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# Influencing Factors of Chinese Proficiency Test Learning Application Under the Framework of Seamless Learning

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**Abstract:** With the development of modern information technology and network society, the era of digital transformation has arrived, many educational resources have been developed and utilized, and the problem of space-time separation of global Chinese learners is gradually being solved. The use of mobile application learning can achieve convenient and fast learning, reduce learning costs, and flexibly adjust learning progress. After experiencing COVID-19, the demand for human-computer interaction in mobile learning is even more necessary. Therefore, to make applications achieve seamless docking with the needs of learners in the design of learning, the research investigates and analyzes the five dimensions of time, space, mode, subject, and object. The research tests the reliability and validity of the questionnaire, removes the relevant items and conducts non-parametric tests, then puts forward corresponding strategies according to the results of the questionnaire. It aims to enhance the efficiency of Chinese learners in HSK (*Hanyu Shuiping Kaoshi*, Chinese Proficiency Test) learning and promote Chinese learning and the spread of the Chinese language and culture.

**Keywords:** Seamless learning; *Hanyu Shuiping Kaoshi*; Application; Influencing factors

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## 1. Introduction

In recent years, driven by the "Belt and Road" initiative, the "Chinese fever" in countries along the route has been heating up, and Chinese is gradually becoming an international language, with more and more Chinese learners choosing to study in China. The vigorous development of Chinese international education cannot be separated from the huge demand generated by frequent business exchanges between China and overseas. Both government agencies and various enterprises need a large number of staff with Chinese skills, and the number of Chinese learners has increased sharply. However, the shortage of teachers, the monotonous types and forms of teaching materials, and the lack of pertinence of modern teaching methods and modes are still bottlenecks in the field of Chinese learning. Therefore, how to meet the personalized learning needs of Chinese learners and

provide more accurate learning resources to solve the problems of the HSK (*Hanyu Shuiping Kaoshi*, Chinese Proficiency Test) examination is one of the key research areas of modern Chinese education.

With the rapid development of "Internet+" technology and the deepening of social informatization, the development and popularization of information technology make the functions of smartphones more and more powerful, and people's learning habits and methods are also affected accordingly. At present, the use of electronic communication devices to assist learning is favored by many Chinese learners, making mobile learning a hot spot in education.

The Chinese language proficiency test (HSK) is an international standardized test, which focuses on the ability of non-first language candidates to communicate in Chinese in life, study, and work [1]. Although there are many applications for HSK learning on the market, there is still a big gap in the design and development of HSK learning applications compared with English test learning applications; it is still in its infancy, which makes it difficult for learners to learn Chinese. Chinese learners have varying learning goals, knowledge levels, learning styles, etc., which lead to different needs for learning resources [2]. Therefore, with the help of new media technology and according to the learning characteristics and needs of Chinese learners, intelligent push of applications learning resources, seamless docking of different learning spaces and times, personalized learning anytime and anywhere, as well as expanding the vertical and horizontal degree of knowledge, have become an urgent problem to be solved in Chinese mobile learning. This study is also expected to have important theoretical and practical value for improving the efficiency of Chinese learning and enhancing the promotion of Chinese.

# 2. Status of research

## 2.1. Research on seamless learning

### 2.1.1. Concept definition

The concept of seamless learning was first put forward in 2006. In 2010, Singaporean scholar Longxiang Huang put forward the definition of seamless learning. He believed that seamless learning is a ubiquitous learning mode, that is, under the general situation and ubiquitous technology, learners use mobile devices as learning intermediaries and take learners' personalized learning needs as the core. It is a learning mode that seamlessly links formal learning and informal learning, individual learning and group learning, and real learning and virtual learning [3]. The concept of seamless learning is essentially developed from the "mobile learning theory," so the theoretical basis of the two is similar. However, the concept of seamless learning emphasizes the connection between learning elements, which is an inevitable change brought about by the upgrading of mobile learning devices, and a challenge that must be faced at the theoretical level.

