do not adequately incorporate cultural elements into their curriculum. This omission can lead to a superficial understanding of the language, devoid of the rich cultural nuances that give the language its depth and vibrancy (Lee & Park, 2020).

Finally, technical issues such as user interface (UI) design, interaction design, and overall user experience (UX) significantly impact the effectiveness of these apps. Poorly designed interfaces can frustrate users, leading to disengagement and abandonment of the learning tool (Liu, 2021). Moreover, the integration of advanced technologies such as artificial intelligence (AI) and natural language processing (NLP) remains underexplored, with significant potential for improving personalized learning experiences and real-time feedback (Jiang & Zhao, 2021).

In summary, while Chinese language learning apps have the potential to revolutionize language acquisition, their development faces several challenges. These range from ensuring pedagogical effectiveness and user engagement to integrating cultural content and leveraging advanced technologies for personalized learning. Addressing these challenges is crucial for developers aiming to create effective, engaging, and educationally valuable learning tools.

2.2 User Experience in Mobile App Design

In the age of mobile internet, an abundance of mobile apps is at our fingertips. However, the key to the success of an APP depends on its ability to offer high value and a great user experience (Shi & Hu, 2019). This is why designers must prioritize user experience when creating products. A user's experience with the app is the essential means for product design to meet its target demand (Yuan, 2024). While there is no universal standard for defining and evaluating user experience in academia, it remains a crucial consideration in the development of any successful app.

The concept of user experience was first introduced by Norman in 1994, and since then, it has been extensively discussed by scholars worldwide. Among foreign scholars, the ISO (2010) definition is the most widely accepted, defining user experience as the cognitive impressions and reactions people have towards products, systems, or services intended for use. According to Garrett (2003), user experience encompasses the behavior and usage of a product, including brand features, information usability, functionality, content, and other aspects of the experience. He also proposed the five-layer model. In China, various scholars have provided their perspectives on UX. Hassenzahl (2006) believes that UX refers to the user's inner condition and the results produced by a system with specific characteristics in a particular interactive environment. Yin and Zhou (2020) and Yuan (2024) suggest that UX is the user's purely subjective feelings while using a product or service. Peng and Tao (2022) define UX as the user's experience of using a product or service during the process of use. Tao (2022) defines user experience as the physical and mental feelings formed by users while using a product, including the clarity of information delivery and ease of operation.

Numerous scholars have proposed theoretical models to evaluate user experience. For instance, Whitney (2004) developed the 5E model, which comprises five aspects: usability, ease of learning, effectiveness, attractiveness, and fault tolerance. Similarly, Vyas (2006) suggested the APEC model, which includes four aspects: aesthetics, utility, emotion, and cognition. Wang (2006) categorized UX

into three aspects: functional experience, technological experience, and aesthetic experience. In his writings, Steve Krug proposed six aspects of UX usability, usefulness, learnability, memorability, effectiveness, efficiency, and meeting expectations. Peter Morville (2014) developed the honeycomb model or seven-factor model. Yang (2017) categorized user experience into three aspects: functionality, usability, and ease of use. Yin & Zhou (2020) studied the user experience of short video apps through three levels: the sensory layer, interaction layer, and psychological layer. Zhang, Zhu, and Li (2019) evaluated the user experience of mobile learning apps based on five dimensions: pleasantness, reliability, availability, accessibility, practicality, and interactivity. Scholars typically use questionnaires and interviews to measure user experience.

In essence, product designers must consider the user's viewpoint when creating software functionalities, alongside conducting comprehensive research to pinpoint the actual necessities of the users and integrate them into the product's features productively and promptly (Yuan, 2024). With this research in mind, the report aims to assess the interface and functionalities of a Chinese language learning application, utilizing three core criteria: pleasantness, practicality, and interactivity. We will construct an evaluation index system from the user experience perspective, which will be illustrated in the following table.

2.3 Second Language Acquisition Theory (SLAT)

With the development of society, the theory of second language acquisition has emerged, which is called “Second Language Acquisition”(SLA). SLA is the process of learning a second language without the habits of the first language, on the premise that people have mastered the first language. People learn a second language passively and actively in the context of their first language. Second language learning requires continuous imitation and repetition of responses to stimuli to form habits. The language level and learning attitude of the target audience as well as the social environment of the language learners will have a direct and significant impact on their language learning effects. Therefore, second language acquisition needs to be closely related to the realities of life and be carried out in a specific language environment (Zhou, 2023).

