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# *Design and Development of Teaching System for Quick Abacus Mental Arithmetic*

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***Abstract:*** Traditional abacus mental arithmetic teaching faces problems of single teaching mode, low student participation, and insufficient integration with information technology. In view of this, a classroom on-demand teaching system that can meet the needs of classroom teaching and teacher-student interaction is proposed to assist abacus mental arithmetic teaching. The system applies mobile Internet application technology, supports the interconnection through "mobile terminal-router-service host", and adopts split-screen display technology, which can meet the needs of abacus mental arithmetic teaching under the current pandemic. It provides a new information-based teaching method and approach for the current abacus mental arithmetic teaching.

## 1. Introduction

Chinese abacus represents a major invention by ancestors of the Chinese nation. With its contribution no less than any of the "Four Great Inventions" in the development history of the Chinese nation, it is hailed as the "Fifth Great Invention" by us [1]. However, with the popularization of electronic computers, abacus lost its original function, which faces growing marginalization in modern society, nearly falling into extinction. Effective measures by all concerned parties are urgently needed for rescue and protection. In December 2013, UNESCO announced after deliberation that "Chinese Abacus" was officially included in the list of human intangible cultural heritage, which became the 30th item in China to be listed as intangible cultural heritage [2]. With the inclusion of Chinese abacus in the list of human intangible cultural heritage, Chinese abacus receives attention and protection domestically [3]. However, due to the long-term marginalization of Chinese abacus in the modern society, the traditional skill of Chinese abacus now faces uneven teacher and talent training in inheritance, which seriously restricts the inheritance and innovative development of Chinese abacus as a traditional skill [4]. Externally, Chinese abacus spread to Japan, North Korea, Vietnam, Thailand, Nansha Islands etc. in the Ming Dynasty, and then to the United States, the United Kingdom, Mexico, Brazil, Canada, Tanzania in the 1960s, creating far-reaching influence in world culture [5]. After learning Chinese abacus, many countries became aware of its good role in education and then popularized it. For example, in Japan, "reading,

writing, and calculation on an abacus" have become a basic knowledge and skills requirement in its national basic education. The United States also has special preference for abacus, which introduced Chinese abacus as a "new culture" and established “American Abacus Education Center”. Mexico has established the Abacus popularization system since 1977. Hence, foreign countries respect Chinese abacus and attach importance to its education. On the contrary, in recent years, due to the influence of electronic information technology and culture in China, many young people have gradually lost their impression in Chinese abacus, and gradually ignored the educational function of Chinese abacus, as if there is no need for abacus with the presence of electronic computers. It makes the once brilliant Chinese abacus gradually marginalized in modern society. Hence, Chinese abacus faces unpopularity and development dilemma in skill inheritance and talent training [6]. It can be seen that, it is urgent and necessary to carry out research on the inheritance and development of Chinese abacus skills and its combination with modern education information technology. The traditional Chinese abacus training often adopts the apprentice mode, focusing on the teaching of abacus skills and formulas, so application of information technology is often ignored. In view of this, in order to improve the teaching modes and teaching methods of Chinese abacus, the ideas and solutions for designing and developing the abacus mental arithmetic teaching system are proposed to provide an auxiliary teaching method and teaching tool for the application and development of Chinese abacus.

## 2. Problems Faced by Abacus Mental Arithmetic Teaching

Abacus mental arithmetic is also known as abacus-based mental arithmetic or quick abacus mental arithmetic. Abacus mental arithmetic is a method of calculation by turning figures into beads on the abacus, which is developed on the basis of abacus [7]. Studies have shown that through abacus mental arithmetic training, learners can not only learn a special and beneficial calculation method [8], but also cultivate good learning habits, inspire brain intelligence [9], strengthen image thinking ability, coordinate between left and right brains, allow more balanced and coordinated development of the whole brain to enable greater creativity [10-11]. This is why abacus mental arithmetic education is promoted and developed. At present, abacus mental arithmetic education has become an important way for the promotion, inheritance and development of Chinese abacus skills [12]. However, at present, abacus mental arithmetic mainly follows the traditional teaching method in inheritance, featuring teacher's classroom teaching skills and students' hard training. Although this method is effective, there are still some problems. With the rapid application and development of information technology in modern teaching, these problems are more striking.