### 2.1.2. Characteristics of seamless learning

As for the characteristics of seamless learning, in 2011, Professor Marcelo Millard of Linnaeus University in Sweden and Longxiang Huang of the Institute of Learning Science of the National Institute of Education in Singapore summed up ten characteristics of seamless learning concept based on Professor Dehuai Chen's point of view, with the aim of achieving seamless learning through mobile networks and devices. It is called mobile-assisted seamless learning (MSL) [3,4]. Specific contents include formal and informal learning; individual learning and collective learning; learning across time; learning across space; ubiquitous learning resources; real world and virtual world; integrated use of multiple devices; seamless switching of multiple learning tasks; integration of prior knowledge, new knowledge, and multidisciplinary knowledge; integration of multiple teaching and learning modes [5]. The above ten characteristics can be summarized and refined into three aspects: the infinity of time and space; the diversity of ways; and the integration of knowledge. With the progress and

development of mobile Internet technology, learning can span the real world and the virtual world, connect classroom learning and extracurricular learning, and allow learning activities to change freely in a seamless connection. In addition, the communication between teachers and students can also be boundless, no matter when and where students are, they can ask questions to teachers through electronic mobile devices and teachers can also answer questions immediately. Therefore, establishing connections among various kinds of knowledge through mobile devices as learning centers helps learners to grasp the differences among the knowledge, thus forming knowledge construction [6].

### 2.1.3. Dimension division of seamless learning

Through the development and integration of these ten characteristics, Zhu and Sun refined the three performance dimensions of the seamless learning concept, namely, time, space, and mode [7], as shown in **Table 1**.

**Table 1.** Performance dimensions of seamless learning

| Dimension | Performance |
|---|---|
| Time dimension | Integration of classroom learning and extracurricular learning |
| | Integration of instant and non-instant communication |
| Spatial dimension | Learning across spaces |
| | Integration of the real and virtual world |
| Mode dimension | Integration of formal and informal learning |
| | Integration of various teaching methods and teaching activities |

Hou divided it into four dimensions, namely time, space, subject, and object, on the basis of three-dimensional, combined with CAD (computer-aided design) mobile learning theory model and mobile language double-loop learning guidance concept [5].

This study is based on the studies by Zhu and Sun, and Hou. For the dimensions of seamless learning, the scale is divided into five levels, and the performance rules are determined according to the actual function design and content arrangement of the current Chinese learning application. The five levels of dimensions under the concept of seamless learning are numbered, as shown in **Table 2**. Let T, Q, W, S, and O represent the five dimensions in the comparison framework respectively, T: time, Q: space, W: manner, S: subject, O: object. For the convenience of analysis, the comparative items mentioned later will be replaced by numbers. This dimension division also establishes the theoretical basis for the construction of resource classification and push model in this study.

**Table 2.** Dimensions of HSK learning application under the concept of seamless learning in this study

| Dimension | Performance | Division basis |
|---|---|---|
| Time (T) | Applicability of learning records (T1) | Zhu and Sun (2015) |
| | Continuity of learning progress (T2) | Hou (2017) |
| Space (Q) | Correlation between real situation and virtual situation (Q1) | Zhu and Sun (2015) |
| | Correlation of different learning situations (Q2) | |
| | Switching between different learning devices (Q3) | Hou (2017) |
| | Assistance to classroom learning activities (Q4) | |
| Way (W) | Degree of integration of multiple teaching methods (W1) | Zhu and Sun (2015) |
| | Degree of integration of multiple learning activities (W2) | |
| | The relevance of formal and informal learning (W3) | |
| Subject (S) | The degree of interaction between learners (S1) | Hou (2017) |
| | The degree of interaction between teachers and students (S2) | |
| | The extent to which learners personalize (S3) | |
| | Dynamic satisfaction of learners' needs (S4) | |
| Object (O) | Ubiquity of learning content (O1) | Hou (2017) |
| | Integration of learning resources (O2) | |
| | Timeliness of learning content updates (O3) | |

## 2.2. The status of HSK learning application resources

With the continuous development of new media technology and the in-depth application of new media in Chinese language teaching, in recent years, more and more scholars have realized the shortcomings of the current HSK learning application content design, market positioning, practical application, and its huge development space. Among the numerous new media learning tools, the application combines the development technology of smart mobile device software and mobile communication technology and has the characteristics of diverse functions, powerful performance, and strong interactivity. Nowadays, the mainstream mobile terminals on the market use Android and IOS operating systems. Users can get the application resources they want in various application stores, and most applications are available for download in multiple application stores at the same time.

Currently, the commonly used HSK learning applications are HSKOnline, HSK Hero, e-learning Chinese, SuperTest, HSK Exam, Elephant HSK, Hello HSK, etc. Classifying Chinese learning applications from the perspective of content and function can comprehensively reflect the needs of learners in different categories. It can also summarize the hot spots and difficulties in the current research of Chinese learning applications. At present, there are some deficiencies in content design, market positioning, and practical application of the HSK learning application, which has great development space. Many scholars and learners are looking forward to personalized HSK learning resources that can be combined with the actual market demand and have certain practical significance and value to better meet the needs of Chinese learners for HSK learning.

