

Retraction

Retracted: Teaching Morphophonetic Characters in Teaching Chinese as a Foreign Language Based on Internet of Things Assistance

Wireless Communications and Mobile Computing

Received 27 June 2023; Accepted 27 June 2023; Published 28 June 2023

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

- (1) Discrepancies in scope
- (2) Discrepancies in the description of the research reported
- (3) Discrepancies between the availability of data and the research described
- (4) Inappropriate citations
- (5) Incoherent, meaningless and/or irrelevant content included in the article
- (6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

In addition, our investigation has also shown that one or more of the following human-subject reporting requirements has not been met in this article: ethical approval by an Institutional Review Board (IRB) committee or equivalent, patient/participant consent to participate, and/or agreement to publish patient/participant details (where relevant).

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named

external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

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- [1] Q. Xiao, "Teaching Morphophonetic Characters in Teaching Chinese as a Foreign Language Based on Internet of Things Assistance," *Wireless Communications and Mobile Computing*, vol. 2022, Article ID 9633738, 9 pages, 2022.

Research Article

Teaching Morphophonetic Characters in Teaching Chinese as a Foreign Language Based on Internet of Things Assistance

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Received 12 April 2022; Revised 26 April 2022; Accepted 5 May 2022; Published 21 May 2022

Academic Editor: Mohammad Farukh Hashmi

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Teaching Chinese as a foreign language is a very important part of teaching Chinese as a foreign language, and morphemes account for a large proportion of Chinese characters. In this paper, a questionnaire survey on the cognition of morphemes was conducted for each grade of students in the School of International Cultural Education of Heilongjiang University. Through the survey, it was concluded that international students in the Chinese culture circle and non-Chinese culture circle affect the cognition of morphemes at the primary stage, and a study on the teaching of morphemes in teaching Chinese as a foreign language based on the assistance of Internet of Things was proposed to analyze that students learning Chinese no longer affect the cognition of morphemes. In teaching Chinese as a foreign language, the use of the Internet of Things system and the introduction of video sensors (mainly for the access and computer analysis of spoken Chinese as a foreign language learner model) and voice sensor (mainly for the Chinese as a foreign language learner voice access and computer analysis), with the standard spoken language pattern in the software and the comparison of standard pronunciation, the oral mode and pronunciation of TCSL learners can be corrected. The experiment knows the biases that international students are prone to when learning Chinese characters and summarizes the implications for teaching Chinese characters to foreigners; in addition, the higher the level of learning, the higher is the degree of cognition of morphophonetic characters.

1. Introduction

The biggest difference between IoT and Internet is that IoT is directly connected with all kinds of sensors and does not require people to input information through keyboards but automatically obtains information and carries out automatic processing [1, 2].

In the teaching of Chinese as a foreign language, using the IoT system, we introduce video sensors (mainly used for foreign Chinese learners to acquire their oral patterns and for computer analysis) and speech sensors (mainly used for foreign Chinese learners to acquire their speech and for computer analysis), and by comparing them with the standard oral patterns and standard speech in the software, we can correct the oral patterns and speech of foreign Chinese learners [3].

Morphophonetic characters are made up of a morphological side, which indicates the meaning of the character, and a vocal side, which indicates the pronunciation. The

morphological side helps us to understand and distinguish the meaning of a character; for example, a character with a morphological side is usually related to the action of the hand. The sound side can help us understand the pronunciation of the character [4]. About a quarter of the characters with the sound side have the same pronunciation as the whole character; for example, “change, call, huan, and lax” have the same pronunciation as the sound side [5–7]. Although some morphemes are not pronounced exactly the same as the sound side, there is a certain pattern. Therefore, the proper use of the morphological and acoustic sides of morphemes can help us to infer the pronunciation and meaning of unfamiliar morphemes [8–10]. However, there are significant limitations to the use of ideographic and phonetic characters. Due to the change and simplification of Chinese character shapes, the role of the vocal and vocal paraphernalia has become less obvious, and many of them have become difficult to recognize in future generations [11].

