



# Design of Visual Listening Music Teaching System in Local Colleges and Universities Based on Mobile Augmented Reality

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**Abstract.** The design of audio-visual music classroom teaching system should be based on the characteristics of music classroom teaching, and the design and implementation of music classroom teaching system are completed. According to the current situation of music classroom teaching, based on the commonly used music teaching software, combined with the characteristics of the actual music classroom teaching, the overall structure design of the visual listening music classroom teaching system is completed. Through experiments, it is proved that the visual listening music teaching system based on mobile augmented reality in local colleges and universities has high practical value and fully meets the research requirements.

**Keywords:** Mobile augmented reality · Audio visual · Music teaching

## 1 Introduction

With the rapid development of the information age, multimedia technology teaching has been widely recognized. Through the continuous popularization and application of computer technology, colleges and universities put forward higher requirements for music teaching. Visual listening to music classroom teaching is one of the key points of music teaching at this stage. Various music teaching software have appeared one after another, but in the public's view, there are few system software that can really meet the actual needs of music classroom teaching.

Some scholars put forward the design and application of music teaching system based on Moodle platform, using B/S structure to design Moodle platform module and database module, analyzing the actual needs of music teaching. Although it improves the interaction between teachers and students in the classroom, the storage capacity of music knowledge resources is low, which affects the actual experience. Some scholars have proposed a music teaching system based on virtual reality, which realizes the interactivity and immersion of virtual technology through audio processing and analysis. Although the music information resources meet the needs of daily teaching and have a new mode of interactive experience, it takes a long time to connect in the information interaction and has a poor sense of experience.

In order to solve the above problems, this paper proposes a visual listening music teaching system based on mobile augmented reality technology, which makes the music teaching software and hardware configuration updated and improved. The proposed design can meet the actual needs of music classroom teaching, and has important practical significance for music teaching system.

## 2 Visual Listening Music Teaching System in Local Colleges and Universities

### 2.1 Hardware Configuration Optimization of Visual Listening Music Teaching System in Local Universities

The overall architecture design of music assistant teaching system based on mobile enhancement can be realized with modular design idea. In the process of modular design, not only the division of the whole system architecture should be considered, but also the comprehensive design of communication, continuity, retention and protection between modules should be carried out [3]. In the modular design, the main aspects of attention are as follows: when the internal requirements of the module change, the changes of the module should be carried out without affecting the normal work of other modules; when deleting the module, the deleted part should only act on the deleted module itself, without affecting the functions of other modules; when deleting the module, the deleted part should not affect the functions of other modules; When the new module has the function of the original module, it is necessary to ensure that the interface of the module is consistent, and the function of the whole system will not be affected after replacement [4]. From the functional structure and architecture, the architecture of music assistant teaching system based on mobile enhancement is designed. The system architecture will directly determine the future operation of the system. Based on the comparative analysis of the current C/s and B/C modes, the B/S mode is adopted. The main reason is that the maintenance and development cost of the three-tier mechanism system is lower than that of the C/S mode [5]. The specific system architecture design is shown in the figure (Fig. 1):

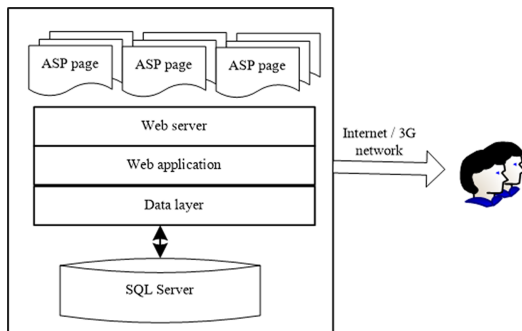
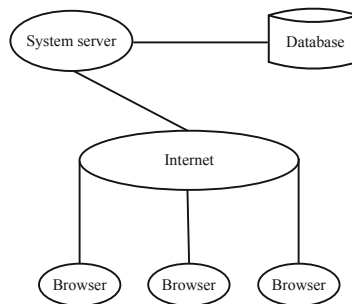