## 2.3. Selection rules for mainstream HSK learning applications

The selection of mainstream learning applications should be based on the total download volume of applications, user ratings, version updates, similar rankings, actual operation experience, and other factors [8]. Therefore, it is recommended to use the ASO (App Store Optimization), which is also known as the "App Store Optimization Tool,"

that is, the process of improving the ranking of an application in various application stores or markets and the ranking of search results. ASO tools generally cover Android and iOS systems, thus collecting data on all aspects of an application in the form of big data, which is equivalent to monitoring the application in an all-round way.

## 3. Survey on the use of HSK learning applications for Chinese learners

### 3.1. Questionnaire description

(1) The purpose of the survey is to understand the basis for Chinese learners to choose applications. In addition, we need to understand their attitudes, comments, suggestions, and expectations for the design of a certain function in the application.

(2) Survey content: According to the five performance dimensions, 16 comparison items, and quantitative scoring results under the concept of seamless learning, the corresponding questionnaire content was formulated.

(3) Questionnaire form: Likert five-point scale method was used as the questionnaire form.

(4) Survey objects: Foreign students in China (including those who have graduated) were selected as survey objects. The reason for the selection is to take into account the particularity of foreign students in the group of Chinese learners. First of all, foreign students are the backbone of Chinese learners and have certain representativeness; secondly, compared with other types of learners, foreign students have strong learning motivation and are easy to accept innovative learning tools; in addition, foreign students have a certain foundation in Chinese and are easy to communicate.

### 3.2. Implementation of the questionnaire

#### 3.2.1. Interview

Before distributing the questionnaire, ten foreign students were selected to conduct interviews, in order to obtain the attitudes of foreign students towards the use of HSK learning applications, including whether to use applications for test preparation training, what suggestions and opinions they have on the function design and content arrangement of the current mainstream applications, and their expectations for ideal HSK learning applications. The specific interview questions include the following: Do you have any experience using Xianguan application to prepare for HSK? What related applications have you used? Why do you choose these applications? Which function or content in the application do you think is the most helpful to you? If you are asked to develop an HSK learning application, what is your idea?

Through interviews, we can see that at present, most foreign students seldom use HSK learning applications because they have received training and guidance from Chinese tutorial classes and related examination materials, only a few of them have used them, and because of the scarcity of market resources of such applications, the applications they use are similar to the mainstream applications introduced above. Such as the Hello HSK series application, HSK Online, and so on. However, through communication, it was found that these foreign students, whether they have been exposed to HSK learning applications, want to know some information about this because they expect better network resources to help them pass the HSK grade examination faster.

#### 3.2.2. Design of the questionnaire

Through the description of the mainstream HSK learning applications and the comprehensive evaluation and comparison of the applications under the concept of seamless learning, combined with the preliminary interview with foreign students, the questionnaire was designed. The researcher conducted a pre-survey on 50 foreign students. During the survey, the volunteers reflected on some problems, for example, it was difficult for the

respondents to make a choice about their attitude toward some questions, and they needed to have open questions as a supplement. Considering the language level of the respondents, the English version of the questionnaire was set up. There were too many questions in the questionnaire, and the volunteers easily lost patience. Thus, the questionnaire was revised many times, and two versions in Chinese and English were finally made, with each version having four questions, including three multiple-choice questions and one subjective question: What is the reason you choose the application for HSK preparation?; In the process of using HSK learning application, do you have the following experience? Please select your attitude towards the following statements; Do you think the ideal HSK learning application should improve the following functions? Do you think other aspects need to be improved? The question settings of these four aspects were designed according to the five dimensions of the seamless learning concept. The first three multiple-choice questions were 16 questions, a total of 48 questions, the fourth was an open question, and the respondents were required to give suggestions based on their own experience. The expression design was adjusted as much as possible in order to make the respondents better understand the meaning of the question. In the process of formal investigation, when it was really difficult for the respondents to understand the meaning of the question, it was explained orally in order to obtain more effective results.

### 3.2.3. Basic information

215 were distributed questionnaires to HSK 4–6 foreign students, and 210 valid questionnaires were collected. The basic information included gender and HSK level. The frequency analysis results are shown in **Table 3**.