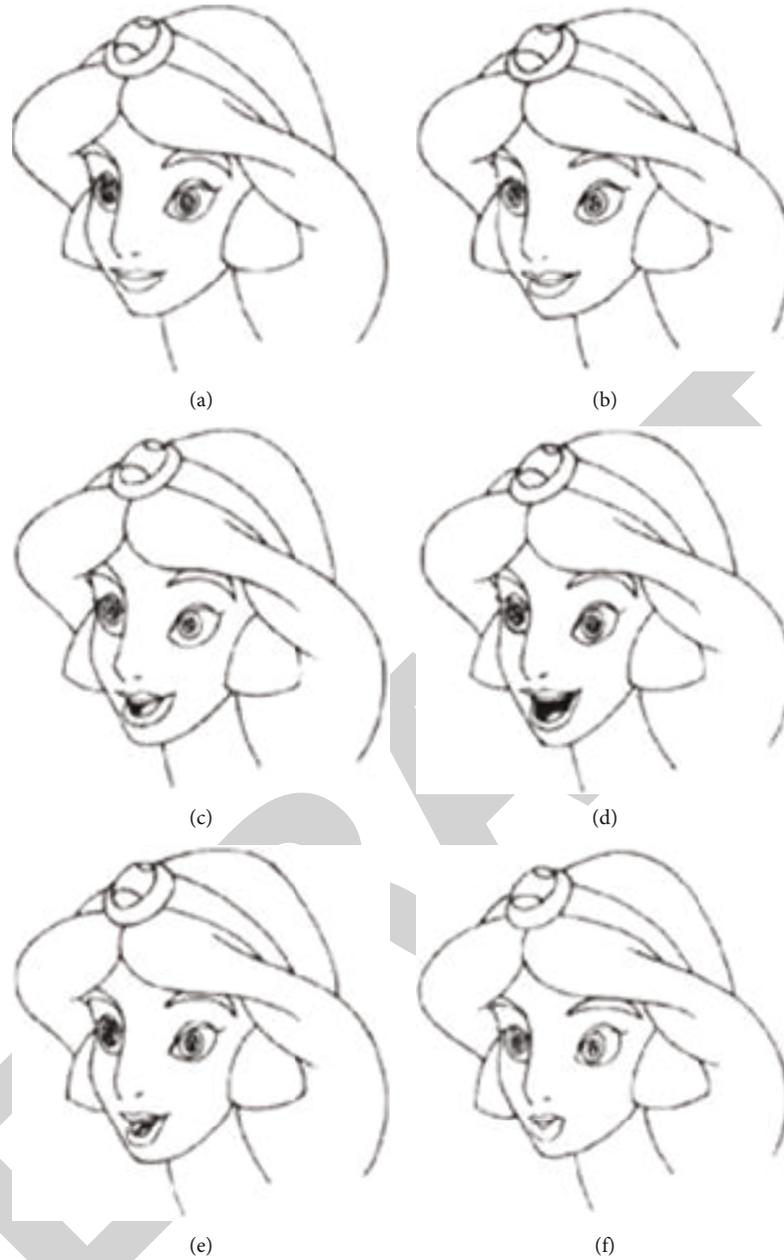


FIGURE 1: Main parameters of the port type.

Chinese characters are ideographic characters, and their pronunciation cannot be spelled out according to the alphabet like the phonetic script, which often causes a kind of confusion to foreign students in acquiring Chinese characters. When foreign students acquire Chinese characters, due to their limited literacy, they are eager to use certain phonetic rules to recognize the pronunciation of these characters when they are faced with a large number of unknown characters; however, there is not a very regular system for the morphological and vocalic sides of Chinese characters, which results in biases in the acquisition of Chinese characters by foreign students [12–14].

One is the phonetic analogy, i.e., the use of the phonetic side of a character as a phonetic symbol, and the generaliza-

tion of the phonetic side of a character to make it sound the same as long as the phonetic side is the same. The ideographic function of the morphological side is not absolute either. In modern Chinese, the morphological side of some Chinese characters is no longer effective for ideographic purposes, such as “cup,” “mirror,” and “pillow.” If we must extrapolate morphological symbols to morphemes, we will inevitably make mistakes.