Fig. 1. Overall architecture design of the system

In the hardware system of the server, the CPU is required to be intel5, and the memory is more than 2G. The data service and application service are configured separately, and the minimum memory should not be less than 4G. The data hard disk adopts the way of disk array, so as to improve the speed of data storage, and the hard disk size should not be less than 500 g. In the development tool, visual studio is selected as the development tool [6]. The application server adopts IIS 6.0, and the server operating system adopts Windows Server 2003. SQL Server 2010 is used as the database management system. In terms of client requirements, the CPU of the computer is Intel Pentium III or above, and the memory is 1g. The minimum version of IE is 6.0. The system is mainly composed of user management, music knowledge learning, music appreciation, homework management, resource sharing, online examination and online question answering modules. The user management module includes the following functions: add users, edit the basic information of users, delete the basic information of users [7]. The function of music knowledge learning module includes: display music knowledge learning materials, display music teacher's materials, browse and consult music materials, reply to submit materials. The main function of music appreciation module includes: video information classification display, video detail information display, video information retrieval, video information upload and download. The function of homework management module includes: Homework submission, score check Inquiry, job release management, job online review. The main functions of the resource sharing module include: resource upload, music resource download, music resource evaluation; the main functions of the online examination module are: question editing and uploading, students' online examination, submitting papers, marking papers, score entry and score query. The main functions of the online answering module include: asking questions, answering online, and submitting feedback.

The system adopts the structure of B-S mode, that is, browser server structure mode. Users only need to use any browser on their own computer to access the server, all the data processing work is completed by the server, and the browser is only responsible for presenting the processing results of the server, which greatly reduces the workload of the user's computer. For users, a browser can access, convenient and simple [8]. For the system design, a lot of energy can be spent on the server program design, without considering the specific situation of the client, which is conducive to better improve the



**Fig. 2.** Structure of audio visual music teaching management system

data processing and security of the server. The figure below shows the structure of the network-based excellent audio-visual education resource management system (Fig. 2):

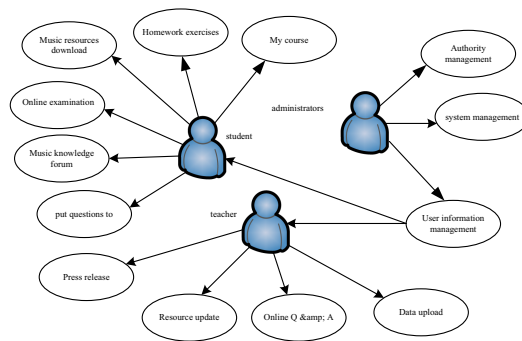
Because B/S mode concentrates many core parts of system functions on its server, it can unify the clients together. Because of this structure, the system is easier to maintain and upgrade in use, and its operation is more concise [9]. B-S system architecture generally adopts three-tier structure, that is, adding an intermediate structure between the user data server layer and the user layer, and the intermediate structure includes different hierarchical structures such as presentation layer, logic layer and data processing layer. The middle layer builds a bridge between the server and the client, which enables the effective data communication between the user's browser and the server. However, each layer of the three-tier structure is independent of each other, and the modification of one layer does not affect the functions of the other layers and the whole. The design of the excellent audio-visual teaching resource management system is inseparable from the consideration of the technical factors that support its realization [10]. Based on the investigation of the current teaching management system and the development of network technology, Moodle is selected as the basic system architecture. Augmented reality itself is a global development project, its function is more comprehensive, at the same time, its support characteristics of constructivism teaching concept is very clear, in line with the teaching needs of the system. Moodle provides users with flexible modification freedom, which can meet the personalized needs of different users. Moodle itself is an application based on B-S mode, which is consistent with the original idea of the system.

## **2.2 Software Function Optimization of Audio Visual Music Teaching Management System**

The excellent audio-visual teaching resource management system based on network is mainly used to assist teachers and learners in the management and use of teaching resources, in order to provide a reliable way to make better use of audio-visual resources. From the perspective of the performance of the whole system, the educational resource management system needs to be flexible and convenient in use, and can meet the needs of human-computer interaction. The flexibility and popularization of the system is the key. It can provide timely feedback when processing command requests, so as to avoid the situation of users' anxiety and waiting [11]. Finally, the educational resource management system must be safe and reliable, because the number of resource visitors may be large, the system should be able to ensure the concurrent processing of multiple commands. At the same time, because the formation of educational resources requires a lot of manpower and financial resources, it is more likely that some resources are accumulated by teachers' painstaking efforts for many years. Therefore, it is necessary to ensure the safety and reliability of the database itself, strengthen the protection function and timely backup work, and avoid data loss caused by loopholes. The overall goal of the system is to coordinate the smooth human-computer interaction between different users, and then make rational use of the excellent audio-visual teaching resources on the network to serve their own learning and Teaching [12]. In order to make different users use the system according to their own needs, four user roles with different permissions are set up, which are system administrator, teacher, student and visitor. The system administrator

has the highest authority and is responsible for the initialization and data maintenance of the whole system, realizing the functions of user management, data management, information management and resource management. Teachers are responsible for the update and release of teaching resources and the interaction with students. After successful registration, students log in to the system and use the system resources for online learning and questioning. Visitors can only browse audio-visual resource information.