Constructivism is a further development from behaviorism to cognitivism. First of all, the idea of “construction” has already existed in J.Piaget's thoughts. J.Piaget believed that knowledge does not come from the subject nor from the object, but is generated in the process of interaction with the subject and object. Vogotsgy also believed that human activity is the bridge between internalization and externalization. When constructivism as a theory of knowledge and learning, it emphasizes the learner's initiative - the learner constructs and comprehends knowledge based on their prior knowledge and experience, and in the context of social-cultural interactions. In addition, many famous psychologists and educationalists, such as Ausubel, Bruner, have made in-depth research from the developmental conditions of cognitive structure, the influence of the social environment and other aspects of psychological development and the importance of individual initiative for the construction of cognitive structure, so as to make the constructivism further enriched and developed, which provides a strong support for the practical application of the theory of constructivism in teaching and learning. The development and application of these advanced scientific and technological

The development and application of advanced science and technology provide ideal tools and means to realize the application of constructivism in Chinese learning. Analyzing from the two aspects of constructivism, both emphasize individual initiative

and interaction between learners and environment. On the one hand, the constructivist view of the student believes that "students do not walk into the classroom with empty heads." In the face of various problems, students will form their own unique views based on their previous relevant experiences, i.e., logical conclusions based on their own experiential backgrounds, which emphasizes the richness of students' experiences and individual differences, and pays attention to the uniqueness of learners in the learning process. On the other hand, the constructivist view of learning holds that learners are not passive receivers of information, and learning is not simply transferring and transmitting knowledge from the outside to the inside, but rather, students construct their own knowledge experience by actively giving meaning to information. Some researchers evaluated the impact of online collaborative learning environments (OCLE) on the development of creative learning skills through a constructivism learning approach and found that OCLE significantly mediates the impact of certain constructivist tenets such as optimizing known knowledge, experimental learning, and adaptive cognition towards developing creative thinking skills (S. Vijayakumar Bharathi & Mandaar B. Pande, 2024).

The pedagogical paradigms of Behaviorism and Constructivism are often seen as opposing paradigms at the ends of an instructional design continuum. However, some researches implied that teachers and students can select appropriate pedagogical paradigms and methods based on the domain of knowledge and learners' mastery of learning outcomes (Ronald C. Aylward & Johannes C. Cronjé, 2022). Behaviorism is that the behavior of each learning individual is the individual's response to the stimulus of the external environment (learning material), and the acquisition is the response of the human brain after learning new knowledge from the outside world. They view the environment in which new knowledge is generated and acquired as the stimulus, and the individual behavior that ensues after being stimulated as the response, and consider all individual behavior in the context of new knowledge to be acquisition. Thus, even if the environment is the same (the stimulus is the same), the response (acquisition) varies from one individual to another. The process of acquiring a language can then be viewed as an uninterrupted process of receiving stimuli (receiving new knowledge) and responding as expected (following the syllabus). If the result of the action is satisfactory, the language learner repeats the action and the "response", and the "positive" response is then "reinforced" by the repetition. This "positive" response is then "reinforced" by repetition. This is also known as "positive reinforcement" in the behaviorism, where the "positive" response can be repeated in order to get the desired reinforcing result. The "stimulus-response" concept of behaviorism, when applied to education, means arranging events that are likely to be reinforcing in order to promote learning and thus acquisition. In our practice, in addition to arranging opportunities to facilitate learning, the principle of facilitating learning lies in the principle of immediate feedback: there should be feedback and evaluation following the learners' responses to the instructional stimulus in order to reinforce the correct behavior in learning. Literature reveals that a Behaviorist uses feedback for modifying students' behavior while a Cognitivist employs feedback to guide and support their students' mental connections (Moss & Brookhart, 2019).

Humanism emerged in the United States in the 1950s and 1960s, emphasizing human-centeredness, and represented by American psychologists Maslow and Rogers. According to Rogers, human are born curious about the world and have the potential for development. Teaching should be student-centered to give full play to students' potential abilities. Maslow's Hierarchy of Needs argues that all basic human needs are determined by human potential, and that the key to

completing human self-actualization lies in enabling people to recognize their inherent potential or value, and that education should promote human self-actualization.

Rogers expressed his viewpoint in his book Freedom to Learn (1969) that students learn by doing, by engaging in meaningful, experiential learning. Education should not only inform about the state of the nation and the present, but also prepare for the future; the goal of education is to develop individuals who are ready to adapt.

Humanism holds that the goal of education should be the education of the whole person, focusing on the development of human potential, so as to cultivate people whose personalities can be fully realized. Education should be student-centered, so that students realize their own potential, firmly believe in their own abilities, and engage in the most sustained and deepest meaningful learning activities, so as to achieve all-round development. On the basis of valuing students' intrinsic motivation and needs, teaching materials relevant to students' individual experience are selected and used to stimulate students' motivation and interest in learning and to increase their motivation to learn.

3. Methodology

3.1 Sample and Sampling

68 students were invited to participate in this methodological study. All of the participants are volunteered to attend to the work. Before administration, all of the participants were informed that their contribution and participation are as a part of this current research work, then, the research goals and ethical considerations were clarified specifically. They were also being set free in mind with the emphasis that their identification and answers are merely used for research work and would not be divulged to anyone.

We invited participants to complete the survey and answered 24 questions to get the knowledge of their basic information and some assessments or suggestions on Chinese learning applications. They came from different countries, and we divided them into three groups according their language level. 40 students are in the intermediate group, 21 students are in the advanced groups and 7 students' language skills are not as good as others. Generally, the language level of these participants is relatively high. The study's sample comprised 37 female students and 31 male students, and most of them are undergraduates. All participants had used some Chinese learning applications for a period of at least one month.