2. Learning the Basics of Morphemes

The memorization and writing of Chinese characters are a constant part of international students' Chinese language learning. As an important part of Chinese characters,

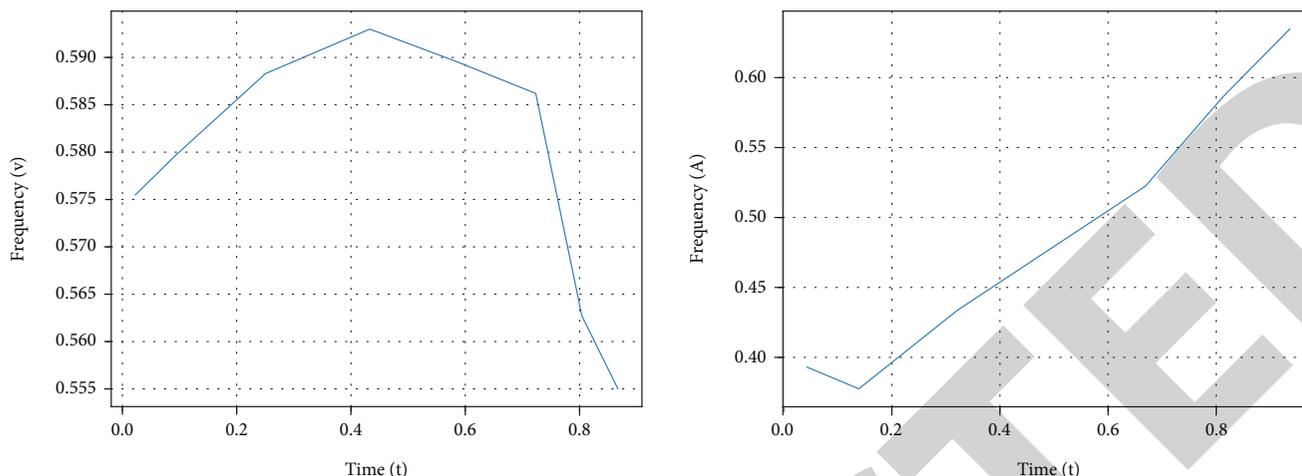


FIGURE 2: Main technical parameters of foreign Chinese phonetic pronunciation.

morphemes have become the most important part of international students' memory and writing. The subjects of our study were international students from the College of International Cultural Education of Heilongjiang University [15–17]. In terms of countries, Russian and Korean international students accounted for the total number of international students. In terms of age, they are mainly concentrated in the age range. In terms of levels, they include refresher courses, undergraduate courses, and graduate courses. The advanced class mainly learns the language of life and is mostly used for simple daily communication; the undergraduate class mainly learns Chinese systematically and is mostly used for future work and life; the postgraduate class mainly learns Chinese at a deeper level and is more focused on culture and thought. Because the focus of learning is different, the emphasis on Chinese morphological characters is different, and the learning situation is also different. The undergraduate class can learn Chinese systematically and will have a comprehensive mastery of Chinese characters, so the following survey we conducted was mainly in the undergraduate class [18]. Based on the Chinese Character Rating Scale and combined with the textbook, we determined the scope of the questions and conducted the survey analysis.

2.1. A Survey and Analysis of International Students' Perception of Ideographic Characters. The survey was conducted on a total of international students in the College of International Cultural Education of Heilongjiang University [19]. The students of each level were basically the same in terms of study time, study conditions, and Chinese language level.

The survey was conducted by means of questionnaires, and each level of international students used one set of questionnaires, three sets in total. The questionnaires included three parts: international students' learning of Chinese characters, their knowledge of the ideograms of morphemes, and whether they could determine the meaning of morphemes through the morphemes of morphemes.

The first part was in the form of multiple-choice questions, which included what do you think is the most difficult part of learning Chinese, which character formation method do you think is more common in Chinese characters, whether you often record Chinese characters in your native

language, and whether you use the morphological side to infer the meaning of morphemes.

The second part of the survey was conducted using four morphemes, including one that had been learned in textbooks and 10 that had not been learned.