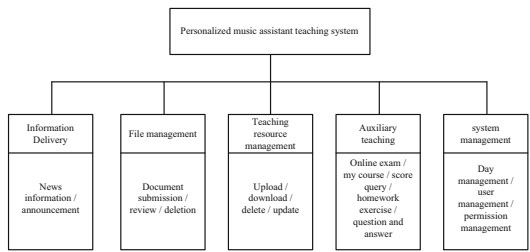
Combined with the reality of the current music teaching course, the role of the system is divided into teachers, administrators and college students. At the same time, through the analysis of the specific work in the music assisted instruction system, the overall use case of the system is as shown in the figure. Through the above use case analysis, the function of the system is designed as shown in the figure (Fig. 3).



**Fig. 3.** Software function case of audio visual music teaching management system

Information release in the system mainly includes news release and announcement release. The news release is mainly for all users who log in to the system, including news editing, news maintenance and news release. Announcements are mainly for registered users of the system, including the management, release and maintenance of announcements. File management is mainly used for the management of system files, including file submission, file audit, file deletion and other functions, so as to provide the paperless office of the system and improve the overall work efficiency. Teaching resource management mainly realizes the management of music video resources, homework system and classroom courseware. Auxiliary teaching includes online examination, my courses, homework exercises, questions and answers, performance analysis, learning resources, etc. Through this way, we can make clear the main significance of computer teaching system and traditional teaching methods, make clear the teaching objectives, improve the teaching quality, and make clear what is the key link to improve the efficiency. In order to further improve the advantages of system implementation. In the design of music assistant teaching system, the main functions are summarized from the actual investigation. First of all, for a system, the most important and basic function is the identification function. The main task of students using the auxiliary teaching system is to learn better, so it should fully reflect the content of music learning, the completion of music homework and other links, and need the learning and homework submission function of network classroom. And in the process of students' learning, they may encounter problems that

can not be solved, which requires timely communication with teachers. There should be a teacher’s question answering module on the system to realize the real-time communication between teachers and students. Thirdly, from the teacher’s point of view, to be able to verify the students’ learning results, we need to submit homework online. In order to better complete the teaching task, the system needs to have the function of lesson preparation management. Finally, from the perspective of managers, any system should have the function of user management and resource management. Among them, the online examination is used to test the basic knowledge of music through teachers’ uploading of test questions; my courses are mainly used to record personal learning, including time, course type, etc.; score query and analysis are mainly used to query the test results; question answering is mainly used to provide space for teachers and students to communicate (Fig. 4).



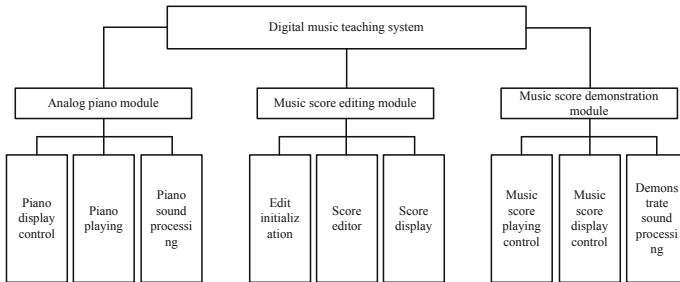
**Fig. 4.** System function structure optimization

System management mainly includes log management, user basic information management, authority management and so on. Log management is mainly used to record the system operation records and processes; user basic information management is mainly used to modify and delete the basic information of registered users; authority management is mainly used to assign roles to users of the system. The main function of audio-visual education resource management system is to achieve teacher assisted teaching and students’ autonomous learning. Each registered student user has a “personal space” module. Remind learners of the gap between the current learning progress and their own learning plan, or provide comparison with other learners’ progress, so that learners can adjust their pace. The recommendation part mainly recommends relevant learning resources according to learners’ learning preferences, so that learners can learn more efficiently according to their own interests and habits. The main learning resources of this system are video resources, and the personal learning space also records the progress of the last learning for learners. The system will automatically remind students to choose to learn from the beginning or continue to learn from the last time when they continue to learn the next time, so as to humanize the learning process.

