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The effectiveness of Music Hearing learning Outcomes of Higher Education Chinese Students

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Abstract

Purpose: This study focuses on the effectiveness of music majors using EarMaster software for music hearing training. The research objectives are as follows: 1. To determine whether using music learning software can improve the learning effect of hearing training; 2. Determine the difference in learning effect between the use of learning software and the use of traditional learning methods; 3. Determine students' learning attitude towards music hearing training by using music learning software. **Research design, data, and methodology:** A quasi-experiment and questionnaire survey were used. A total of 192 students were selected using the purposive sampling method. Music perception, analysis, and reproduction ability were tested in an eight-week quasi-experiment. Through a questionnaire survey, the perceived ease of use, perceived usefulness, and learning attitude towards the software use were investigated. **Results:** After the experimental intervention, the students in the experimental group improved significantly higher than the control group in music perception, analysis ability, reproduction ability, and total score on hearing test. **Conclusions:** The method of using music learning software significantly improves the hearing ability of music majors compared with the traditional learning method. The research has a specific value to the practice of listening and learning for music majors.

Keywords: Music Hearing training, Perception ability, Analysis ability, Reproduction ability, Learning attitude

JEL Classification Code: C12, I21, I29, O30

1. Introduction

The application plays an active role in an individual's educational process (Apaydinli, 2020). Mobile learning is more conducive to collaboration and feedback and provides students with a convenient, flexible, and timely new learning style that is different from traditional ones (Senaidi, 2019). Higher education takes students' independent learning as an important part of course learning, and in some studies, a significant amount of time is applied to students' independent learning time (Butson et al., 2020). The importance of using network information technology for independent learning among middle students in informal learning environments has also received some attention (Ruokonen & Ruismäki, 2016).

China's education management department actively promotes the information-based development of art education. It is proposed to improve the modernization level and information level of art education, promote the integration of information technology and art courses, and expand the ways and selection scope for teachers and students to obtain art and related information (China's Ministry of Education, 2002). Information technology can be applied to music education fields such as music hearing training, music knowledge learning, music work analysis, music performance skills training, and assisted learning (Apaydinli, 2020). In some earlier case studies, the

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application of information technology to the learning process of music education has improved students' learning quality by 43% and reduced their learning time by 30% (Frasson & Aimeur, 1998).

More and more information technology equipment was applied in music teaching. From early audio and video learning materials, PowerPoint to the iPad (Henderson & Yeow, 2012), and mobile cell phones, until now, the MIDI technology (Shen & Wu, 2023), MuseScore (Macrides & Angeli, 2018), KAiKU Music Glove (Danso et al., 2021). In the solfeggio course, Auralia CN software is used for listening training, which provides an interactive learning environment for students and evaluates the learning effect (Wang, 2015). The combination of information technology and music classroom teaching gets the attention of music education researchers. Revenko (2021) said that Web 2.0 serves the public and could be integrated. Applied it to music learning can reduce students' anxiety, motivate students to learn, enhance students' participation, and have a deep impact on music education. Goncharova and Gorbunova (2020) mentioned that the application of familiar equipment and competitive games to the learning of music theory courses will make learning more interesting and attractive so as to stimulate students' learning.

The researchers used EarMaster software as an assistant instrument of intelligence learning, focusing on the effectiveness of music learning software in listening training of music majors. The research objectives were identified as: 1. To determine whether the use of music learning software can improve the learning effect of hearing training. 2. To identify the difference in the learning effect between using learning software and using traditional learning methods. 3. To determine the student's learning attitude towards using the music learning software for the music hearing training.