3.2 Instrument

3.2.1 Questionnaire

Essentials in the questionnaire rooted in learning theories such as constructivism, behaviorism and humanism. The questionnaire about interface design is on a 5-point Likert scale (1=in total unimportant; 5=in total important) and questions about functions is on a 5-point Likert scale (1=in total unsatisfactory; 5=in total satisfaction) order to obtain students' satisfaction and evaluation of the importance of the interface design and functionality of some Chinese learning applications. The rating scale was adapted from Hu Junru's (2022) rating scale for revisions. In Hu's scale,

Table 1 Basic Information of Participants

Students	Number	Language level		Language level		
		Male	Female	Beginner	Intermediate	Advanced
undergraduate	41	19	22	3	28	10
postgraduate	16	5	11	3	3	10
current employee	11	7	4	1	9	1

she concluded three main parts,including interface, content design and function. This paper focused on interface design and function, so we excluded the points of content. The rating scale and the corresponding definitions and examples are displayed as follows (see Table 2):

Table 2 Essentials of User Experience

Number	Category	Essentials
1	Interface (6)	Navigation and modules are clear
2		Clear pages with a good mix of visual elements
3		Adjustable fonts, audio, and video playback speed
4		Supporting personalized customization
5		Switchable language versions
6		Good responsive design, adaptable to different devices
7	Function (11)	Study reminders
8		Instant and clear feedback and push messages
9		Learning progress can be controlled or learning objectives and content can be adjusted
10		Regular tests to help consolidate
11		Provide test feedback and analysis
12		Records of the learning process, error-prone points, and difficult points
13		Image linkage, multimedia presentation of content
14		Multiple strategies to stimulate user interest (games, leaderboards, stories)
15		Targeted scenario selection/simulation
16		Intelligent assistance (voice recognition, error correction)
17		Interactive/social learning formats

Through the examination of Q8-13 (related to the interface design), Cronbach's Alpha showed satisfactory reliability 17among the ten items (α= 0.875, α=0.887). Follow-up questions (Q14-24) were used to gather additional information about learning applications' functions, relevant items also showed reliable outcomes (α=0.942, α=0.946). In addition, the validity of the questionnaire has been examined and KMO all achieved positive level with KMO=0.856 among first 6 items and KMO=0.883 among other 11 items ($p<0.005$).

3.2.2 Interview

8 interviewees were willing to be interviewed and gave us valuable feedback and suggestions, they each participated in a face-to-face semi-structured interview with one of the researchers. On one hand, since we only involved a small sample of students to participate in our research, interviewing some students and gain more information can compensate that. On the other hand, we believe that focusing on these participants allows us to report more detailed results and to conduct a more in-depth examination of the research questions. At each interview, the participants were asked the same questions. The questions most

Table 3 Analysis of the Reliability and Validity

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.874	.875	6

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.885	.887	6

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.942	.942	11

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.945	.946	11

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.856
Bartlett's Test of Sphericity	Approx. Chi-Square	601.975
	df	66
	Sig.	<.001

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.883
Bartlett's Test of Sphericity	Approx. Chi-Square	1400.814
	df	231
	Sig.	<.001

relevant for the present study were those concerning the participants' experiences with using Chinese learning applications.

In the interview section, we focused on the following five questions to understand the actual needs of the interviewees in terms of the interface design and functionality of the Chinese language learning app, as well as the problems they encountered now concerning these two aspects: What are the factors that influence your choice of an app? Do you think Chinese learning apps are helpful to your learning? What are the main aspects? What problems do you think exist in your learning software? What are your expectations and suggestions for improving the functions of Chinese learning software? Do you have any expectations and suggestions for improving the interface design of Chinese learning software? To ensure a vigorous data analysis, we analyzed the data independently and then collaboratively through comparison and discussion to reach a consensus.

3.3 Data Collection and Analysis

The data in this study were collected over two weeks in April 2024 and came from Chinese learners in Wen Zhou University. After obtaining necessary data, to ensure the validity and reliability of this research and learn more about students' attitude to Chinese learning applications, we apply IBM SPSS Statistics 25.0 to analyse the collected data. The scale used for investigating participants satisfaction about learning application's interface design and functions and their assessments of the importance of that. Through analysis from different dimensions, we could optimize the applications if participants regard some parts of them as important but they are not satisfied with the corresponding contents.

4. Results

This study has collected and processed the questionnaire data. Questions 1-7 show that the respondents are from 23 countries. The largest group of international students is Vietnamese, accounting for about 26.47%, followed by Indonesian students with about 19.12%. Among the 68 international students, 37 are female and 31 are male. Most respondents are 18-35 years old, with a balanced ratio of males to females, indicating that male and female students are not treated differently in the current study abroad environment. The majority of the respondents are undergraduates, accounting for about 60.29% which is more than twice that of graduate students, and a small percentage of the current employees accounted for

about 16.18%. This shows that the Chinese learning app's audience is relatively broad. Regarding Chinese language proficiency, about 58.82% of international students are at the intermediate level, about 30.88% are at the advanced level, and only about 10.29% are beginners (Chart 4). This indicates that the Chinese language proficiency of international students is relatively good, and the questionnaire and interview data results are highly credible. Questions 8-13 on interface design and 14-24 on functionality, rated with 1 being the lowest and 5 being the highest according to importance and satisfaction. The following data analysis is based on the three previously mentioned research questions.