### 2.1. Single Classroom Teaching Mode of Abacus Mental Arithmetic

At present, abacus mental arithmetic learning still follows the traditional way in which teachers instruct and school children practice hard. Such classroom teaching mode pays attention to explanations, and teachers often worry that students cannot understand correctly, which may easily lead to too long explanation time and excess teaching content. As a result, students are easily tired of class, while teachers fall into a state of exhaustion in teaching, so there is insufficient energy to introduce new teaching methods to activate the classroom teaching atmosphere, leading to teachers and students' reduced enthusiasm for teaching and learning. In addition, this method will also result in difficult and boring training due to teachers’ uneven proficiency in abacus mental arithmetic, thus making students lose interest in learning.

### 2.2. Insufficient Student Participation

The traditional teacher-centered classroom teaching mode that emphasizes content explanation has many disadvantages for modern students. First, students easily get distracted at class; second, this method easily leads to insufficient student participation, making students less motivated in class. Student concentration and enthusiasm in the classroom will directly affect the teaching effect of abacus mental arithmetic. How to mobilize students' enthusiasm for abacus mental arithmetic classroom is a problem that plagues many teachers of abacus mental arithmetic.

### 2.3. Insufficient Integration with Information Technology

Judging from the current status of abacus mental arithmetic teaching, abacus mental arithmetic is insufficiently combined with information technology, and abacus mental arithmetic teaching still follows the traditional way in most cases. These teachers often ignore the application of information technology in the teaching of abacus mental arithmetic, and just adopt electronic whiteboards and PPT presentations. This makes it difficult to integrate abacus mental arithmetic teaching with modern information technology, which in turn restricts the further development of abacus mental arithmetic.

To conclude, how to improve students' classroom participation and stimulate students' learning interest is very important for the current abacus mental arithmetic teaching and talent training. Where, student-centered, teacher-led classroom teaching mode with rational use of multimedia and other modern teaching methods will represent the future trend. Hence, to transform this classroom teaching mode, information technology is required to carry out various forms of teaching activities. Teachers should not only teach the teaching content well, but also design and guide students' practice in the classroom, answer and solve the problems raised by students in practice. Therefore, considering the current status of abacus mental arithmetic classroom teaching, as well as the classroom teaching and learning needs of teachers and students, it is necessary to develop an interactive on-demand classroom teaching system based on mobile Internet technology. The system can assist teachers in accomplishing the classroom teaching tasks, so that teachers are completely freed from traditional teaching explanations. In this way, they can fully guide students' practice and solve students' problems arising from practice, which reflects the leading role of teachers in the classroom in abacus mental arithmetic education. Therefore, developing an abacus mental arithmetic classroom teaching system that can meet the classroom teaching and teacher-student interaction needs is of great practical value and application prospect for the current teaching and skill inheritance of abacus mental arithmetic.

## 3. Design of Teaching System for Quick Abacus Mental Arithmetic

Quick abacus mental arithmetic is a rapid calculation method combining abacus and mental arithmetic, which belongs to a skill of Chinese abacus mental arithmetic. Considering the teaching needs of quick abacus mental arithmetic and the actual needs of classroom teaching for improving students' classroom participation and stimulating students' learning interest, the design ideas and solutions of quick abacus mental arithmetic teaching system software are proposed. The solution is based on mobile Internet technology. Through intelligent mobile terminals and service hosts, WIFI wireless communication is used to achieve interactive on-demand teaching of quick abacus mental arithmetic, thus achieving the integration of traditional skills teaching and information-based teaching, enhancing students' enthusiasm, initiative for learning and strengthening skill inheritance effect.