**2.3 The Realization of Audio Visual Music Teaching Management**

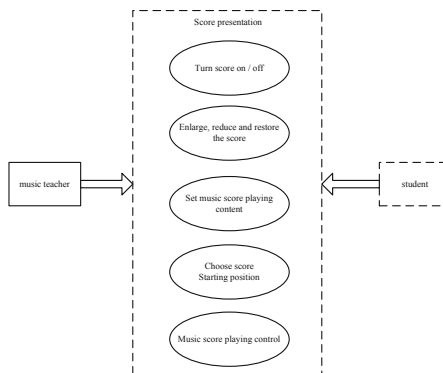
In view of the problem that the visual listening music classroom teaching system involves multiple functional modules, on the premise of ensuring the overall function of the system, the overall design of the system is carried out, including functional structure design and functional module design, in order to ensure the stable operation and scalability of

the system. According to the actual needs of the visual and auditory music classroom teaching system, the overall function of the system is divided into three parts: simulation teaching template, music teaching resource editing module and music demonstration module. The structure of the system operation module is optimized as shown in the figure below (Fig. 5):



**Fig. 5.** Structure design of system operation module

The three functional points of the overall design of the functional structure are: the music editing module needs to realize the basic open or new music, edit and preview music, store music and other functions; the music demonstration module needs to realize. In music classroom teaching, playing demonstration is the core component. In the process of music learning, the corresponding music can not only promote the interaction between teachers and students, but also make students understand music more deeply. In order to improve the combination of the system and the classroom, and ensure the playback effect, the system combines the actual situation of music classroom teaching, further enriches the classroom playback demonstration methods, including single track/multi track playback, multi instrument selection playback, up and down tone playback, specific section playback and other methods, and achieves high-quality playback effect through special processing. Further, the demonstration module of visual listening music course is designed as follows (Fig. 6):



**Fig. 6.** Design of audio visual music course demonstration module

This module is mainly responsible for the display of teaching courses, such as determining the specific position of piano keys in the process of piano teaching, pressing and releasing multi post piano keys at the same time, realizing the processing of sliding piano keys, etc. As the core module of analog piano, the implementation of piano playing sub module is the most difficult, and the performance effect of analog piano depends on the quality of its implementation. In order to meet the needs of better interactive friendliness, it is realized by using mobile augmented reality technology combined with multi touch interactive technology. Excellent audio-visual education resource management itself needs regular maintenance and management, including account management, database management and version information management. In addition to the login user name, each registered user also has a serial number configured according to the corresponding order. The allocation of the serial number is specified according to different permissions as the unique identification of different users. The effective serial number is sorted regularly and the expired serial number is deleted. Only scientific and reasonable serial number management can ensure the normal operation of the system. The database connected with the server stores user information, audio-visual resource information, learning process records and other important information, so the database itself also

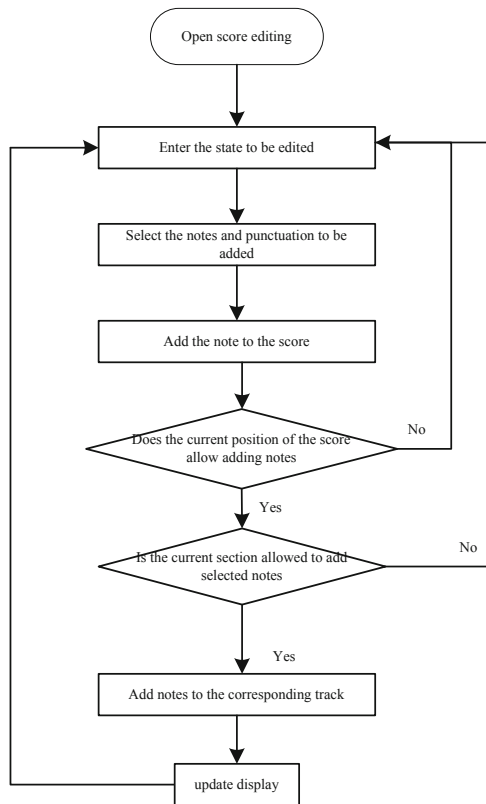


Fig. 7. System operation process

needs to be constantly updated and maintained to ensure its normal work. With the progress of the times and the development of technology, it is bound to put forward more new requirements for the education management system, so the system also needs to be constantly updated, each update will be a new version of the system, the smooth transition between the systems is needed, to ensure the compatibility of each version in the use process is also an important part of the system management.