In general, the survey revolves around four types of morphemes: recognized ideographs, unrecognized ideographs, recognized nonideographic morphemes, and unrecognized nonideographic morphemes. In this way, we were able to understand the general situation of international students' learning of morphemes from the perspectives of different countries, different levels, different morphemes, and the familiarity of international students with morphemes [20].

The questionnaire for each grade level consisted of the above three parts, and the difficulty was set according to the middle school advanced level of the Kanji Scale and in relation to the class word they were studying. The difficulty of the test matched the level they were studying. A paper-based questionnaire was used for the survey process. Each person was given one questionnaire and about minutes to answer the questions. Copying and consulting information during the questionnaire were prohibited, and they were encouraged to guess what they could not know and to thank the test takers.

The results of the survey showed that the average scores of the first year students were 72.8 for European and American students and 83.2 for Japanese and Korean students, with the average scores of 37.2 for learned ideographic characters, 20 for learned nonideographic characters, 11.8 for unlearned ideographic characters, and 8 for unlearned nonideographic characters. The average scores of European and American students and Japanese and Korean students in the third grade were 85.4 and 87.2, respectively. The average scores of the fourth year students were 92.5 for European and American students and 94.8 for Japanese and Korean students, with the average scores of 45.2 for learned ideographic characters, 20.3 for unlearned ideographic characters, 20 for unlearned ideographic characters, and 8.5 for unlearned nonideographic characters.

After the survey results, we can conclude the following.

First, there is a significant difference between the performance of European and American students and Japanese and

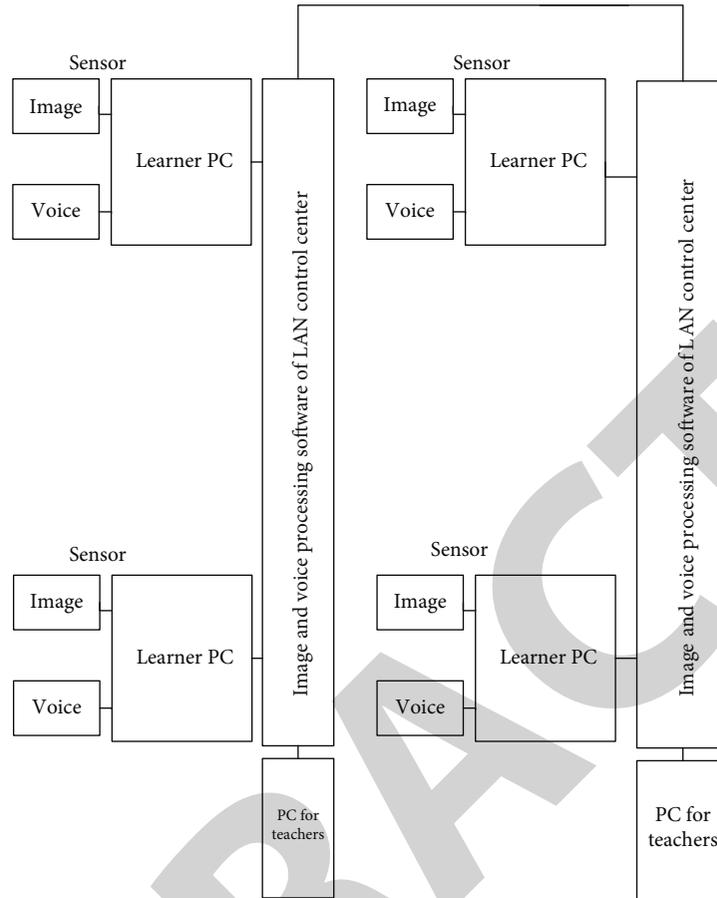


FIGURE 3: Composition and working principle of IoT interactive teaching system.

Korean students in the first year, with Japanese and Korean students' knowledge of morphophonetic characters' morphemes being significantly higher than that of European and American students, but the performance in the second and third years is basically equal. In other words, the knowledge of morphophonetic characters among international students from different cultural circles is relatively obvious at the beginning, but with the increase of learning time and level, the difference basically disappears. The difference basically disappears as the learning time grows and the learning level increases.

