APPLYING COMPUTER-ASSISSTED MUSICAL INSTRUCTION TO MUSIC APPRECIATION COURSE: AN EXAMPLE WITH CHINESE MUSICAL INSTRUMENTS

Shi-Jer LOU
National Pingtung University of Science and Technology
lousj@ms22.hinet.net

Yuan-Chang GUO
National Kaohsiung Normal University
yuanman99@yahoo.com.tw

Yi-Zhen ZHU
National Tung Kong Maritime & Fishery Vocational High School
ycchu@mail.tkms.ptc.edu.tw

Ru-Chu SHIH
National Pingtung University of Science and Technology
vincent@npust.edu.tw

Wei-Yuan DZAN
National Kaohsiung Marine University
dwydanel@mail.nkmu.edu.tw

ABSTRACT
This study aims to explore the effectiveness of computer-assisted musical instruction (CAMI) in the Learning Chinese Musical Instruments (LCMI) course. The CAMI software for Chinese musical instruments was developed and administered to 228 students in a vocational high school. A pretest-posttest non-equivalent control group design with three classes designated as the experimental group for the "CAMI in LCMI," and another three classes as the control group for the "traditional narrative teaching approach." Collected data were analyzed through descriptive statistics analysis, ANCOVA, and structural equation modeling (SEM) by SPSS 10.0 for Windows and LISREL 8.52. The results indicate that (1) the CAMI approach is superior to the traditional narrative teaching approach, (2) students show a positive perspective on the use of CAMI for instruction in the LCMI course, (3) software interface and content design have positive and direct influence on students' learning attitude and self-awareness learning results, (4) learning attitude has a positive and direct influence on self-awareness learning results, and (5) the CAMI in Chinese musical instruments software is satisfactory assistive material for teachers in the LCMI course.
Keywords: computer-assisted musical instruction (CAMI), music appreciation instruction, and Chinese musical instruments

INTRODUCTION

Music education is one of the humanistic studies that Chinese people have emphasized since ancient times. In Taiwan, the purpose of music education is mainly to nurture students' interest and habits in music through related activities and to enhance their perception of music.

Of all the music courses in high school in Taiwan, the easiest and preferable course to teach and learn is the music appreciation class. "Music appreciation" is an aesthetic learning activity. Through the teaching of music appreciation, we can understand a composer's motivation and historical background as well as the music's form, structure, and style. Students' perception of music can be enhanced, and good personality qualities can be encouraged. Wu (1994) pointed out that a music appreciation course played an important role in music instruction and was one of the most popular classes among students. For those students who have not yet received professional training in music, music appreciation is the most enjoyable learning activity. However, even though music appreciation is the most preferable course in which to learn to enjoy music, how to teach students to appreciate music is still a difficult question (Cheng, 1997).

In addition, lessons in understanding musical instruments are an important part of music appreciation courses because musical instruments are the tools employed by humans to express their thoughts and feelings (Du, 1999). The primary function of a musical instrument is for performing music and transmitting information (Han, 1991).

In Taiwan, the ratio of Chinese traditional music instruction courses to Western musical instruction in high schools is currently quite low, due to the influence and impact of Western culture. Some studies show that the best way to recognize and memorize musical instruments is to allow students to see the physical instruments and actually touch them in courses introducing the instruments. However, limited by teaching resources, facilities and budget, schools usually cannot afford the necessary instruments. Zhu (2006) mentioned in her research that most music teachers felt that understanding the teaching of Chinese instrument appreciation was difficult for them.

There is no doubt that the 21st century is a high-tech information era. Teaching in high school has also gone through a revolutionary change. Integrating computer technology into teaching activities has become a new trend in modern teaching. Through the implementation of computer-assisted musical instruction, a teacher can combine textual materials, images, animation, audio and video on a computer to provide students with a variety of learning experiences. As a result, the CAMI can open up a new door in teaching and dramatically changes ways of learning Chinese musical instruments.