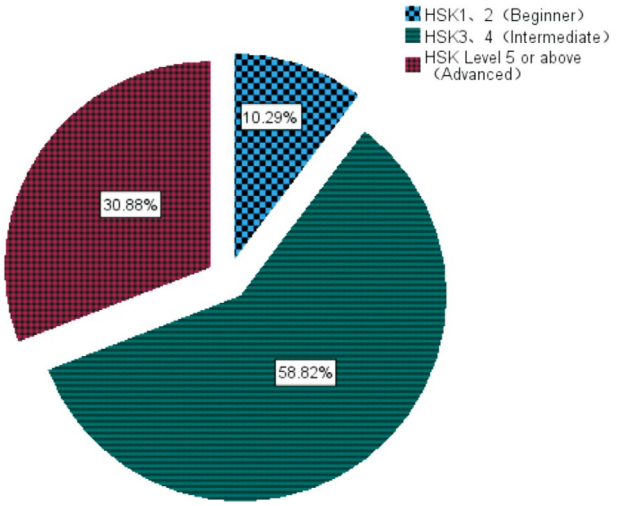

Chart 4 Chinese Language Level

4.1 Current Issues in the Interface Design and Functionality Experience

The survey was conducted in six key areas to study the satisfaction of interface design and eleven areas for functionality experience (Table 5). The mean value of each satisfaction reveals that respondents are significantly more satisfied with the interface design than the functionality. The top three highest satisfaction ratings were all for interface design. People are most satisfied with the 'good responsive design', 'the clear navigation and modules', and 'the clear pages with a good mix of visual elements' of Chinese learning apps. Concerning the functionality experience, most people are satisfied with its 'instant and clear feedback and push messages'.

When it comes to current issues, a lower mean of satisfaction can be informative. In the interface design part, 16.2% of people are dissatisfied with 'switchable language versions', and they think that there is a general lack of different language versions for Chinese learning apps. Just as the comment, "Sometimes the instructions can't be translated, and we are not clear about what the software asks us to do. I am sure other non-English speakers may have faced the same problems" (Interviewee C). In terms of functionality, firstly, the lowest level of satisfaction was 'multiple strategies to user interest', such as games, leader boards, and stories. Secondly, 17.7% of respondents are dissatisfied with 'study reminders', and 5.9% feel very dissatisfied. Similarly, 17.6% were dissatisfied with 'interactive formats' in apps. They see the types of functionality like online discussions and online groups as necessary. Thirdly, 19.1% of the respondents are dissatisfied with the image linkage and multimedia presentation of content, and they felt that most existing apps could not utilize images or other multimedia presentations. In addition to the sections mentioned above, many other sections are also problematic. For example, 4.4% are very dissatisfied with the lack of 'providing test feedback and analysis' and 'intelligent assistance features'. Furthermore, most of the Chinese learning apps do not provide 'regular tests' to help consolidate, they lack 'scenario selection/simulation' and fail to 'provide records of the learning process, error-prone points, and difficult points'.

In addition to the issues mentioned above, some interviewees noted that the current apps have insufficient or too old content and lack cultural background introduction. What's more, many apps provide limited learning content and require high additional fees for some features.

Table 5 Satisfaction of Interface Design and Functionality

Titles	Mean (1-5)	Median (1-5)	Mode (1-5)	Variance
8.Navigation and modules are clear.	3.81	4.00	4.00	.784
9.Clear pages with a good mix of visual element (Such as pictures, buttons, etc).	3.76	4.00	4.00	.839
10.Adjustable fonts, audio and video playback speed.	3.62	4.00	4.00	.956
11.Supporting personalized customization (e.g. theme, background, etc).	3.57	4.00	4.00	.815
12.Switchable language versions.	3.56	3.50	3.00	1.116
13.Good responsive design, adaptable to different devices (e.g. cell phones, electronic tablets, computers).	3.90	4.00	5.00	.989
14.Study Reminders.	3.47	3.50	3.00	1.268
15.Instant and clear feedback and push messages	3.60	4.00	4.00	1.138
16.Learning progress can be controlled or learning objectives and content can be adjusted.	3.63	4.00	4.00	.803
17.Regular tests to help consolidate.	3.56	4.00	3a	1.146
18.Provide test feedback and analysis.	3.53	3.00	3.00	1.089
19.Records of the learning process, error-prone points, and difficult points (e.g. wrong question sets, learning history)	3.49	4.00	4.00	.880
20.Image linkage, multimedia presentation of content.	3.51	3.50	3.00	1.239
21.Multiple strategies to stimulate user interest (e.g. games, leader boards, stories).	3.46	3.00	3.00	.938
22.Targeted scenario selection/simulation.	3.54	4.00	4.00	.908
23.Intelligent assistance (e.g. voice recognition, error correction).	3.49	3.00	3.00	1.179
24.Interactive/social learning formats (e.g. online discussions, online study groups).	3.47	3.00	3.00	1.208

a. Multiple plurals exist. The smallest value is shown.