## 3.1. Overall Functional Design

Figure 1 shows the overall functional design of quick abacus mental arithmetic teaching system. The teaching system mainly includes four software functions: service host controller, intelligent terminal controller, host data manager, and host split-screen display plug-in. Where, the service host controller software is the core business processing software of the teaching system, which is used to process and respond to the control requests sent by the intelligent terminal. At the same time, it provides the service host with the function of interactive on-demand teaching control. The intelligent terminal controller software provides the Android intelligent mobile terminal with interactive on-demand control function in classroom teaching to facilitate interactive on-demand teaching between teachers and students. The host data manager software is used on the host to handle the storage management of teaching resources and resource information. The host split-screen display software is used to control the split-screen display of the host control interface and the teaching resource playback interface. The service host control operation and the teaching resource playback display are independent and separated from each other, so that the teaching resource playback and resource control do not interfere with each other in independent operation and display. The split-screen control of the host split-screen display software can support common display devices such as projectors, electronic whiteboards, liquid crystal displays, and LED displays.

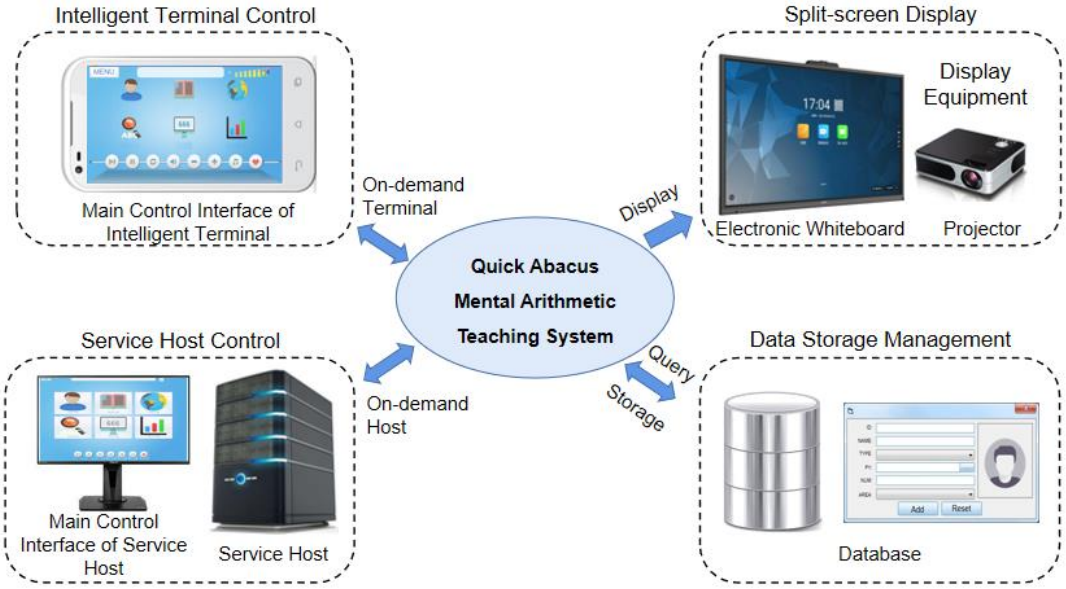



Figure 1: Overall functional design

## 3.2. Hardware Structure Design

In order to facilitate the teaching of abacus mental arithmetic, the hardware design of the teaching system for quick abacus mental arithmetic adopts common communication methods and equipment hardware. The overall hardware structure design is shown in Figure 2. It can be seen from the structural design diagram that the entire hardware system only needs a laptop, a wireless router, an Android smartphone, and an electronic whiteboard (or projector). The service host can be a laptop or PC computer (supporting WIN7 and WIN10 operating systems). A common WIFI wireless router is used as communication device controlled by an intelligent mobile terminal, and an electronic whiteboard or projector is used as a teaching display device. Therefore, the teaching system does not have high requirements for hardware components, so it is easy to implement in the teaching implementation process.