2. Literature Review

2.1 Theoretical basis of musical ability test

Hearing training is an essential ability for all music students (Hwang & Chu, 2018). Seashore Measures of Musical Talent (SMMT) (Seashore, 1915) is the first internationally standardized musical ability test (Henson & Wyke, 1982). It focuses on the musical cognitive ability test and can systematically grasp the individual musical ability fundamentally (Liu Y., & Liu H., 2012). In the Max Schoen musical test (1928), the test of auditory ability was designed based on "musical sensitivity, musical feeling, and musical understanding." In a survey of the concept of musical ability in the 21st century, the results of the study showed that for both professional and non-musical musicians, musical ability was considered to be the perception of pitch and rhythm first, followed by the ability to understand music and to express oneself and communicate with others through music (Hallam, 2010). Music hearing training from easy to difficult includes pitch, rhythm, interval, chord, and melody discrimination training (Pearce, 2023). Based on the study of Seashore Measures of Musical Talent, combining the personal construction psychology, music education evaluation type, and qualitative standards of music development, constructed the qualitative diagnosis of harmony hearing development as the research and practice of future music teachers and acoustic ability development mode. The music hearing standard involves three important aspects of music hearing: music perception, music analysis ability, and music reconstruction ability.

2.2 Related literature about the application of music learning software in music hearing training

Igor Nikolić and Kodela (2020) believe that the development of music listening is the basis of the development of music learning and music practice. The traditional music listening learning method requires the guidance of professional teachers, and its repetitive exercises not only increase teachers' workload but also reduce students' learning efficiency, which is not conducive to students' self-study and growth (Shen & Wu, 2023). Independent learning ability plays an important role in the process of learning to listen to music.

Chenette et al. (2022), based on the elaboration of music listening training materials, learning content, and teaching practice. They believe that the current teaching of classroom listening training still maintains the traditional form, mainly listening, to distinguish activities such as pitch, interval, harmony, and melody. The use of technology has become an effective supplement to students' self-learning outside of classroom teaching.

Sofia Martinez Villar (2015), based on her observation and practice, believes that music learning software cannot replace teachers' intention and guidance of students' hearing learning or classroom teaching. However, as an effective supplement to classroom teaching, the application of music learning software helps to improve music hearing.

EarMaster is a multimedia music education software developed by the Royal Conservatory of Danish. The primary function is to provide users with assistance in music hearing, solfeggio, and rhythm training. Through the user's practice and learning, the software can summarize and analyze the user's learning situation and automatically adjust the user's learning progress. (Apaydinli, 2020)

In the study conducted by Benites et al. (2023), questionnaires were distributed by email to understand the actual situation of French music major college students' computer technology-assisted listening, teaching, and learning. The survey results show that the main reasons for students' hearing training difficulties are their music element perception ability, music memory, and attention concentration. They believe that music-learning software has game characteristics, and in the survey, 88.9% of the students believe that music-learning software is helpful for listening.

The music learning software is applied to teaching, which changes the role of the teacher from an omniscient master to a knowledge adviser providing advice (Parkita, 2021), and the students are entirely the subject of learning. Schüler (2021) uses music learning software in her college classes, including the use of public websites and applications. He conducted the research in the form of quasi-experimental research and interviews. Students believe that the music learning software increases their learning motivation and improves their learning efficiency. The researcher believes that music learning software is more suitable for students to use in home practice, while classroom teaching can teach students to listen to music.

2.3 Variables in this study

2.3.1 Independent Variables

The method of using EarMaster software for learning is as follows: Students set the corresponding hearing difficulty on the EarMaster software according to the practice requirements and then complete the hearing training questions automatically generated by the software.

The method of traditional music hearing learning refers to the hearing learning mode in which students play musical elements such as intervals, chords, and melodies on the piano and carry out simulating, dictation, and creation.

2.3.2 Dependent Variables

Music perception ability: In this research, perception ability was determined as the auditory perception of the essential elements of music (pitch, interval, chord, rhythm, melody structure, etc.) and the ability to describe their emotional intention.

Music analysis ability: Music analysis ability was determined as the ability to make accurate judgments on the form, structure, and characteristics of musical elements based on music perception and music knowledge.

Music reproduction ability: Music reproduction ability was determined as the ability of internal music auditory perception developed by musical hearing to copy and flexibly create simple types of music elements when learning to make music.

2.3.3 Hypotheses

$H_0$1: The use of music learning software has a significant impact on the improvement of students' hearing perception ability.

H_a1: The use of music learning software did not significantly improve students' hearing perception ability.