**Table 3.** Frequency analysis result

| Name | Options | Frequency | Percentage (%) | Cumulative percentage (%) |
|---|---|---|---|---|
| Gender | Male | 97 | 46.19 | 46.19 |
| | Female | 113 | 53.81 | 100 |
| HSK level | Level 4 | 72 | 34.29 | 34.29 |
| | Level 5 | 83 | 39.52 | 73.81 |
| | Level 6 | 55 | 26.19 | 100 |
| Total | | 210 | 100 | 100 |

### 3.2.4. Reliability test of the questionnaire

SPSS29 was used to test the reliability of 16 items in the three dimensions of "reason," "attitude," and "expectation." The Cronbach's alpha coefficients were 0.929, 0.937. and 0.91, respectively, all greater than 0.9, indicating that the reliability of the questionnaire data was high (**Table 4)**.

**Table 4.** Cronbach reliability analysis

| Dimension | Number of items | Sample size | Cronbach's α |
|---|---|---|---|
| Reason | 16 | 210 | 0.929 |
| Attitude | 16 | 210 | 0.937 |
| Expectation | 16 | 210 | 0.910 |

### 3.2.5. Validity test of the questionnaire

This study adopted the more mature scale of previous studies [5,7], so it does not carry out exploratory factor analysis but directly adopted the confirmatory factor analysis (CFA) method. The three dimensions of the

questionnaire all adopted the five factors of "T: time, Q: space, W: way, S: subject, O: object," and confirmatory factor analysis of 16 items. The effective sample size of the analysis was 210, which is 10 times more than the number of analysis items, and the sample size is moderate. According to the measurement relationship, the absolute values of the standardized loading coefficients of Q2, Q3, W3, and S4 in the "reason" dimension were less than 0.6, the absolute values of the standardized loading coefficients of W3, S4, and O3 in the "attitude" dimension were less than 0.6, and the absolute values of the normalized loading coefficients of S2, S3, and O3 in the "expectation" dimension were less than 0.6, which means that the measurement relationship is weak. In this study, these items were removed and then confirmatory factor analysis was carried out. The absolute value of the standardized load series of each item was greater than 0.6 and significant, which means that there is a good measurement relationship. The AVE (average variance extracted) values corresponding to the five factors of the three dimensions were all greater than 0.5, and the CR (composite reliability) values were all greater than 0.7, which means that the data of this analysis have good convergent validity, as shown in **Table 5**.

**Table 5.** Results of AVE and CR indicator

| Dimensions | Factors | AVE | CR |
|---|---|---|---|
| Reason | Time (T) | 0.717 | 0.83 |
| | Space (Q) | 0.934 | 0.966 |
| | Way (W) | 0.78 | 0.876 |
| | Subject (S) | 0.895 | 0.962 |
| | Object (O) | 0.585 | 0.808 |
| Attitude | Time (T) | 0.944 | 0.971 |
| | Space (Q) | 0.625 | 0.869 |
| | Way (W) | 0.706 | 0.826 |
| | Subject (S) | 0.706 | 0.875 |
| | Object (O) | 0.955 | 0.977 |
| Expectation | Time (T) | 0.789 | 0.918 |
| | Space (Q) | 0.921 | 0.972 |
| | Way (W) | 0.698 | 0.873 |
| | Subject (S) | 0.686 | 0.812 |
| | Object (O) | 0.912 | 0.954 |

In order to verify the goodness of fit of the model, this study used AMOS29 to analyze the goodness of fit of each item in the three dimensions and used MI (modification indices) to correct the relevant residual values and adjust the fitness of the model. The main index parameters of the corrected model fit are shown in **Table 6**.

**Table 6.** Fitting index of model

| Common indicators | $\chi^2$/DF | GFI | AGFI | CFI | TLI | RMSEA | RMR |
|---|---|---|---|---|---|---|---|
| Criteria for judgment | < 3 | > 0.9 | > 0.9 | > 0.9 | > 0.9 | < 0.10 | < 0.05 |
| Dimension (reason) | 2.892 | 0.913 | 0.829 | 0.978 | 0.964 | 0.095 | 0.0355 |
| Dimension (attitude) | 2.468 | 0.934 | 0.868 | 0.985 | 0.974 | 0.084 | 0.0407 |
| Dimension (expectation) | 2.438 | 0.916 | 0.853 | 0.974 | 0.960 | 0.083 | 0.0713 |