4.2 User's Specific Needs and Expectations

In addition to the basic information of the interviewees, it also includes their specific needs and expectations for the interface design and functionality in the interview section. Many respondents suggested that they used Chinese learning apps to help them learn Chinese better. "I think this software helped me better understand every small detail. Because when I come home from school and try to review, I realize I haven't fully understood. With the help of apps, I can review even without a teacher being next to me. And there is also no exact time like a real-life class. So I can learn calmly" (Interviewee C). For the question "What are the factors that influence your choice of app", whether it's an app that's popular or one that's been recommended by a friend, respondents hold they'd prefer one that's easy to understand and rich in features. "I choose these apps based on how easy they are to use, and how much they can help me improve my level" (Interviewee C). In addition, whether this software has learning content that meets the needs is also considered. "When choosing learning apps, I consider whether they cover what I need to learn, such as grammar, vocabulary, and listening exercises" (Interviewee D).

In terms of expectations for interface design, firstly, almost all respondents suggested that they would like the interface of Chinese learning apps

to be more simple and efficient. “I hope they can be more intuitive and easy to use so that people can find what they want at a glance” (Interviewee D). What’s more, more choice of languages is essential. “I would prefer them if they had more language options. I think the software should offer us more than Chinese and English instructions” (Interviewee C). When it comes to the need for functional design, there are two main aspects. Firstly, People hold that Chinese learning apps should provide a socialization platform. Just as the comments “I expect the Chinese learning software to be more functional, such as adding more interactive exercises and introducing cultural elements” (Interviewee D) and “Learners can communicate in mutual support groups to share learning experiences and enhance motivation and effectiveness” (Interviewee B). Secondly, users are in great need of a comprehensive learning program. A lot of people pointed out that they use many learning apps at the same time, because each app is not comprehensive, for example, some lack speaking practice function. It’s quite common that apps have incomplete functions, “Pleco works well, it has pronunciation and idioms on it, but some words are taught with strokes and some aren't, which makes it inconvenient for me” (Interviewee E). Many interviewees hold that the existing learning can be improved by making the functionality comprehensive. Thirdly, people mentioned that a learning app that can provide personalized learning content and feedback is desired. “If the app can provide real-time feedback and progress tracking, that is even more ideal” (Interviewee D). For instance, some people pay more attention to tone. If learning apps provide more targeted learning content and learning records will greatly improve learner outcomes. “It is hoped that the Chinese learning software will add more comprehensive functions and also provide personalized learning suggestions and progress tracking functions to better meet the needs of different learners” (Interviewee G).

Besides those enumerated above, users have three more expectations. Firstly, they want registration fees to be reduced and preferably free, “Some apps offer limitations, not free apps that we have to pay to get full access, but some programs have expensive registration fees. It would be easier to learn Chinese if there was a free app” (Interviewee F). The second is that the content of Chinese learning apps should be relevant to their lives, and it's better to add more cultural elements. “The content of the app is too outdated, it needs to be update, and I expect the Chinese learning software to add more interactive exercises and cultural elements” (Interviewee D). Lastly, some respondents suggested that Chinese learning apps can be combined with artificial intelligence to provide learners with more convenient and efficient services.

4.3 Optimizations in Interface Design and Functionality

According to the IPA chart (Chart 7). There are five items located in the Quadrant I, “dominance zone”: items 8, 9, 10, 13 and 16. The importance and satisfaction of these items are good, which are the strengths of the existing Chinese language learning app and should be endeavored to maintain. Quadrant II, the “maintenance area”, only item 15, which is low in importance but high in satisfaction, and efforts should be made to maintain satisfaction with it. Quadrant III, “Opportunity Zone”, has a lot of room for optimization, all of which have a low level of satisfaction and importance: items 11, 14, 17, 18, 19, 20, 21, 22, 23, 24. The fourth quadrant, “Improvement Area”: switchable language version. That is a priority for optimization and for which efforts should be made to increase subject satisfaction. Combining the comparison of satisfaction and importance between interface design and functionality (Table 6), if the importance of that part is greater than the satisfaction, it can be proved that this part of the user experience is poor and needs to be optimized, the following findings are available.