$H_0$2: The use of music learning software significantly improves students' Hearing analysis ability.

H_a2: The use of music learning software did not significantly improve students' Hearing analysis ability.

$H_0$3: The use of music learning software has a significant impact on the improvement of students' hearing reproduction ability.

H_a3: The use of music learning software did not significantly improve students' hearing reproduction ability.

3. Research Methodology

3.1 Research Design

The method of quasi-experiment and questionnaire survey was used. Before the start of the quasi-experiment, all the participating students took a music listening test to determine musical perception, analysis, and reproduction ability. The researchers divided the students into a control group and an experimental group based on their pre-test scores. The experimental group used EarMaster software for hearing learning, and the control group used traditional hearing training. Both groups were tested eight weeks later. After the quasi-experiment, the researchers conducted a questionnaire survey on the perceived ease of use, perceived usefulness, and learning attitude of the students in the experimental group. Figure 1 is the research framework.

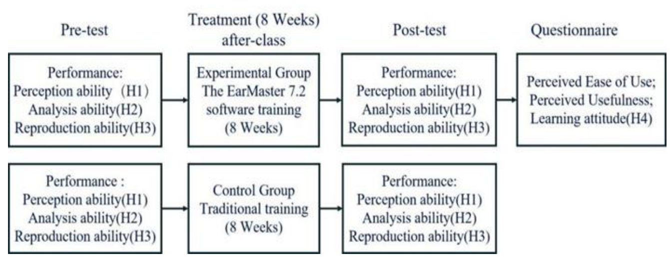

Figure 1: The research framework of the application of EarMaster software for music performance professional students

3.2 Population and Sample

The population studied in this project is all the students who participate in the Solfeggio course in music performance major at Henan Polytechnic. The college has built a relatively complete teaching management platform and advanced smart classrooms. Students are proficient in the application of information technology and have strong operational abilities. These provide the fundamental guarantee for the smooth conduct of the quasi-experiments. The project adopts the Purposive sampling method and selects 192 first-year students majoring in music performance as samples according to the sampling scale of Krejcie and Morgan (1970). The students were tested for listening to music. The students were equally assigned to the experimental and control groups according to their scores on the test. There were 96 participants in the experimental group and the control group.

3.3 Research Instruments

3.3.1 Performance Tests

In the process of quasi-experiment, the examination papers jointly reviewed by the Academic Affairs Office of Henan Polytechnic and the Department of Music were used to pre-test and post-test the students' music perception ability, analysis ability, and reproduction ability. The test questions are formulated by experts and teachers in the theory teaching and research section of the school according to the curriculum standards and the examination outline. In July 2020, the school's academic Affairs Office approved it. The test question is used in the course test of students of 2020, 2021, 2022, and 2023. It is a standardized test paper to measure the musical hearing ability test of students of Henan Polytechnic, which can effectively evaluate students' musical hearing ability.

3.3.2 Questionnaire

The questionnaire contains 27 questions. The validity of the questionnaire was evaluated using the IOC index. Three professors of music performance were invited to rate each question in the questionnaire. According to the scores of the three experts, the IOC index ranges from 0.5 to 1.00, indicating a strong content validity between the survey content and the target. At the same time, a pilot study was conducted before the project to test the internal consistency or reliability of the comprehensive rating scale with Cronbach's alpha (Cronbach, 1951). SPASS analyzed the internal consistency, and the results are shown in the following table.

Reliability of the comprehensive rating scale with Cronbach's alpha (Cronbach, 1951). SPASS analyzed the internal consistency, and the results are shown in Table 1.

Table 1: Results of Cronbach's Alpha of the research instruments

Variable	Number of Items	Cronbach's Alpha
Perceived Ease of Use	9	0.963
Perceived Usefulness	9	0.973
Learning attitude	9	0.964

3.4 Data Collection

Before the start of the quasi-experiment, the students were organized to complete the music hearing test papers at the same time and place, and the pre-test results were obtained. According to the pre-test results, the students are divided into five grades: excellent, good, medium, pass and fail. The students were divided into two groups according to their grades. After eight weeks of quasi-experimentation, all students in both groups were tested again to obtain post-test scores. The test method is to complete the music-listening content of the same difficulty as the pre-test. Pre-test and post-test times are the same. At the end of the test, the students in the experimental group were surveyed by using the questionnaire star, and the questionnaire data were collected online. All the obtained data were analyzed with SPSS.