### 3.2.6. Difference test of questionnaire items

After confirmatory factor analysis, the "reason" dimension retained 12 items, including T1, T2, Q1, Q4, W1, W2, S1, S2, S3, O1, O2, and O3; the "attitude" dimension retained 13 items, including T1, T2, Q1, Q2, Q3, Q4, W1, W2, S1, S2, S3, O1, and O2; the "expectation" dimension retained 13 items, including T1, T2, Q1, Q2, Q3, Q4, W1, W2, W3, S1, S4, O1, and O2. Since the questionnaire used "gender" and "HSK level" to test the difference with each item, and the three dimensions are not suitable for normal distribution, the non-parametric test method was used to test the difference. Firstly, the "gender" and each item were analyzed. "Gender" was composed of "male" and "female" groups, so the Mann-Whitney test was used. The results showed that there was a significant difference in the dimension of "reason" (*$P$ < 0.05): Q1 = 0.035*, S1 = 0.049*, S2 = 0.029*, S3 = 0.013*, and O2 = 0.038*. The other items did not show significant differences. There were 8 items with significant differences in "attitude" dimension (*$P$ < 0.05, **$P$ < 0.01): T1 = 0.013*, T2 = 0.049*, Q1 = 0.01*, Q3 = 0.038*, W1 = 0.046*, W2 = 0.019*, S1 = 0.028*, S3 = 0.009**; There were 7 items with significant differences (*$P$ < 0.05, **$P$ < 0.01) in the "expectation" dimension: T2 = 0.046*, Q3 = 0.026*, W1 = 0.019*, W2 = 0.002**, W3 = 0.018*, S1 = 0.002**, S4 = 0.033*. As there is no difference in the median of the items with significant differences, it shows that the source of the difference is the different distribution of data, supplemented by **Figures 1**–**3** to see the difference.