Secondly, the results of the first, second, third, and fourth grades show a gradual increase. This means that the higher the Chinese level, the better the ability to learn morphemes, and the better the ability to figure out the meaning of morphemes from the characteristics of the morphemes themselves. The higher the level of teaching of morphemes, the more inclined it is, but of course, the foundation of the elementary level must be poor, so that if the awareness of morphemes is formed at the elementary level, then the awareness and understanding of morphemes at the advanced level will be significantly improved.

In terms of the performance of learned and unlearned ideographs, learned ideographs are much higher than unlearned ideographs, which means that familiarity with Chinese characters directly affects their learning of ideographs.

Fourth, in terms of the scores of ideographic characters and nonideographic characters, the scores of ideographic characters were much higher than those of nonideographic characters. This indicates that the ideographic nature of the Chinese characters is at full play here, enhancing the international students' ability to recognize Chinese characters.

3. Information Acquisition of IoT Interactive Teaching System

From the viewpoint of physiology and physics, the standard pronunciation and phonetics of Chinese as a foreign language are digitized by digital camera and digital voice recording, and the characteristics of the pronunciation and phonetics are described by numbers. Then, the software is written into a corresponding software, which should have the function of demonstrating the standard Chinese pronunciation and oral patterns, and at the same time, has the function of correcting the errors of Chinese pronunciation and oral patterns, and can score the learners' learning situation.

Figure 1 shows the main parameters of the mouth shape, including the width of mouth opening, the degree of mouth opening inside, the degree of mouth opening outside, and the degree of face opening and drumming. Through the comparison of these parameters, we can get the information

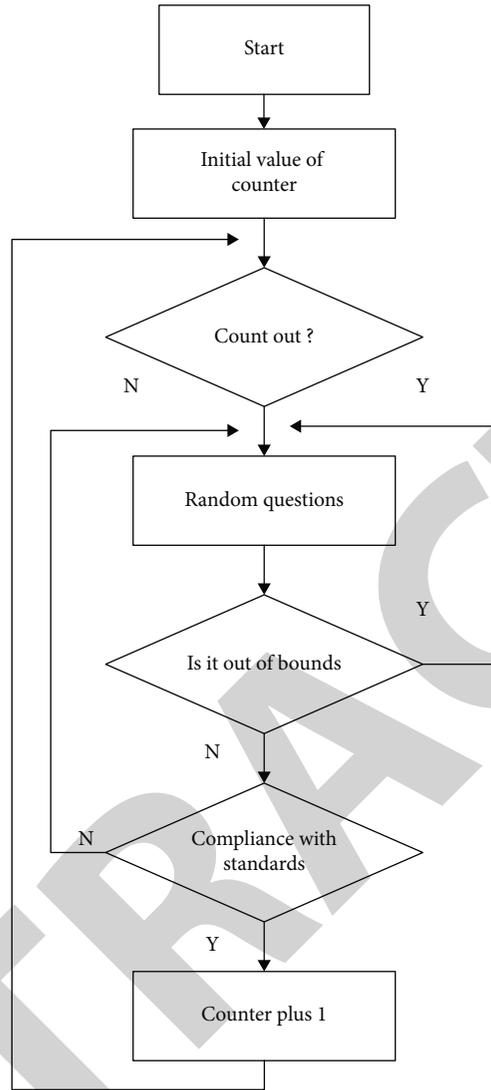


FIGURE 4: Flow chart of randomly selected questions.

of the standard mouth shape when pronouncing Chinese as a foreign language and write the corresponding software to make it have the function of error correction.

Figure 2 shows the main technical parameters of foreign Chinese speech pronunciation, mainly including frequency, intonation, amplitude, speech rate, and other main parameters, which are used to obtain the technical index of foreign Chinese speech.

4. Composition and Working Principle of IoT Interactive Teaching System

Figure 3 is a schematic diagram of the composition and working principle of the IoT interactive teaching system. The role of the image sensor is to take in the mouth shape of the learner during pronunciation into the system and compare it with the stored standard mouth shape. The speech sensor is mainly used for frequency, intonation, and speech analysis during pronunciation. The system also has the usual learner PC, LAN control center, system image,

TABLE 1: Format of data collected.