4. Results

The pre-test and post-test scores of the two groups were analyzed using a T-test. Table 2 presents group statistics on the pre-test and post-test scores of the two groups. The data included the mean and standard deviation of music perception ability, music analysis ability, music reconstruction ability, and the total score of music hearing ability

Table 2: Group statistics on the pre-test scores and post-test scores of the two group

Variables	Group	Pre-test			Post-test		
		MEAN	N	MEAN	N	MEAN	N
Perception ability	Control	96	23.05	3.017	96	25.02	2.384
	Experimental	96	22.292	3.321	96	26.25	2.072
Analysis ability	Control	96	25.93	4.440	96	27.83	4.457
	Experimental	96	26.68	4.219	96	30.57	4.078
Reproduction ability	Control	96	18.40	2.328	96	20.05	2.231
	Experimental	96	18.86	2.654	96	22.14	2.570
total score	Control	96	67.375	8.583	96	72.91	7.882

Variables	Group	Pre-test			Post-test		
		MEAN	N	MEAN	N	MEAN	N
	Experimental	96	67.833	9.098	96	78.96	7.448

4.1 Independent sample T-test for the pre-test scores of control and experimental groups

Table 3 shows the results of the independent sample T-test of the two groups of pre-test scores. Perception ability t-value= -1.661, p=0.098, p> 0.05. It is shown that there were small differences in perceptual ability between the two groups. Analysis ability t-value= 1.200, p=0.232, p > 0.05. This means that there was no significant difference in the ability to analyze the two groups. Reproduction ability t-value= 1.301, p=0.195, p> 0.05. It is shown that there was no significant difference in reproduction ability between the two groups. The total score t-value= 0.359, p=0.720, p> 0.05. This means that their overall level of listening to music was comparable. From the data point of view, despite some degree of effect size difference between the two groups for some capacity measures, these differences were not statistically significant. The results of the independent sample t-test showed that the perception, analysis, and reproduction abilities of the two groups were not significantly different before the quasi-experiment, which provided a prerequisite for ensuring the effective validation of the study hypothesis.

Table 3: The results of independent sample T-test data of pre-test scores for two groups

Variables	t	df	p
Perception ability (pre)	-1.661	190	.098
Analysis ability (pre)	1.200	190	.232
Reproduction ability (pre)	1.301	190	.195
total score (pre)	.359	190	.720

4.2 Paired sample T-test for the pre-test and post-test scores in the control groups

The purpose of this test is to understand whether there is a significant improvement in the three variables in the research hypothesis after only traditional music hearing learning. The data for this test is shown in Table 4. The t-value of perception ability was -16.823 and p<0.001. The t-value for analysis ability was -23.091 and p <0.001. The t-value for the reproduction ability is -19.23, and the p <0.001. The t-value of the total score was -34.391, and the P-value <0.001. The t-values for all paired sample tests were significant (p <0.001). It also indicates a significant difference between the pre-test and the post-test of the control group. Post-test scores were significantly higher than pre-test. This means that the control group's musical hearing ability also showed a steady improvement despite being without music-learning software. These data provided valid comparative data for whether the research hypothesis holds.