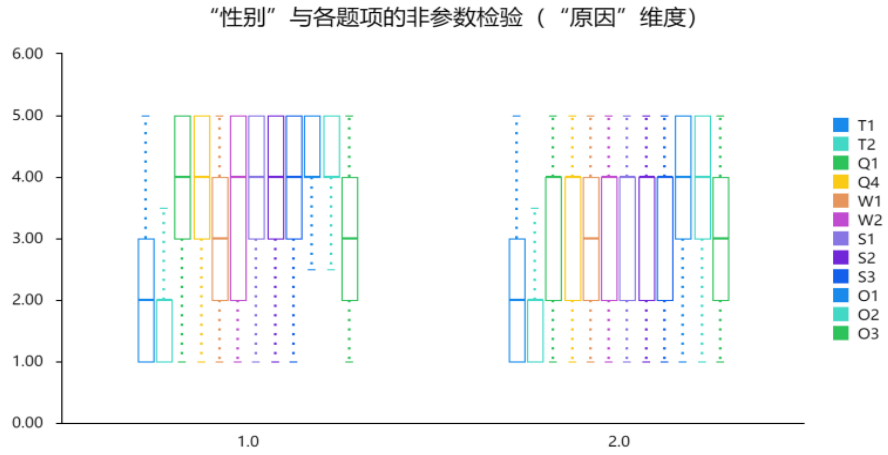


**Figure 1.** "Gender" and the test of the difference of each item (Reason)

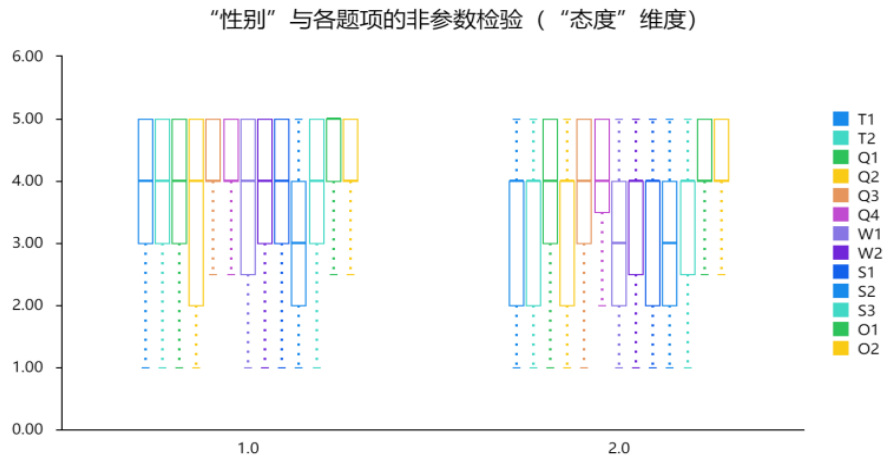


**Figure 2.** "Gender" and the test of the difference of each item (Attitude)

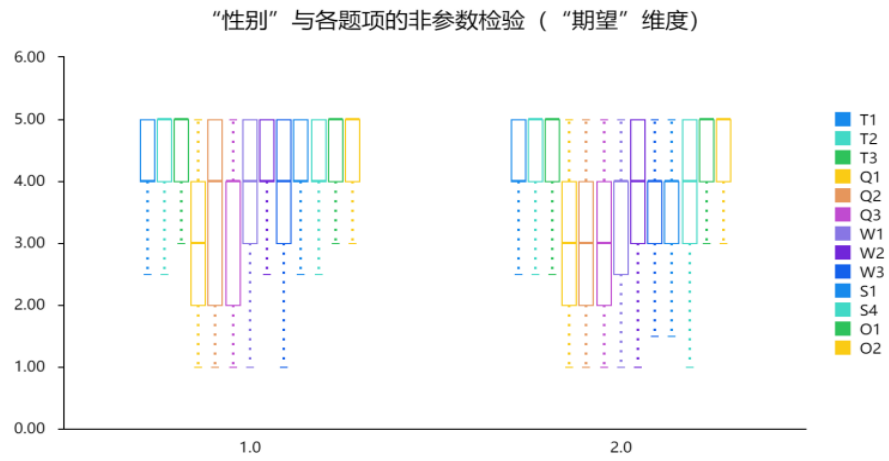


**Figure 3.** "Gender" and the test of the difference of each item (Expectation)

Secondly, "HSK level" and each item were analyzed, because "HSK level" consists of three groups of options, more than two groups, so the Kruskal-Wallis test statistic was used for analysis. Through the statistical analysis of each item of the three dimensions, the results show that different HSK levels did not show significant differences for all items ($P > 0.05$).

# 4. Results

## 4.1. Advantages

Through the above comparative analysis and investigation, several outstanding advantages of mainstream HSK learning applications were summarized and elaborated according to the five dimensions of the seamless learning concept.

In terms of time dimension, most HSK learning applications have the function of saving learning records and learning progress. Among them, learning records have rich functions, such as "wrong question book," "new word book," "my notes," "topic collection," various progress reports, and so on. These functions classify the details of the user's learning process, which is convenient for learners to plan and review their learning, so as to improve their learning efficiency. In addition, users can flexibly adjust these functions at any time according to their own needs.

In terms of spatial dimension, the vast majority of applications have realized the free switching of a variety of electronic devices. As an HSK learning application, most of them focus on the output of exercises and the amount of exercises is rich, and the topic setting will also refer to the form of HSK examination. In terms of the setting of virtual and real situations, many applications have begun to explore the combination of virtual and real situations and the relevance of multiple language situations, such as the selection of example sentences in HSK new word teaching, the selection of materials for listening, reading, writing, and other exercises, etc.

At present, each HSK learning application will form its own set of teaching methods, which are rich in variety and novel in form. In addition, learning activities are mostly carried out around the five aspects of listening, speaking, reading, writing, and practicing, and the content of the activities is extensive, not limited to the requirements of the HSK examination syllabus, focusing on the cultivation of students' real language skills rather than examination skills. Many applications adopt the teaching form of "daily push" to fragment large pieces of knowledge for learners to acquire and master.

In terms of subject dimension, most applications pay more attention to personalization. For example,

before users start learning, they have to register their accounts, and the registration process is also a process for the platform to understand the user's information, including nationality, Chinese level, gender, age, etc. Then the platform will recommend the corresponding learning content for users based on this information; Chinese learners of different nationalities can adjust the guiding language of the interface according to their own needs. It can be adjusted to simplified Chinese, traditional Chinese, English, Japanese, French, and so on. In addition, with the development of information technology, artificial intelligence, and virtual reality, the interactive feedback mechanism of real-time scenarios is becoming more and more perfect, so many applications are embedded with communication and dialogue functions in various forms and rich contents, such as virtual chat rooms, post replies, comments, and attention, which can effectively promote the interaction between teachers and students as well as students and students.

In terms of object dimension, due to the rich variety and easy access to network resources, the mainstream HSK learning applications perform well in the universality of learning resources, whether it is new word teaching, grammar interpretation, listening training, or real exercises, composition guidance, traditional culture introduction, most applications can be involved. In addition, as an HSK preparation learning application, it is also essential to collect information about the HSK test. Many applications will not only remind the HSK registration method, test time, test form, etc. but also analyze and even classify and integrate the HSK test questions.

## 4.2. Weaknesses

At present, the mainstream HSK learning applications also have some weaknesses that need to be improved, as follows.