Dataset	Data collection format
Student error data	Student ID, title JD, whether it is wrong
Gowalla	User ID, location ID, check in
Amazon Books	User ID, book ID, purchase or not

TABLE 2: Statistical information on the dataset.

Dataset	Users	Items	Interactions	Density
Gowalla	27458	40685	1027424	0.000074
Amazon Books	54231	95478	2948712	0.00059

speech processing software, etc. The LAN is connected to the LAN via fiber optic.

4.1. Implementation of IoT Interactive Teaching. The IoT website is mainly established according to the teaching objectives and talent training program of our university's

foreign Chinese courses. Its goal is to use IoT as a second classroom and make it a method and mode to assist foreign language teaching, so that the interactive learning website for foreign Chinese provides foreign language teaching services for all students in the university and becomes an IoT foreign language teaching base. We make full use of the website to motivate and inspire students to learn foreign languages and create a virtual foreign language learning environment for students through a series of online activities and the application of various multimedia courseware.

The teaching part of IoT is directly included in the homepage of foreign language department, which mainly consists of the following parts: courseware learning, online communication, and foreign Chinese language forum, and also has the columns of department introduction, announcement page, friendly links, and entertainment. All sections are written in ASP program with AC-CESS database, which is powerful, flexible, and easy to use. The courseware learning section provides students with some Chinese teaching courseware for foreigners.

- (1) *Parameter Input Module*. It can accept various control condition input by the user and put various control conditions in the automatic grouping of papers for reasonable and flexible matching, which is an important guarantee of the system's scientificity and flexibility. It is worth mentioning that this module can dynamically reflect the important information of the question bank in the system, such as various assessment points, the amount of questions of various assessment points, and generate question papers accordingly
- (2) *Automated Paper Assembling Module*. The core part of the system, its efficiency is closely related to the structure of the question bank. A well-designed automatic paper-forming module should be able to interface well with the parameter input module and complete the function of randomly generating examination papers under strict control
- (3) The output module of the system can output test papers directly to a printer or to Word for typesetting and printing. It is particularly worth mentioning that the organic combination of the system and MS Word, borrowing Word's powerful typesetting functions and spell checking and grammar checking tools, makes it possible for the user to have a complete and beautiful examination paper in front of him
- (4) *System Output Module*. The system output module can output test papers directly to the printer or to Word for typesetting and printing. It is particularly worth mentioning that the organic combination of the system and MS Word, using Word's powerful typesetting functions and spell checking and grammar checking tools, makes it possible to present the user with a complete and beautiful examination paper [21, 22]

The main purpose of this module is to allow users to use the system for on-board testing and paper maintenance. The

web-based version can remotely load teacher-generated test papers for examinations [23].

The flowchart for randomly selected questions is essentially a random selection of questions under a variety of conditions, see Figure 4.

The focus is on random selection, and the key is on condition control. Two types of question banks have been designed: special and general. The dedicated question bank contains a few typical question types already available in the system, such as reading comprehension. One of the difficulties of the system is that the parameter input module should allow the user to control the criteria for new question types.

About the interface between the system and WORD, in the output module, the system queries the registration information on the user's machine to detect whether WORD is installed and where it is located and then uses OLE AUTOMATION to communicate with it [24, 25].

In order to take advantage of the system's on-board testing and paper maintenance capabilities, the system provides a dedicated storage and loading module in addition to text files to hold the papers. This storage can of course be done by storing a single paper in a single file, but this would result in a flood of files and inconvenience to manage, so the system uses a single file to store multiple papers.

5. Experiments and Data

5.1. Dataset Selection. In order to complete the test recommendation function, the first step is to obtain the data. The data can be obtained from the exam system database wrong question record table; you need to collect the student ID, question ID, whether the question is wrong (0 or 1), and all students' wrong question record data. In this paper, the recommendation data interface is reserved for the recommendation exercise module of the examination system, which can obtain data from the database and call the recommendation algorithm. However, as the system prototype implemented in this paper is still in the testing stage, the data of real students' question records are being collected, and a large amount of data cannot be obtained. In order to ensure the accuracy and effectiveness of the recommendation algorithm, two publicly available datasets, Amazon Books and Gowalla, which can be mapped to the database structure of the prototype, were selected for experimentation to verify the effectiveness of the recommendation algorithm [26, 27].