There are two main issues in the interface design part. The first is 'switchable language versions'. The data shows that it has the largest difference between satisfaction and importance, and 14.7% are less satisfied with it. For instance, Some hold that they would not say Chinese learning apps have serious problems, but they would prefer them if they had more language options. Existing apps can improve the user experience by adding optional language versions. The second is 'adjustable fonts and audio and video playback speed'. The data shows that 11.8% are less satisfied with it. The conclusion can be drawn that adjustable fonts has a poor user experience in the learning section or in the contact section, and thus need to be optimized urgently. In terms of functionality, the four main items have the larger differences. Firstly, respondents showed relatively high importance but the lowest satisfaction with 'social learning formats'. Just same as 'switchable language versions', 14.7% are less satisfied with it. For software designers, this section needs increased attention, they are suggested to add functions such as online groups. Secondly, 'image linkage of presentation' has a poor user experience, for the difference between its satisfaction and importance is 0.02, the same as 'Intelligent assistance'. That indicates that using multimedia to present learning content to respondents is necessary. Meanwhile, functions such as voice

Table 6 Difference between Satisfaction and Importance of Interface Design and Functionality

Titles	Satisfaction Mean (1-5)	Importance Mean (1-5)	Difference (S-I)
8.Navigation and modules are clear.	3.81	3.90	-0.10
9.Clear pages with a good mix of visual element(Such as pictures, buttons, etc).	3.76	3.75	0.01
10.Adjustable fonts, audio and video playback speed.	3.62	3.85	-0.23
11.Supporting personalized customization(e.g. theme, background, etc).	3.57	3.63	-0.06
12.Switchable language versions.	3.56	3.94	-0.38
13.Good responsive design, adaptable to different devices (e.g. cell phones, electronic tablets, computers).	3.90	3.99	-0.09
14.Study Reminders.	3.47	3.57	-0.10
15.Instant and clear feedback and push messages	3.60	3.62	-0.02
16.Learning progress can be controlled or learning objectives and content can be adjusted.	3.63	3.79	-0.16
17.Regular tests to help consolidate.	3.56	3.69	-0.03
18.Provide test feedback and analysis.	3.53	3.65	-0.12
19.Records of the learning process, error-prone points, and difficult points (e.g. wrong question sets, learning history)	3.49	3.68	-0.19
20.Image linkage, multimedia presentation of content.	3.51	3.71	-0.20
21.Multiple strategies to stimulate user interest (e.g. games, leader boards, stories).	3.46	3.60	-0.14
22.Targeted scenario selection/simulation.	3.54	3.65	-0.11
23.Intelligent assistance (e.g. voice recognition, error correction).	3.49	3.69	-0.20
24.Interactive/social learning formats (e.g. online discussions, online study groups).	3.47	3.69	-0.22

recognition and error correction should be optimized to enhance the ease of using the apps. Lastly, people also have a poorer experience with 'records of the learning process, error-prone points, and difficult points'. Accordingly, apps will be a better experience for Chinese learners if they help them record their learning history and keep track of wrong questions.

In summary, the 'switchable language options' in the interface design are the most important part to be optimized. What's more, Supporting 'personalized customization' is a relatively easy way to improve the user experience. For the functionality, except for the 'responsive design' and the function that 'learning progress can be controlled or learning objectives and content can be adjusted', the other features mentioned were recommended for focused optimization and have a lot of room for improvement. In addition, software designers can also provide modest optimizations for the practical needs expressed by users in the previous section.

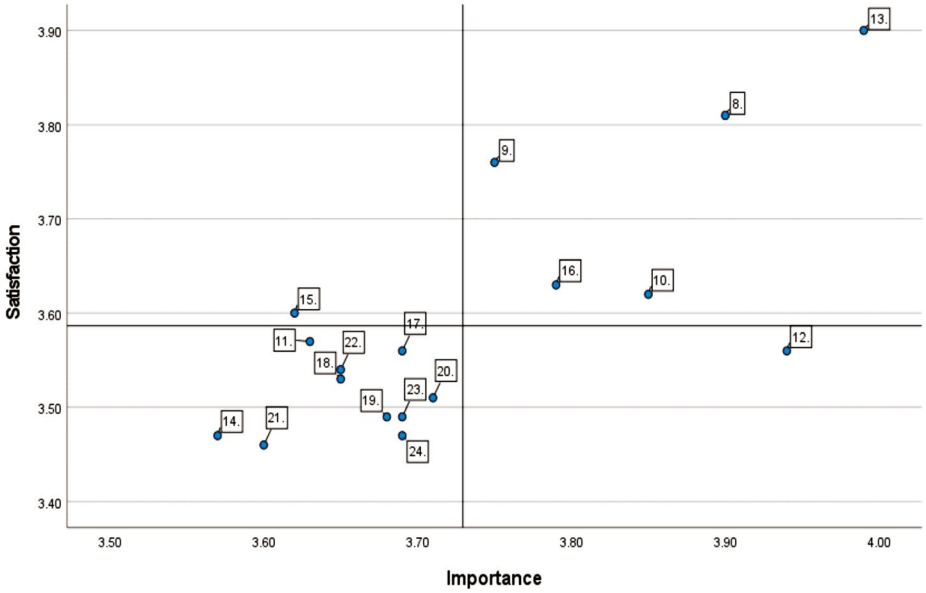

Chart 7 Box Plot of Satisfaction and Importance

5. Discussion

This section critically examines the findings from the collected data on the interface design and functionality of Chinese learning apps, integrating insights from user feedback and comparing them with existing research. The discussion seeks to underline the implications of our results, comparing them with the broader field of mobile app development, especially in educational contexts that involve language learning.