Computer-assisted teaching has six characteristics: it is interactive, adaptive, learner controlled, inexhaustible, and unlimited in time, space and manageability (Zhu and Chang, 1998). During computer-assisted teaching period, teachers can reduce time spent writing on blackboard; teaching materials can be converted into CDs or put on the Internet for students to study for pre-class practice and after-class review. Furthermore, it provides learners with a very convenient learning environment because it is not limited by time and location (Lin, 2003). In other words, students can repeatedly view and practice unfamiliar contents without any time limitations (Lu, 2003; Rosser, 2000). With so many benefits, it has become a very useful mode of teaching and learning.

Style models for computer-assisted teaching systems can be characterized as tutoring, practicing, simulating, game playing or testing (Hsu, 2007). Any model of computer-assisted teaching systems needs to combine varied learning theories as its basis of design. For example, the "behavioral approach" argues that individual learning is the result of stimulus and response. The computer-assisted teaching pattern developed from this approach is practice-style, multi-media computer-assisted instruction (Hsu, 2007) that emphasizes enhancement of existing knowledge. The "cognitive approach" argues that, based on past experiences and knowledge, and using people as a symbol for operation, processing complicated information, and with limited cognition contents to experience multi-stage processing and initially construct knowledge. Based on this approach, the tutor-style computer-assisted instruction tends to emphasize teaching new information (Wang, 1992). In addition, "constructivism" states that a learner should organize and construct his own knowledge system through initial self-motivated attempts and exploration using existing knowledge in the process of acquiring new knowledge. The characteristics that should be applied in computer-assisted teaching would be those characteristics that give a student an appropriate freedom to control the learning process, during which the role of teacher will change from that of the dominant leader of a traditional a classroom to that of a guide and assistant. The conception of "situation learning theory" emphasizes constructing knowledge through students' initial explorations and operations in practical situations. In recent years, many types of teaching media have been designed and developed according to "situation learning." The computer-assisted teaching pattern developed by situation learning theory is simulation-style multi-media computer-assisted instruction.

Computer-assisted music instruction (CAMI) combines computers and music instruction to provide a good learning environment for achieving pre-set teaching goals. Computers could be used in teaching music composition or editing, music appreciation and musical instruments. Many related studies have shown positive and affirmative views on the results of CAMI (Bauer, 2003; Bowyer, 2003; Wu, 2007; Gao, 2007; Cheng, 2007; Ewers, 2004; Chan, Jones, Scanlon, & Joiner, 2006; Yang, Lay, Liou, Tsao, & Lin, 2007; Lee, 2007).

However, very few studies have addressed the topic of computer-assisted teaching of the appreciation of Chinese musical instruments in particular, and related studies do not even exist. Therefore, this study hopes to develop a set of CAMI software for Chinese musical instruments to advance teaching effectiveness for music teachers and enhance students' interest in learning and consequently leads to results that are conducive to the inheritance of Chinese traditional culture. Based on these considerations, this paper tries to integrate CAMI into courses in appreciation and understanding Chinese musical instruments. Using Flash software, we produced a set of Chinese musical instrument software and integrated the software into practical teaching methods with the goal of combining theory and practice.

PURPOSE OF STUDY

Based on the research background and motivation described above, the purposes of this study are as follows:

1. To develop CAMI software for Chinese musical instruments;
2. To explore the differences between CAMI and traditional instruction in terms of students' learning achievements in music appreciation courses;
3. To explore learning satisfaction among students using CAMI in music appreciation course on understanding Chinese musical instruments;
4. To explore the relationship and mutual effects between learning using the software interface, learning attitudes and subsequent changes in self-consciousness;
5. To provide teachers with recommendations and references for applying the CAMI software to music appreciation courses in understanding Chinese musical instruments.

RESEARCH DESIGN AND IMPLEMENTATION

Research Structure

Based on the literature review and purposes of study, the research structure is designed as described in Figure 1.