Table 4: The results of paired-sample T-test for pre-test and post-test scores of the control group

	Variables	t	df	p
Paired 1	Perception ability (pre) - Perception ability(post)	-16.823	95	.000
Paired 2	Analysis ability (pre) - Analysis ability(post)	-23.091	95	.000
Paired3	Reproduction ability (pre) - Reproduction ability(post)	-19.230	95	.000
Paired 4	total score (pre) - total score(post)	-34.391	95	.000

4.3 Paired sample T-test for the pre-test and post-test scores of the experimental group

Through the paired sample t-test of the pre-test and post-test of the experimental group, it is understood whether the three variables in the hypothesis have significantly improved after the experimental intervention, which completes the first step of verifying the hypothesis. The data of Table 5 showed that the t-value of music hearing perception ability in the experimental group was -20.689, p <0.001. This suggests that there are significant differences between the pre-test and post-test music perception abilities. The post-test score was significantly higher than the pre-test. The t-value for analysis ability was -16.825 and p< 0.001. This indicates that there are significant differences in the ability of students in the experimental group to analyze the results of the pre-test and post-test. Post-test scores were significantly higher than the pre-test. The reproduction ability test yielded a t-value of -18.702 and a significance level of 0.000. It shows that there are significant differences in the reproduction ability, and the post-test score is significantly higher than the pretest. The t-value for the overall level of musical hearing in the experimental group was -27.175. The total score of music hearing was significantly higher than the pretest score (p<0.001). The results of the paired sample test of the experimental group provided preliminary data for the three hypothesis verification in this study.

Table 5: The results of paired-sample T-test for pre-test and post-test scores of the experimental group

	Variables	t	df	p
Paired 1	Perception ability (pre) - Perception ability(post)	-20.689	95	.000

	Variables	t	df	p
Paired 2	Analysis ability (pre) - Analysis ability(post)	-16.825	95	.000
Paired3	Reproduction ability (pre) - Reproduction ability(post)	-18.702	95	.000
Paired 4	total score (pre) - total score(post)	-27.175	95	.000

4.4 Independent sample T-test of post-test scores in the control and experimental groups

The purpose of this test is to compare two different learning methods and determine which method is more effective in improving students' music hearing. This result directly supports the three hypotheses of this study. The test results of independent sample T in Table 6 show that the mean post-test scores for the experimental and control groups were respectively 26.25 and 25.02. The experimental group was 1.23 higher than the control group. t-value=3.813, p <0.001. It indicates that there are significant differences in perception ability between the two groups. This result directly verified H01. The means of the experimental and control groups were 30.57 and 27.83, respectively, in analysis ability. The average score of the experimental group exceeds the control group by 2.74 points. t-value = 4.443, P<0.001. The data indicated significant differences in the ability to analyze. This result directly verified H02. In the aspect of reproduction ability, the average score of experimental groups was 22.14, and the group was 20.05. The average score of the experimental group exceeds the control group by 2.09 points. t-value = 5.999, P<0.001. These showed a significant difference in the reproduction ability between the two groups. This result directly verified H03. The mean value of the total music hearing score in the experimental group was 78.96. The mean value for the control group was 72.91 for the total score. The experimental group was 6.05 points higher than the control group. T-value=5.468, p<0.001. These show a significant difference in the total score. The overall improvement degree of the experimental group was significantly higher than that of the control group.

Table 6: Independent sample T-test of post-test scores in the control and experimental groups

Variables	t	df	p
Perception ability(post)	3.813	190	.000
Analysis ability(post)	4.443	190	.000
Reproduction ability(post)	5.999	190	.000
total score(post)	5.468	190	.000

4.5 Data statistics and analysis of the questionnaire survey results

After the end of the quasi-experiment, the experimental group focused on three aspects: perceived ease of use, perceived usefulness, and the learning attitude questionnaire. The results are shown in Table 7, which is based on the analysis of survey data.

Table 7: Descriptive statistics for the analysis of questionnaire results

Item No.	Perceived ease of use		Perceived usefulness		learning attitude	
	Mean	SD	Mean	SD	Mean	SD
1	4.29	.614	4.28	.644	4.35	.615
2	4.25	.665	4.36	.682	4.30	.618
3	4.29	.597	4.25	.665	4.36	.600
4	4.31	.586	4.32	.607	4.38	.620
5	4.29	.597	4.31	.586	4.34	.595
6	4.31	.621	4.32	.589	4.26	.653
7	4.30	.600	4.30	.634	4.32	.624
8	4.36	.600	4.30	.583	4.31	.621
9	4.24	.677	4.25	.598	4.33	.610

The average values of the questions about the perceived ease of use of software ranged from 4.24 to 4.36, the average values of the questions about perceived usefulness ranged from 4.25 to 4.36, and the average values of the questions about the learning attitude towards the activities of the experimental group ranged from 4.26 to 4.38, with relatively small standard deviation. The results show that students generally have a positive evaluation of the perceived ease of use and perceived usefulness of the software and have a very positive learning attitude towards using EarMaster for music listening training.