The music editing sub module is mainly responsible for the editing process of music, including dragging to modify the staff score, key and time sign; adding or deleting music punctuation, bars and notes, etc. As the core module of music editing, music editing sub module involves many complex music rules. The accuracy and stability of music editing depend on the quality of its implementation. In order to further improve the effect of music editing and presentation, WPF technology is adopted to complete the design of the module. The specific flow of music editing sub module is shown in the figure (Fig. 7):

As shown in the figure, editing music can be realized by editing menu and symbol panel. For example, adding or deleting notes and dots can also be realized by editing menu for newly built music with two tracks. Music clef, key and time can be modified by symbol panel on the left. The resource management module of the network-based excellent course teaching resource management system is mainly in the charge of teachers. Teachers can add and update audio-visual resources at any time, delete obsolete and useless resources, and modify the classification and storage mode of resources. At the same time, with the collection and increase of resources, it will become more and more difficult to find information, so the system provides search function, users can query and retrieve resources through keywords. It should be noted that querying resources is applicable to users with all permissions. Excellent audio-visual teaching resources are the core of learning, and its management is also the most important part of all management services. At the same time, in order to avoid unnecessary loss caused by the loss of resources, teaching materials should be backed up safely in time. Especially in the network environment, audio-visual resources can be stored in the cloud server, which is safe and convenient, and can reduce the workload of the local server, so as to improve the operation effect of the system.

### 3 Analysis of Experimental Results

In order to verify the practical application effect of the teaching system, the experimental setup is carried out. The test of the system includes function test, overall test and performance test. In order to ensure the test effect, the test environment is preferred to be standardized. In terms of software environment suggestions, the system is based on Web service architecture, so it can adapt to most of the operating systems, mainly involving the following aspects:

Operating system: windowserver2008;

Java virtual machine: sunj2sdk5.0/beatrockit5.0;

Application server: tomcat7. X;

Database: sql2008.

Hardware environment: server.

Configuration: Intel Xeon es-2600, 2 gigabit network cards. Memory: 8g.  
 Hard disk: above 2506, use disk array to improve the speed and security of the system.

Unit test cases of system login module are shown in the table:

**Table 1.** Unit test of login module

Test entry	User name	Anticipate result	Test result
Click menu: user login	Admin	Enter the user login interface	Normal
Fill in user name	Admin	The system will query according to the user name	Normal
Fill in the password	Admin	The system will query with the password according to the input	Normal
Choose roles	Admin	The system will check according to the input role	Normal
Click login	Admin	The system will check according to the user name and password	Normal
Login successful	Admin	The page shows successful login	Normal
Login failed	Admin	The page shows that the user does not exist. Please register	Normal
Click the register button	Admin	Enter the registration interface	Normal
Click finish	Admin	Prompt that the registration is successful and jump to the login interface	Normal

As can be seen from Table 1, the average response time of the login module of the design system is less than 10 s, and the response time of most things is less than 7 s, which is short. When the login module is running, the utilization rate of CPU, memory and process is low, and the function of login module can meet the requirements of system running. The unit test cases of music information retrieval module are as follows:

**Table 2** Unit test of music teaching information retrieval management module

Test entry	User name	Anticipate result	Test result
Click the menu: music knowledge learning system input keywords	Admin	Enter the music knowledge learning interface	Normal
Input keywords	Admin	Enter the music knowledge retrieval interface	Normal
Key words of input music information	Admin	The system will query according to the key words	Normal

(continued)

**Table 2** (continued)

Test entry	User name	Anticipate result	Test result
Display music knowledge information	Admin	Display the music knowledge information directory of query and keyword matching	Normal