The descriptions of the dataset selection are as follows.

- (1) These two datasets are publicly available and have been widely used in the study of recommendation algorithms
- (2) In fact, the recommendation algorithm in this paper focuses on the implementation of the recommendation function and the accuracy of the algorithm's recommendations and is not specific to a particular scenario, as shown in Table 1

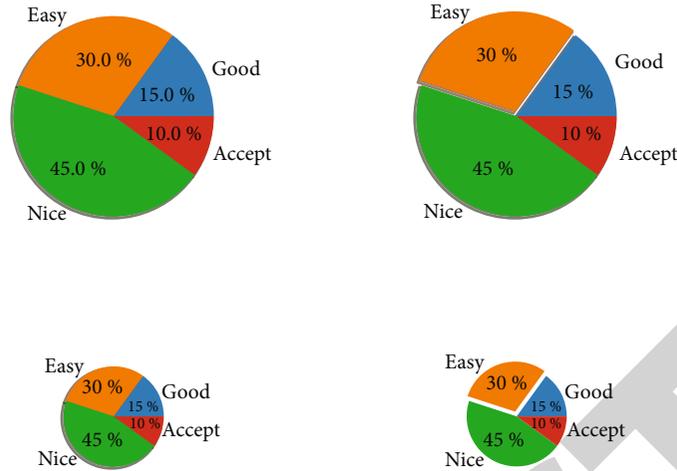


FIGURE 5: Proportion of learning outcomes of different students.

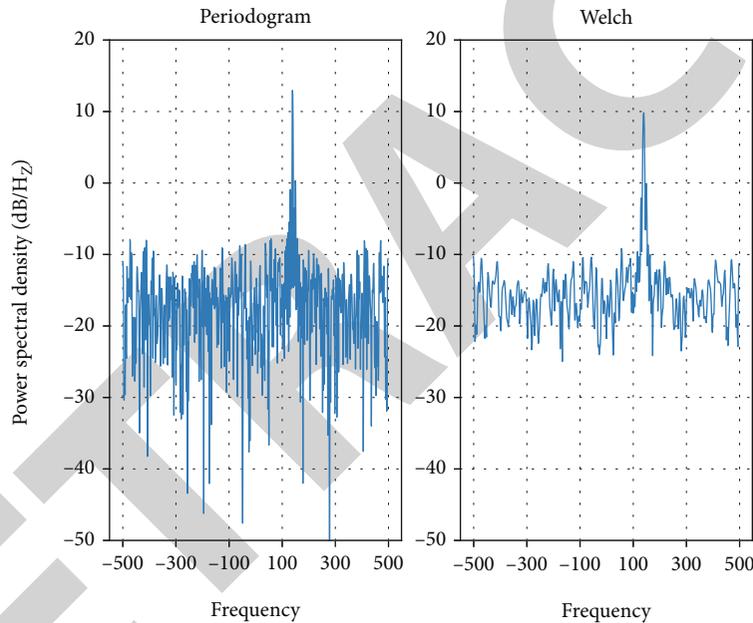


FIGURE 6: Effect of students' Chinese pronunciation.

The table above shows the format of the data recorded for real student errors in the system and the format of the records for the two datasets. For each dataset, in order to perform the algorithm experiments, data processing needs to be performed first.

The two datasets differ in size, sparsity, etc., and the statistics for both are shown in Table 2.