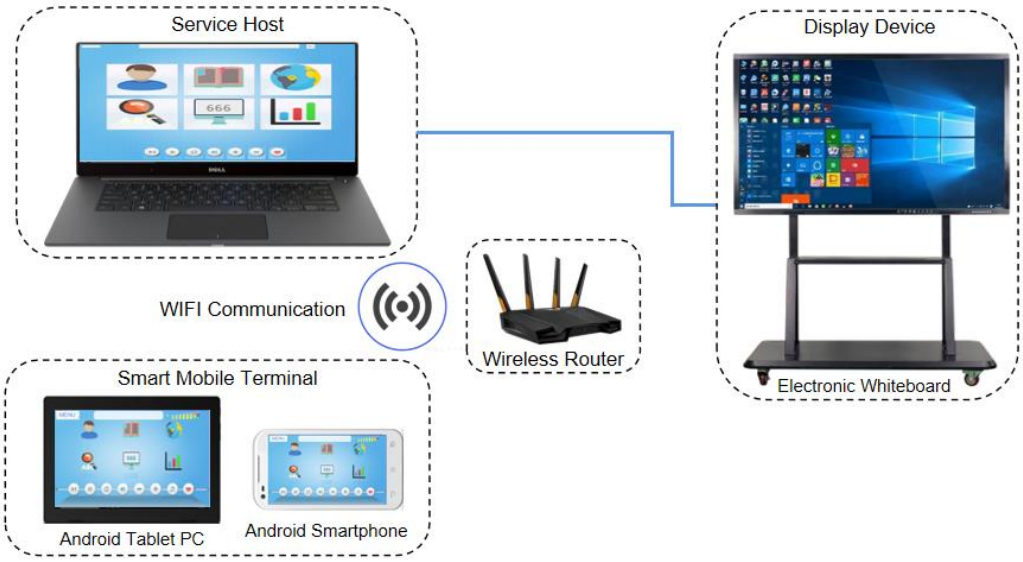



Figure 2: Hardware structure design

### 3.3. Functional Module Design

The functional module of quick abacus mental arithmetic teaching system includes four parts: intelligent terminal playback control, service host playback control, service host data management, and video playback split-screen display, as shown in Figure 3.