As can be seen from Table 2, the average response time of music knowledge retrieval is less than 10 s, and the response time of most things is less than 7 s. When the music knowledge information reaches the peak, the utilization of CPU, memory and process is low, and the storage capacity of music knowledge resources is large, which can meet the needs of the system. It can be proved that the function of music knowledge learning module can meet the requirements of system operation. The unit test cases of the system music appreciation module are shown in the table (Table 3):

**Table 3.** Unit test of music information browsing and playing management module

Test entry	User name	Anticipate result	Test result
Click menu: music appreciation system	Admin	Enter the music appreciation interface	Normal
Input basic information of music appreciation	Admin	Display response music appreciation resources	Normal
Click the play button	Admin	Music appreciation resources begin to play	Normal
Click the stop button	Admin	End of play	Normal

The ability of the system music appreciation system can meet the needs. From the above, we can see that the function of the music appreciation module designed at present can meet the needs of the system operation from the performance.

## 4 Conclusion and Prospect

Under the background that multimedia system is widely used in classroom teaching, this paper puts forward the design of visual listening music teaching system in local colleges and Universities Based on mobile augmented reality. According to the characteristics of music classroom teaching, this paper designs the overall architecture of music assistant teaching system, increases the system memory, establishes user management module, knowledge learning module, music appreciation module, homework management module, resource sharing module, online examination module, online answer module, and constructs effective communication between browser and server through B/S mode. At the same time, it ensures the security of education system and provides technical support for music education classroom. Through the experimental verification of the actual

teaching effect of the system designed in this paper, it can be confirmed that the storage capacity of the visual listening music teaching system based on mobile augmented reality is high, and the average response time is less than 10 s, which can meet the needs of music classroom education, improve the level of music classroom teaching, and reflect the progress of music education system.

In the next research, we plan to start with online interaction, focus on the online learning function of the Internet, strengthen the visual design of online learning module, understand the user preferences through real-time feedback, develop personalized pages, enrich the use experience of music teaching system, and improve the teaching atmosphere of music classroom.

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## References

1. Yuan, F.: Design and application of music teaching system based on Moodle platform. *Microcomput. Appl.* **314**(06), 136–138 (2019)
2. Rui, H.: Implementation of music teaching system based on virtual reality. *J. Suzhou Univ. Sci. Technol. (Nat. Sci.)* **036**(001), 80–84 (2019)
3. Jin, Y.H., Hwang, I.T., Lee, W.H.: A mobile augmented reality system for the real-time visualization of pipes in point cloud data with a depth sensor. *Electronics* **9**(5), 836 (2020)
4. Zhang, D.: Application of audio visual tuning detection software in piano tuning teaching. *Int. J. Speech Technol.* **22**(1), 251–257 (2019)
5. Bogach, N., Boitsova, E., Chernonog, S., et al.: Speech processing for language learning: a practical approach to computer-assisted pronunciation teaching. *Electronics* **10**(3), 235 (2021)
6. Neto, L.P., Godoy, I.R.B., Yamada, A.F., Carrete, H., Jasinowodolinski, D., Skaf, A.: Evaluation of audiovisual reports to enhance traditional emergency musculoskeletal radiology reports. *J. Digit. Imaging* **32**(6), 1081–1088 (2019)
7. Lin, P.-H., Chen, S.-Y.: Design and evaluation of a deep learning recommendation based augmented reality system for teaching programming and computational thinking. *IEEE Access* **8**, 45689–45699 (2020)
8. Cano Ortega, A., Sánchez Sutil, F.J., De la Casa Hernández, J.: Power factor compensation using teaching learning based optimization and monitoring system by cloud data logger. *Sensors* **19**(9), 2172 (2019)
9. Yang, L.: Comprehensive evaluation of music course teaching level based on improved multi-attribute fuzzy evaluation model. *Int. J. Emerg. Technol. Learn. (iJET)* **15**(19), 107 (2020)
10. Liu, S., Bai, W., Zeng, N., et al.: A fast fractal based compression for MRI images. *IEEE Access* **7**, 62412–62420 (2019)
11. Liu, S., Li, Z., Zhang, Y., et al.: Introduction of key problems in long-distance learning and training. *Mob. Netw. Appl.* **24**(1), 1–4 (2019)
12. Vincenti, G., Bucciero, A., Helfert, M., Glowatz, M. (eds.): *e-Learning, e-Education, and Online Training*. LNICSSITE, vol. 180. Springer, Cham (2017). <https://doi.org/10.1007/978-3-319-49625-2>