5.1 Evaluation of Interface Design

The research revealed high user satisfaction with the clarity and navigability of app interfaces. A significant 72% of respondents found the navigation and modules of existing Chinese language learning apps to be clear, suggesting that current design paradigms are effective in these areas. This aligns with the principles of effective mobile app design highlighted by Nielsen and Norman (2020), who argue that usability is key to user satisfaction. It also aligns with findings by Huang and Julio (2023) on mobile app usability, which emphasized the importance of clear visual elements and guidance in enhancing user satisfaction. The emphasis on personalization and adaptability also resonates with the constructivist theory of education, which suggests that learning is most effective when actively constructed by the learner in a relevant context (Piaget, 1954).

However, the study also uncovered a need for more personalized interface options, such as adjustable fonts and audio/video playback speed—a feature only 57.3% of respondents were satisfied with. This echoes the sentiment of the "XingSong" song-based learning application research (2023), which identified personalization as a key factor in user engagement and retention.

The preference for personalized customization options and the ability to switch language versions also stood out as important, though users' satisfaction did not align with the importance they placed on these features. This discrepancy could be due to a lack of personalization options in the apps or the quality of the implemented features. Moreover, the study highlights that while responsive design for various devices was deemed important, satisfaction levels indicate that current apps may not be fully optimized for different screens or operating systems.

The discrepancy between the importance users place on customization options and their satisfaction with these features suggests that Chinese learning apps could benefit from adaptive design strategies. Such strategies could include more flexible user-controlled settings, which, according to Gao and Zhang (2021), can enhance engagement and long-term usage by accommodating diverse user preferences and learning environments.

5.2 Functionality Needs and User Expectations

Functionality plays a pivotal role in the effectiveness of Chinese learning apps. Users expect features that allow them to control their learning progress, such as setting personal goals and tracking achievements (Zhao & Liu, 2017). Providing tools for self-regulated learning can enhance motivation and success rates (Panadero, 2017). Customizable learning paths and progress tracking dashboards can help learners stay organized and motivated. Additionally, providing options for setting daily or weekly learning goals and reminders can encourage consistent practice.

Regular assessments are crucial for consolidating learning. Effective apps should include frequent tests with detailed feedback, helping learners identify strengths and areas for improvement (Brown & Abeywickrama, 2019). Feedback should be immediate and specific, guiding learners towards better performance (Shute, 2008). Including various types of assessments, such as multiple-choice quizzes, fill-in-the-blank exercises, and speaking tests, can cater to different learning preferences and provide comprehensive evaluation.

Interactive and social learning formats are highly valued. Features like forums, peer reviews, and collaborative projects can enhance the learning experience (Anderson, 2018). Users benefit from social interaction, which provides practical contexts for using the language (Kim, 2019). Implementing live classes or webinars with native speakers can offer real-time interaction and cultural insights. Additionally, organizing virtual language exchange events can provide learners with authentic conversational practice.

Multimedia presentations, including images, videos, and interactive diagrams, can cater to different learning styles and make learning more engaging (Harris et al., 2016). Apps should leverage diverse media to illustrate language use in real-life contexts (Mayer, 2017). For example, incorporating virtual reality (VR) experiences can immerse learners in Chinese environments, enhancing their cultural understanding and language skills. Augmented reality (AR) features can also provide interactive exercises, such as labeling objects in a room with their Chinese names.

Instant and clear feedback is essential. Users expect immediate responses to their performance, enabling them to learn from mistakes and improve continuously (Hattie & Timperley, 2007). Apps can utilize AI-driven feedback systems to provide personalized guidance (VanLehn, 2011). For instance,

adaptive learning algorithms can analyze user performance and suggest tailored exercises to address specific weaknesses. This level of personalization can significantly enhance the learning experience and outcomes.

Intelligent assistance features, such as personalized learning paths and adaptive content, can significantly enhance learning outcomes (Chen, 2022). These systems adapt to individual needs, providing tailored support that aligns with the learner's pace and style (Woolf, 2010). For example, adaptive quizzes that adjust their difficulty based on the learner's performance can keep users challenged yet motivated. Furthermore, incorporating AI-powered chatbots can offer instant help and explanations, making the app more responsive and user-friendly.

5.3 Incorporation of User Experience and SLA Theories for Optimization

Optimizing Chinese learning apps involves integrating user experience (UX) design principles and second language acquisition (SLA) theories. UX design focuses on creating intuitive interfaces that enhance user engagement and satisfaction. Clear navigation, consistent layout, and visually appealing designs are crucial (Qing, 2024). Users prefer apps that are easy to use and visually attractive (Kim et al., 2024). For instance, using a clean and modern interface with clear icons and instructions can make the app more accessible and enjoyable.

Feedback mechanisms are critical for UX. Real-time feedback helps learners understand their progress and identify areas for improvement (Shute, 2008). Interactive quizzes, progress tracking, and personalized feedback can significantly enhance user experience (Hattie & Timperley, 2007). Incorporating gamified feedback, such as points and badges for correct answers, can also boost motivation and engagement. Additionally, providing detailed explanations for incorrect answers can help learners understand their mistakes and improve.