In terms of time dimension, most applications cannot save the learning progress to the extent of user autonomy. For example, when a learner suddenly quits when learning a group of new words, when he enters the interface again, many applications will return to the home page, and users need to learn from the beginning, which will cause unnecessary time loss. In this regard, applications may set up a pop-up window to allow learners to choose the starting and ending points of learning according to their own situation. That is, learning from the beginning or continuing from the point of departure. In addition, many applications are not perfect in the function setting of learning notes, that is, they cannot record at any time, they can only realize the preservation of new words or the collection of word meanings, and the recording of notes cannot realize advanced preservation forms such as voice and screenshots except in the form of text editing.

In terms of spatial dimension, due to the technical level and professional level of the development team, there are still many weaknesses in the mainstream HSK learning applications, such as the selection of example sentences in the teaching of new words, some of which are too abstract for students to understand, and some of which are too few to cover all common meanings. In addition, users are also very interested in the auxiliary functions of classroom activities, and the most mature auxiliary functions are mainly vocabulary search functions, such as scanning text, listening, and literacy functions have not yet reached popularization.

At present, only a few applications have mature functional designs in teaching forms such as listening, speaking, reading, writing, and practicing. Most applications have a low level of functional design. For example, Chinese character learning requires a high level of writing, while many applications only have the function of displaying Chinese characters, without the functions of animation display of Chinese character stroke order, touch screen red drawing, touch screen writing, and so on. In terms of output exercises, most applications only have "listening" and "reading" exercises, and do not involve "speaking" and "writing," while language learning is a comprehensive learning of various elements, that is, reasonable input and output, which is conducive to

learners' mastery of Chinese. In addition, the exploration of "the relevance of formal and informal learning" in HSK learning applications is still in its infancy, and few applications are combined with formal HSK classroom teaching.

In terms of the subject dimension, although most applications have set up the dialogue function between students and teachers, the efficiency of the dialogue is low, the teacher's reply is not timely enough, or even lacks responses, and the reply can only be in the form of text or pictures, so it is difficult to explain in place. In terms of the design of learners' personality function, although most applications have made attempts, their scope is relatively narrow, mainly focusing on learners' Chinese proficiency, gender, nationality, and other basic factors, and not involving the determination of students' learning goals, the planning of learning process, and other personalized learning mechanisms.

In terms of object dimension, according to the questionnaire survey, learning resources are the content that learners attach great importance to. However, the update of learning resources in mainstream HSK learning applications is relatively slow, and the update method is mainly version updates. In addition, the integration of learning resources is generally poor, many applications explain knowledge points in the form of "daily push," although this way is easy to accept by learners, few applications can achieve orderly dispersion in disorder, such as pushing knowledge belonging to the same theme according to learners' learning needs in a certain period of time in order to enhance the learner's memory of knowledge.

# 5. Discussion

## 5.1. Design of functions

In addition to the basic functions such as "new word book," we can add functions such as "clock-in calendar," "my sentence," "word recitation," "course collection," and "browsing record" to facilitate learners to understand their recent learning situation and make timely adjustments. In addition, the preservation of learning progress requires user autonomy, that is, users can choose to start learning from scratch or continue learning from the last progress.

At present, mobile phones are used more and more frequently. By the end of July 2022, according to the statistics of the Ministry of Industry and Information Technology of China, the number of mobile Internet users in China has reached 1.455 billion, the number of 5G mobile phone users has reached 428 million, and the number of mobile Internet users has reached 1.455 billion [9]. Therefore, mobile phone users are our main service objects. As for device switching, we can switch directly by scanning the QR code on the mobile phone. In addition, application accounts can be directly logged in through WeChat, Facebook, Twitter, Skype, and other software accounts, which not only facilitates the promotion of the application itself, but also helps users to exchange and share their learning results. In the auxiliary aspect of classroom learning activities, in addition to new word query, we can add a scanning function, that is, many foreign students type slowly or even do not know how to type, so the scanning function can help them quickly get the content they want to query.

The application can assign classes for member users, simulate formal learning scenarios, assign intelligent teachers to each class, and students in the class can communicate with each other, which can promote the interaction between students and teachers and between students and students. In addition, the design of a communication platform can draw lessons from professional software such as WeChat and Facebook, and add auxiliary functions such as pictures, audio, and video. The platform can regularly select the top few in the ranking list to carry out online communication and sharing activities of Chinese learning, so as to activate the learning atmosphere of the platform. The platform can also increase the teacher-student matching area, that is, an intermediary service. The platform recruits and screens some excellent Chinese teachers to do long-term or

short-term part-time jobs. Users can hire teachers to carry out online teaching according to their own needs. This can not only solve the problem that the lack of background teacher resources cannot meet the needs of users, but also earn a certain amount of intermediary fees. In terms of learners' personalized needs, the application can set alarm clock functions, such as alarm clocks for getting up, learning period, and learning reminders, similar to the classroom bell, which can be a text reminder that appears on the lock screen of the mobile phone in the form of a pop-up window. In addition, space memory management is also very important. The platform can set relevant functions to facilitate users to make personalized choices for caching and downloading text, pictures, audio, video, and other files so that the limited storage space can be used most effectively.