6. Case Study

When foreign students first encounter Chinese characters, they may think that they are made up of complicated and unrelated symbols. In fact, although there are a large number of characters, they are not disorganized and unstructured but have a clear systemic nature. Since morphemes are composed of two parts, the sound side and the form side, they

can be used to help international students memorize and understand them. As shown in Figure 5, of the 2,500 commonly used characters, there are 1,644 morphophonetic characters, accounting for 65.7% of the commonly used characters, of which 490 have the same sound and rhyme tones, accounting for 29.81% of the morphophonetic characters and 19.60% of the commonly used characters. Therefore, we should pay enough attention to the teaching of morpho-syntactic characters and make full use of their own phonetic rationale to reduce the learning difficulty and improve the efficiency of Chinese character learning. In teaching Chinese characters to foreign students, it is important to use good methods to improve teaching efficiency.

The effect of student Chinese pronunciation, as shown in Figure 6, includes a number of language activities that use the Internet of Things as a giant virtual library, and students

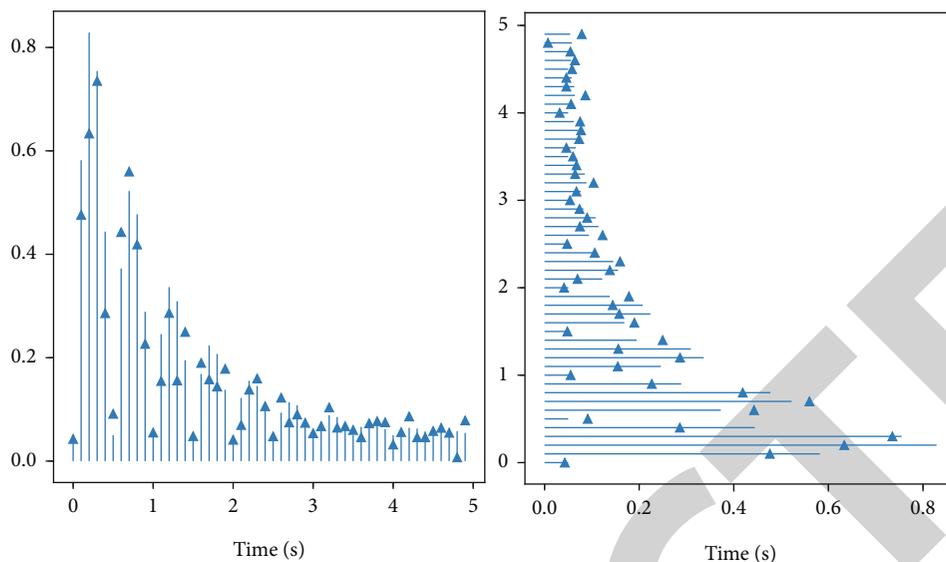


FIGURE 7: Learning the sound note vibration distribution.

do these activities as if they were searching and intercepting information in a library. For example, students can be asked to use online digital libraries and databases to learn to find professional journal literature and other reference materials. This type of activity involves having learners volunteer some information and pasting that information on a web page. Post blogs are written by students in English on the web and can function as a way to communicate and learn from each other.

It involves the collaboration of two individuals or classes that are far apart, i.e., participating together in certain Chinese language activities for foreigners. This is an area that is currently less involved in teaching. As Figure 7 shows the distribution of learning sound note vibration, students can be properly guided to the Internet and combine Internet access with learning Chinese as a foreign language, so that college students can become active learners of Chinese as a foreign language in the Internet of Things and turn Internet fans into fans of learning Chinese as a foreign language, which can greatly improve the quality of teaching Chinese as a foreign language. The environmental functions of IoT in learning Chinese as a foreign language mainly include the function of oral error correction and the function of phonetic correction, which can let learners get the standard learning of Chinese as a foreign language.

7. Conclusions

The acquisition of Chinese characters is a very confusing aspect for foreign students. If teachers do not use appropriate and effective methods to help foreign students to acquire Chinese characters, it will cause obstacles for foreign students to acquire Chinese characters and make them lose their interest in learning Chinese characters; on the contrary, if they use effective methods, they can make teaching Chinese characters to foreign students a course that combines knowledge and fun and also achieve good teaching results. The experiment knows the biases that international students

are prone to when learning Chinese characters and summarizes the implications for teaching Chinese characters to foreigners; in addition the higher the level of learning, the higher is the degree of cognition of morphophonetic characters.

Data Availability

The experimental data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The author declared that there are no conflicts of interest regarding this work.

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