5. Conclusion and Discussion

Through data analysis, this study found that after eight weeks of experimental intervention, the control group and the experimental group had significant improvements in music perception ability, music analysis ability, and music reproduction ability. This also shows that no matter the traditional learning method or the use of music learning software, students will improve their music hearing if they insist on after-class music hearing training under the guidance of teachers. Finally, through the independent sample test of the post-test scores of the two groups, the study found that the experimental group improved their musical hearing ability more significantly than the control group. In the questionnaire survey of students in the experimental group, students gave positive answers to the perceived ease of use and perceived usefulness of the software. The results of the analysis show that EarMaster software positively impacts students' learning attitudes, such as learning interest, confidence, and autonomy. These data further support the quasi-experimental conclusion. Therefore, it is considered that using EarMaster software to learn music hearing is more effective than traditional learning methods.

The most prominent difference between applied music learning software and traditional learning methods is the convenience of learning. In this study, the students in the control group had to practice in the private piano room provided by the school during the limited time after class. The students in the experimental group can study anytime and anywhere, effectively using the fragmented time. In addition, the learning process is more enjoyable when using music-learning software. The software can generate richer practice content according to the needs of students. Using a microphone function to record singing audio enhances the interaction between people and software. Many forms of learning make the learning process more enjoyable. The students in the control group completed the task assigned by the teacher only in front of a piano in the narrow practice room. It is not exciting. At the end of each set of exercises, EarMaster software shows how many questions have been completed and how many have been gotten right and gives guidance based on how well the students have done. Timely learning feedback satisfies students' game psychology and gives students great challenge and encouragement.

It is worth noting that teachers reduce the consumption of work energy in the process of quasi-experiment. When viewing the homework feedback from the control group, the teacher has to spend much time collecting videos of students' exercises after class and then viewing a large number of videos to understand the students' exercises after class. For the homework fed by the students in the experimental group, the students' learning data can be clearly seen through the screenshots used by the software. This reduces the workload of teachers and saves the working time. At the same time, teachers can combine the timely evaluation of the software to understand the problems and weaknesses in the student's after-class practice process. Therefore, teachers can better adjust the classroom teaching strategies, teaching content, and teaching methods and give students more targeted learning suggestions.

5.1 Suggestion

Information technology can improve boring traditional hearing learning methods, stimulate students' interest and initiative, extend learning time and space, and improve the learning effect of music hearing. As an effective supplement to solfeggio classroom learning, independent hearing practice after class will be more and more important in the process of continuously improving students' music literacy. Students majoring in music should make full use of the advantages of information technology, expand their learning time and space, and attach importance to the role of independent learning in the improvement of music ability.

The perception, analysis, and creation of music are more of the thinking activities of subjective consciousness. With the development of information technology and artificial intelligence (AI), the ability to apply technology to develop subjective thinking in music learning will be an important topic in the future development of music education. Information technology is not a substitute for teachers in the process of students using information technology to learn autonomously. Teachers are not only the imparters of knowledge but also the guides of music learning. Music educators should integrate AI technology to innovate teaching methods and content, stimulating students' interest in learning and creativity. By leveraging AI technology to collect and analyze students' learning data, personalized teaching recommendations and guidance can be provided. As AI technology continues to evolve, teachers need to develop the ability for lifelong learning to adapt to new teaching environments and technological changes. The future is a great challenge for teachers' ability to design, evaluate, and manage. In the following study, the researchers will continue to study the application of music-learning software in more fields. It will study the influence of music learning software on music education from two different angles: teachers' teaching and students' learning.

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