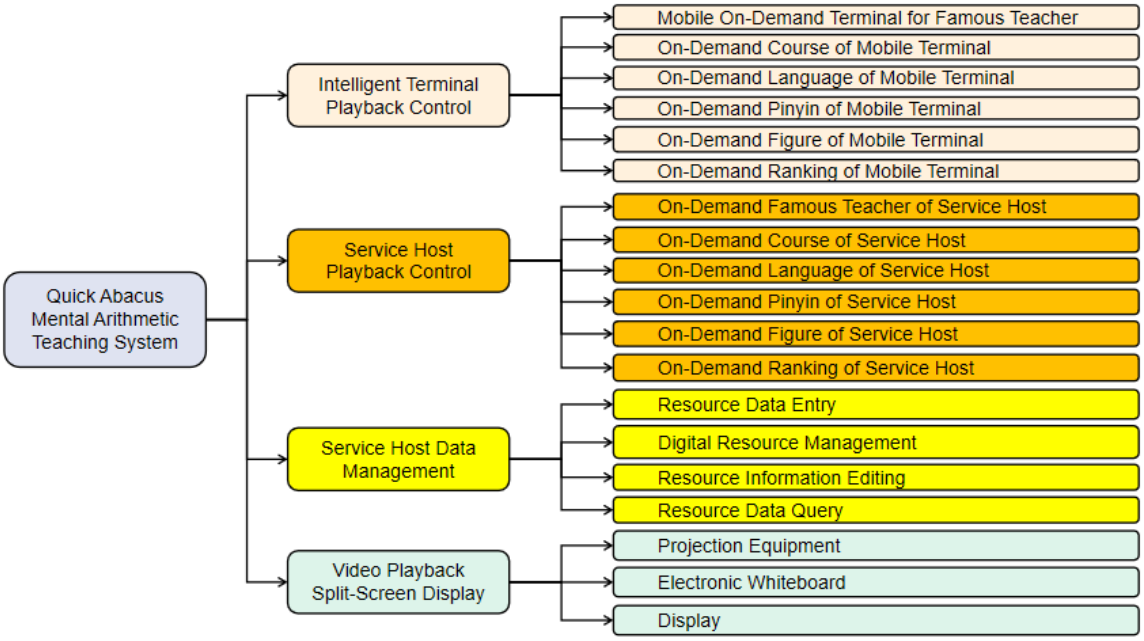
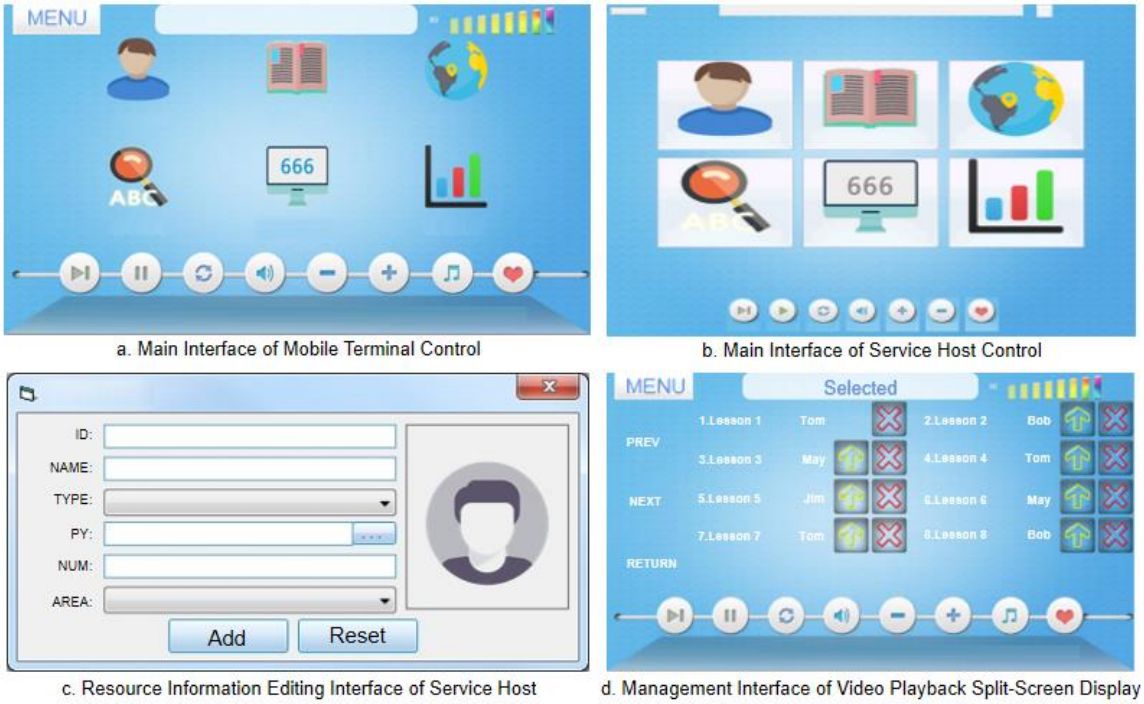



Figure 3: Functional module design

Where, the intelligent terminal playback control has 6 control modules including mobile on-demand terminal for famous teacher, on-demand course, on-demand language, on-demand pinyin, on-demand figure, and on-demand ranking, as shown in Figure 4-a. The service host playback control also provides 6 control modules corresponding to the intelligent terminal playback control, including on-demand famous teacher, on-demand course, on-demand language, on-demand Pinyin, on-demand figure, on-demand ranking, as shown in Figure 4-b. It can realize the simultaneous

control of service host playback and intelligent terminal playback in addition to data fusion identification and mutual recognition. Service host data management is the data storage center of the entire teaching system with functions such as resource data entry, digital resource management, resource information editing, and resource data query, which provides digital resources and resource information for the teaching system. Figure 4-c shows the resource information editing interface. Video playback split-screen display supports the split-screen display of display devices such as projection equipment, electronic whiteboards, display screens, and touch screens. The display management interface is shown in Figure 4-d.




a. Main Interface of Mobile Terminal Control

b. Main Interface of Service Host Control

c. Resource Information Editing Interface of Service Host

d. Management Interface of Video Playback Split-Screen Display

Figure 4: Functional module running interface

## 4. Implementation of Key Functions of the Teaching System for Quick Abacus Mental Arithmetic

According to the overall design and functional design of the teaching system for quick abacus mental arithmetic, the teaching system implements the following main functions and key technologies.