## 5.2. Arrangement of content

The source of learning content should be ubiquitous, and considering the particularity of the HSK learning application, its learning content should include Chinese basic knowledge learning, HSK preparation training, interest knowledge, and so on.

Vocabulary is an important part of Chinese teaching. Different HSK levels correspond to different vocabulary groups. The specific suggestions for vocabulary teaching are as follows. Firstly, a vocabulary teaching area is set up to integrate the vocabulary of HSK levels 1–6. The vocabulary of each level can be classified according to certain standards, such as clothes, colors, furniture, mood, and so on. A user selects a vocabulary group of a certain level and formulates a daily learning task according to the learning situation of the user. Vocabulary learning includes Pinyin, writing, interpretation, example sentences, vocabulary expansion, etc. The writing part should include three links: animation display, red drawing, and touch screen writing. The interpretation part can introduce more meanings, and the corresponding example sentences should be enough to facilitate learners' understanding. In addition, situational teaching can also be carried out through pictures and videos. Lastly, we can integrate each type of vocabulary by writing a short text, so that students can remember it more easily. Grammar teaching is a difficult point, so in addition to the text form, we can film some short teaching videos to increase the interactive question-and-answer after class.

In the HSK preparation training, we should involve listening, speaking, reading, and writing. The topic design can be consistent with the HSK test questions, and can also achieve the purpose of interesting practice through games. For the training of real questions, the real questions can be separated to facilitate learners to use the scattered time for training, and the whole process of the HSK examination can also be completely simulated [10].

For interest knowledge, we should try our best to use high-quality network resources to enrich the Chinese learning process, such as the daily intelligent push of current news and information, listening resources that can extract some high-quality Putonghua radio resources or wonderful clips of Chinese movies, etc. These methods can achieve the integration of learning content with real-life situations. In addition, some programs can be added to the learning content, such as the introduction series of Chinese traditional festivals, the lecture series of Chinese celebrity stories, Chinese folk stories, etc. Such programs are connected and not scattered, which is convenient for learners to remember.

According to the previous survey, users are not very sensitive to the "priority between formal learning and informal learning," so the application platform can cooperate with some professional HSK training schools or Chinese schools according to their own conditions, and set up corresponding informal learning courses according to their textbook content and curriculum arrangement. For example, after-class knowledge review, after-class homework check, classroom video release, curriculum resource sharing, and so on.

## 6. Conclusions

Firstly, according to the analysis of the adaptability between the HSK learning application and the concept of seamless learning, this study designed a corresponding comparative framework, which includes three horizontal dimensions of "reason, attitude, and expectation" and five vertical dimensions of "time, space, mode, subject, and object." Secondly, according to the comparative framework proposed by predecessors, the corresponding quantitative scoring table was designed, and then through the reliability and validity tests, difference tests, and other methods, the questionnaire items were verified and analyzed. According to the results of the questionnaire, this paper analyzes the reasons why they use HSK learning applications, their attitudes toward the design of various functions, and suggestions for improvement. Lastly, this paper put forward the advantages and disadvantages of HSK learning applications and provided suggestions for improvement. Through the research, the following conclusions are summarized. Although the use of mobile application software has been very common, the use frequency of HSK learning applications by Chinese learners is low, and the development of this kind of application itself is relatively backward, and its functions are not perfect enough. At present, the main focus of this kind of application should be to enhance the relevance between the real and the virtual situations of the teaching content, to enhance the relevance of different situations, and to improve the auxiliary role of classroom teaching activities. We should try to combine with formal learning, pay attention to improving the user's personalized functional experience, and pay attention to the ubiquity and integration of teaching content, so that the content is complex but not disorderly. There are also many deficiencies in the study. Due to the limited research conditions, the comparative analysis framework needs to be further improved. At the same time, because of the limitation of objective conditions, the research cannot achieve a large sample survey. In addition, because the update iteration speed of the application is fast, it is impossible to conduct a real-time comparative study on the updated content of mainstream applications. We hope that the research will be further improved.

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## Disclosure statement

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