SLA theories offer valuable insights for optimizing learning processes. Krashen's Input Hypothesis emphasizes the importance of comprehensible input, which can be integrated through graded reading materials and interactive videos (Krashen, 1985). For example, incorporating reading passages with adjustable difficulty levels and interactive glossaries can help learners understand and retain new vocabulary. Vygotsky's Social Interactionist Theory highlights the role of social interaction in language learning, suggesting features like discussion forums and collaborative projects (Vygotsky, 1978). Apps can facilitate virtual language exchange programs or peer review systems to encourage meaningful interactions.

Swain's Output Hypothesis underscores the importance of language production, advocating for speaking exercises and writing prompts (Swain, 2005). Implementing features like voice recording exercises, where learners can practice speaking and receive feedback, can enhance their speaking skills. Additionally, providing writing prompts and peer feedback options can help learners improve their writing abilities. Encouraging users to create and share their content, such as blogs or vlogs in Chinese, can also promote language production and peer learning.

Gamification can enhance engagement and motivation by incorporating game design elements like leaderboards, badges, and rewards (Michael et al., 2017). These features create a sense of achievement and competition, encouraging active participation. For example, implementing weekly challenges with rewards for top performers can stimulate continuous engagement. Moreover, creating a storyline or quest-based learning paths can make the learning process more immersive and enjoyable.

Cultural integration is vital for a holistic learning experience. Apps should include cultural notes, real-life scenarios, and multimedia content that showcase Chinese culture, making learning more meaningful and

engaging (Byram, 2017). For instance, incorporating virtual tours of Chinese cities or interactive lessons on Chinese festivals can enrich the learning experience. Understanding cultural contexts can enhance language comprehension and provide learners with practical knowledge for real-world interactions.

In summary, optimizing Chinese learning apps requires a blend of UX design principles and SLA theories. By focusing on intuitive interfaces, real-time feedback, social learning formats, multimedia presentations, and cultural elements, developers can enhance user satisfaction and learning outcomes. Future research should continue exploring these integrations to develop more effective language learning technologies.

6. Conclusion

While a growing number of empirical findings reveal the importance of user experience (UX) in the design and development process, reliable empirical data about exploring how to optimize Chinese learning applications based on user experience from the different learners' perspective. The present study aimed to find out the evaluation and opinions on improvements of Chinese learning applications. To achieve this goal, a high-standard scale and interviews was applied. The questions measured in-depth information about students' attitude and opinions.

The result from the present study demonstrates that, on average, students' attitude toward Chinese learning applications are positive and most of them regard these applications as useful and helpful. The findings also highlight the need to optimize some parts of these applications. When it comes to current issues in the interface design and functionary experience of Chinese learning apps, switchable language versions and adjustable fonts and audio and video playback speed, these two areas have much lower satisfaction than importance. Satisfaction with the current functionalities of Chinese learning apps is relatively low, such as the importance of interactive/social learning formats, regular tests to help consolidate learning, providing test feedback and analysis, and image linkage of presentation. These aspects should be paid attention to and take actions to optimize corresponding contents. According to some interviewees, some specific needs and expectations have been given. They expect the Chinese learning apps can be more functional, such as adding more interactive exercises and introducing cultural elements. In terms of user interface design, they hope apps can be more intuitive and easier to use, so that people can find what they want at a glance. As the results, to optimize the interface design and functionality of Chinese learning apps, researchers should pay attention to those aspects which gain low-level assessments on satisfactions but be regarded as important.

According to these findings, this research made great contributions to the developments in theory and learning practice. In terms of theory, it can deepen the understanding of user experience and provide researchers with important points of users in the process of using applications to improve the theoretical system of design and provide theoretical support for applications' future developments. Besides, it promotes the integration of interdisciplinary theories such as constructivism, behaviorism and humanism, which can help to form complete theoretical framework. In terms of practice, it can instruct optimization of learning applications and enhance users' satisfaction and loyalty since it can better meet users' needs and enhance the ease of use and attractiveness of applications. More importantly, it can help improve the teaching quality and learning experience of Chinese, and promote the sustainable development of Chinese language education.

Despite the aforementioned findings, limitations should be addressed as well. First,due to the small numbers of sample since only 68 students was invited and all participants are studying at Wen Zhou

University, and the options of applications was limited because of that, the time range and place range are also limited. Meanwhile, some methodological limitations concerning sampling procedure and hierarchical structure in the dataset could not be completely controlled for in the present study. The results should therefore be read with caution. Second, though we get some basic information about participants, the moderating effects of these potential moderators which may have impacts on students' comments and attitude didn't be examined in our research.

Future research should strive to implement experimental study designs to better explore other potential essentials which may have impacts on user experiments and learning effects through Chinese learning applications to provide more effective suggestions on optimizing applications' interface design and functions. In addition, more different age groups and learner from diverse country backgrounds with different language levels should be invited to express their opinions. Last, future studies should also be interested in including more relevant learning applications to gain more information.

Overall, the findings of the present study challenge the way we might think about learning Chinese online according to participants' satisfactory comments and positive hope. The results suggest that Chinese learning applications has become an increasingly important part of most students' choices when they study Chinese.

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