A. Implementation of intelligent multi-on-demand function

According to the needs for selection and request of teaching resources for quick abacus mental arithmetic, the teaching system is developed with intelligent terminal controller APP software based on Android mobile Internet technology to implement 6 major on-demand resource functions, including on-demand famous teacher, on-demand course, on-demand language, on-demand Pinyin, on-demand figure, on-demand ranking. Through keyword arrangement and query analysis, teachers and students can quickly locate relevant teaching resources according to their own learning needs, which improves operation convenience and simplicity, thereby enabling greater on-demand efficiency.

B. Implementation of service host on-demand function

Taking into account the implementation needs of abacus mental arithmetic classroom teaching, the teaching system uses VB programming on the service host to enable on-demand teaching resource function. Corresponding to the intelligent terminal controller function, 6 major on-demand

functions are developed, including on-demand famous teacher, on-demand course, on-demand language, on-demand Pinyin, on-demand figure and on-demand ranking. It solves the problem of data conflict between intelligent mobile terminal and service host due to operation instruction information. Moreover, it allows instruction information interaction fusion and accumulation functions in simultaneous on-demand resource provision by the intelligent terminal and the service host.

C. Implementation of service host data management

In order to facilitate teachers and students' use and improve operation simplicity, the teaching system adopts VB programming technology and Access database technology to achieve the storage and management of teaching resources and data information. Data management using VB+Access has the advantages of simple implementation, stable operation, and easy operation, which is suitable for teaching personnel of abacus mental arithmetic.

D. Implementation of split-screen display of resource playback

According to the interactive needs of abacus mental arithmetic teaching, the teaching system adopts VB programming to achieve split-screen display of video playback, so that the video playback display and the host operation display are separated. In this way, teachers do not have to worry that the host operation screen covers the playback content of the on-demand resources.

## 5. Comparison with Other Teaching Systems

The teaching system herein is compared with the existing online teaching systems such as smart vocational education cloud platform, Deshi hybrid teaching platform, enterprise WeChat live broadcast platform, etc. Comparison and analysis are made in terms of the display mode, playback mode, service host, playback setting, data storage, resource input mode, etc. The comparison results shown in Table 1 are obtained.

Table 1: Comparative analysis with commonly used teaching systems

| Comparison Content | Quick Abacus Mental Arithmetic Teaching System | Vocational Education Cloud Platform | Deshi Hybrid Teaching Platform | Enterprise WeChat Live Broadcast Platform |
|---|---|---|---|---|
| Display mode | Split-screen display | Projection display | Projection display | Projection display |
| Playback mode | On-demand mode | Advance setting | Advance setting | Open directly |
| Service host | Local computer (laptop or PC) | Remote cloud server | Local remote server (professional server) | Remote cloud server |
| Playback setting | resource list can be modified at any time | It is possible to set the playback content in advance, but it is impossible to set the playback resource list | It is possible to set the playback content in advance, but it is impossible to set the playback resource list | Manual switch is required, it is impossible to set the playback resource list |
| Data storage | Local computer storage management | Cloud storage management | Local server storage management | Cloud storage management |
| Resource input mode | Direct input to local computer | Upload to cloud server | Upload to local server | Direct input to local computer |

From the comparative analysis in Table 1, it can be seen that the teaching system herein has the advantages of split-screen display, simple system construction, convenient resource input, and

simple playback control operation, which has the following characteristics:

A. Based on mobile Internet technology, the interconnection of "mobile terminal-wireless router-service host" is achieved

Quick abacus mental arithmetic teaching system is a classroom teaching interactive on-demand system designed and developed based on mobile Internet technology. The system supports the selection and playback of teaching resources through "mobile terminal-wireless router-service host", allows the simultaneous operation, information identification and fusion of the service host by multiple different intelligent mobile terminals. It also allows the selection, identification and control of teaching resources by the mobile client and service host, which is very convenient and practical for the on-demand control of teaching resources in abacus mental arithmetic classrooms.

B. System hardware construction is suitable for classroom teaching

The hardware required for the operation of quick abacus mental arithmetic teaching system only includes a service host (a PC computer or a laptop computer, and the operating system can be Win 7, Win 8 or Win 10), a common home WIFI wireless router, a teaching projector or a monitor, Android smart phone or tablet computer. The simple and inexpensive hardware configuration is common in multimedia classrooms.

C. The system has the advantages of simple and convenient installation, good compatibility and stable operation.

The service host software is written by in Microsoft VB, compiled and packaged into an executable program, which can be used without installation. It is seamlessly connected with Microsoft windows XP or Win 7 operating systems, with good compatibility and stable operation. The mobile terminal software is Android application software, which can be easily installed and conveniently used on Android smartphones or tablets. The service host is integrated with a media database operation program. Using the Access database, media videos can be added and updated at any time, and the video content update is simple.

D. Video playback adopts split-screen display, video files support a variety of common formats with good compatibility

The system video playback adopts split-screen display, so that the host operation and video playback are displayed separately without interfering with each other, which is more suitable for classroom teaching. Teachers do not have to worry that host operation screen covers the playback screen, thus affecting classroom teaching. The system also supports a variety of common video file formats to facilitate teachers' recording of teaching videos or collection of video materials.

## 6. Conclusion

Judging from the current teaching status of abacus mental arithmetic, there is an urgent need for an information-based teaching method and tool, so that teachers are freed from strenuous teaching and can better guide students' practice. At present, there are various teaching platforms such as on-demand teaching systems, micro-courses, MOOCs, and online courses. However, most of the network teaching systems on the market are online systems based on WEB technology, which are suitable for learners' online learning, rather than classroom teaching. In addition, the interaction of these teaching platforms is often limited to the interaction between the system and the learner, rather than the interaction between teachers and students. The development and application of information-based teaching methods helps promote the sharing of high-quality teaching resources. The abacus mental arithmetic teaching system herein is an effective information-based teaching method for promoting the sharing and development of high-quality resources. Therefore, the development and application of this teaching system provides a referential teaching method and tool for the educational informatization in abacus mental arithmetic teaching. It also carries certain

assistance and application value for the inheritance and teaching of Chinese abacus mental arithmetic skills in the new era.

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## References

*[1] Zhao Minsheng, Zhao Minhua. (2022) Strengthen abacus education and promote the popularization and development of abacus knowledge. QILUZHUTAN, (02), 60-62.*
*[2] Niu Teng. (2021) Research progress and prospect of abacus knowledge system. Abacus and Abacus Calculation, (06), 17-20.*
*[3] Li Gen. (2022) Demonstration of the educational value of abacus mental arithmetic culture. Abacus and Abacus Calculation, (02), 20-21.*
*[4] Yang Chen. (2022) Cultivating solid skills and inheriting great culture-On strengthening the occupational security of abacus mental arithmetic coaches. Abacus and Abacus Calculation, (01), 27-30.*
*[5] Gao Chang. (2022) International dissemination and development suggestions for abacus mental arithmetic education. Abacus and Abacus Calculation, (03), 33-36.*
*[6] Zhu Aihua. (2022) Analysis on the inheritance of abacus culture in vocational colleges under the new media. Modern Business Trade Industry, 43(08), 89-90.*
*[7] Qin Yiqin. (2021) Inheriting history and culture and developing students' potential -- a practical exploration into abacus mental arithmetic teaching. Exam Questions and Research, (14), 111-112.*
*[8] Jin Yongqin. (2022) Abacus mental arithmetic teaching strategies aimed to improve computing ability. Abacus and Abacus Calculation, (02), 30-31.*
*[9] Ge Xuelian, Han Xiao, Chen Feiyan. (2021) Effects of abacus mental arithmetic training on mathematical cognition and brain plasticity. Applied Psychology, 27(04), 285-297.*
*[10] Hou Min. (2021) Talking about how to cultivate students' innovative ability in the teaching of abacus mental arithmetic. Abacus and Abacus Calculation, (06), 53-54.*
*[11] Liu Qinying. (2019) Research on strengthening the inheritance and development of abacus mental arithmetic in the new era. QILUZHUTAN, (02), 62-64.*
*[12] Zhu Yongyong, Yuwen Yongquan. (2019) Exploring the scientific connotation and popularization prospect of abacus mental arithmetic. Abacus and Abacus Calculation, (01), 27-31.*