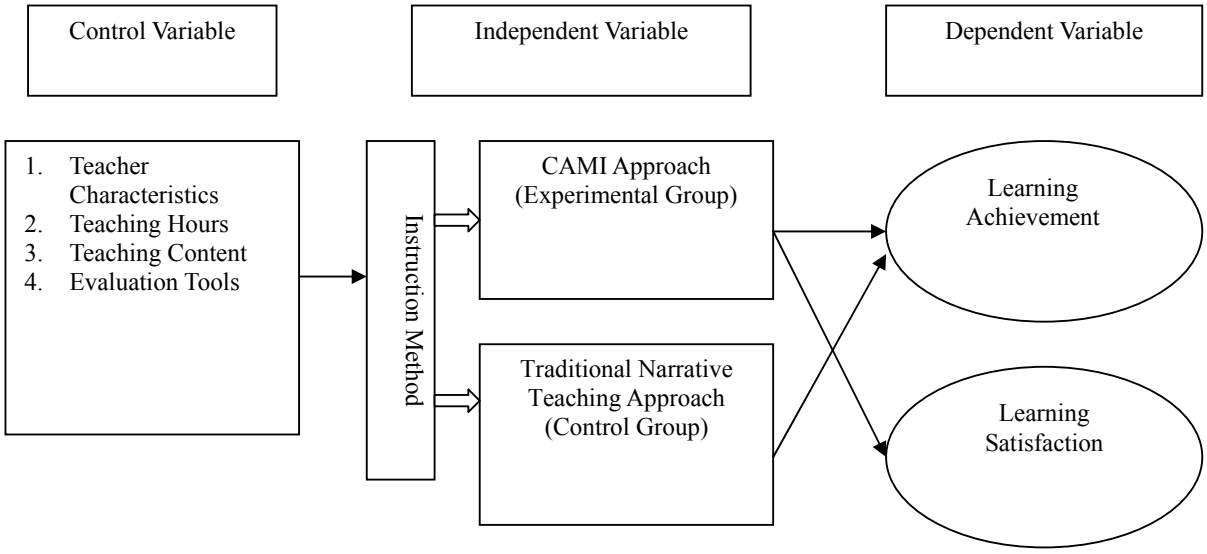

Fig. 1 Research Structure

As shown in Figure 1, the independent variable in the study is the instruction method, that is, the experimental group adopts the CAMI approach, whereas the control group adopts a traditional narrative teaching approach. The dependent variables in the study are learning achievement and learning satisfaction.

To reduce the effects of extraneous variables on the validity of the experiment, the experiment dictated fixed teacher characteristics, teaching hours, teaching contents and evaluation tools. Specifically, both the experimental group and control group were taught by the same teacher during the same teaching hours and using the same teaching contents and evaluation tools.

A quasi-experimental method was used in the study. The purpose of our research was to explore the differences between the CAMI and the traditional narrative teaching approaches in Chinese musical instruments in terms of learning achievement by vocational senior high school students in the "Learning Chinese Musical Instruments" course. The quasi-experimental design is shown in Table 1.

Table 1 Nonequivalent Pretest-Posttest Design

Group	Pre-Test	Experimental Process	Post-Test
Experimental Group	O1	X1	O3
Control Group	O2		O4

The study randomly chose 228 freshmen in a senior high vocational school as research subjects. From these students, three classes (111 students) were assigned to the experimental group, who received "CAMI"; the other three classes (117 students) were assigned to the control group, who received "traditional narrative teaching approach." This teaching experiment was conducted for five weeks.

A pre-test of basic music knowledge was conducted before the teaching experiment. The purpose of the pre-test was to determine the degree of students' knowledge of music in both the experimental and control groups before they received any experimental instruction. The scores of the pre-test will act as covariance in the covariance analysis and exclude the moderating variable by statistical control.

To understand students' learning achievement, we created a post-test according to the subject and teaching materials in the experimental course. Additionally, a Learning Satisfaction Survey Questionnaire was designed for using CAMI in "Learning Chinese Musical Instruments" course in order to understand students' learning satisfaction. The items of the questionnaire were edited and compiled. A five-point Likert scale was used in the survey; higher scores represent higher satisfaction. The reliability coefficient (Cronbach α) of the questionnaire was .93.

The Development of CAMI Software

Design of Software

The CAMI software for Chinese musical instruments was designed to enhance students' learning effectiveness of the "Learning Chinese Musical Instruments" course. In order to develop sound CAMI software, we referred to the outlines of curriculum announced by Ministry of Education, Taiwan and some multimedia and computer assisted software in the markets, and then integrate them with learning theories of CAI teaching and learning.

The development of the flow chart of CAMI software production consisted of five stages, including preparation stage, software design and development stage, materials integration stage, software test stage, and modification stage (as shown in Figure 2).

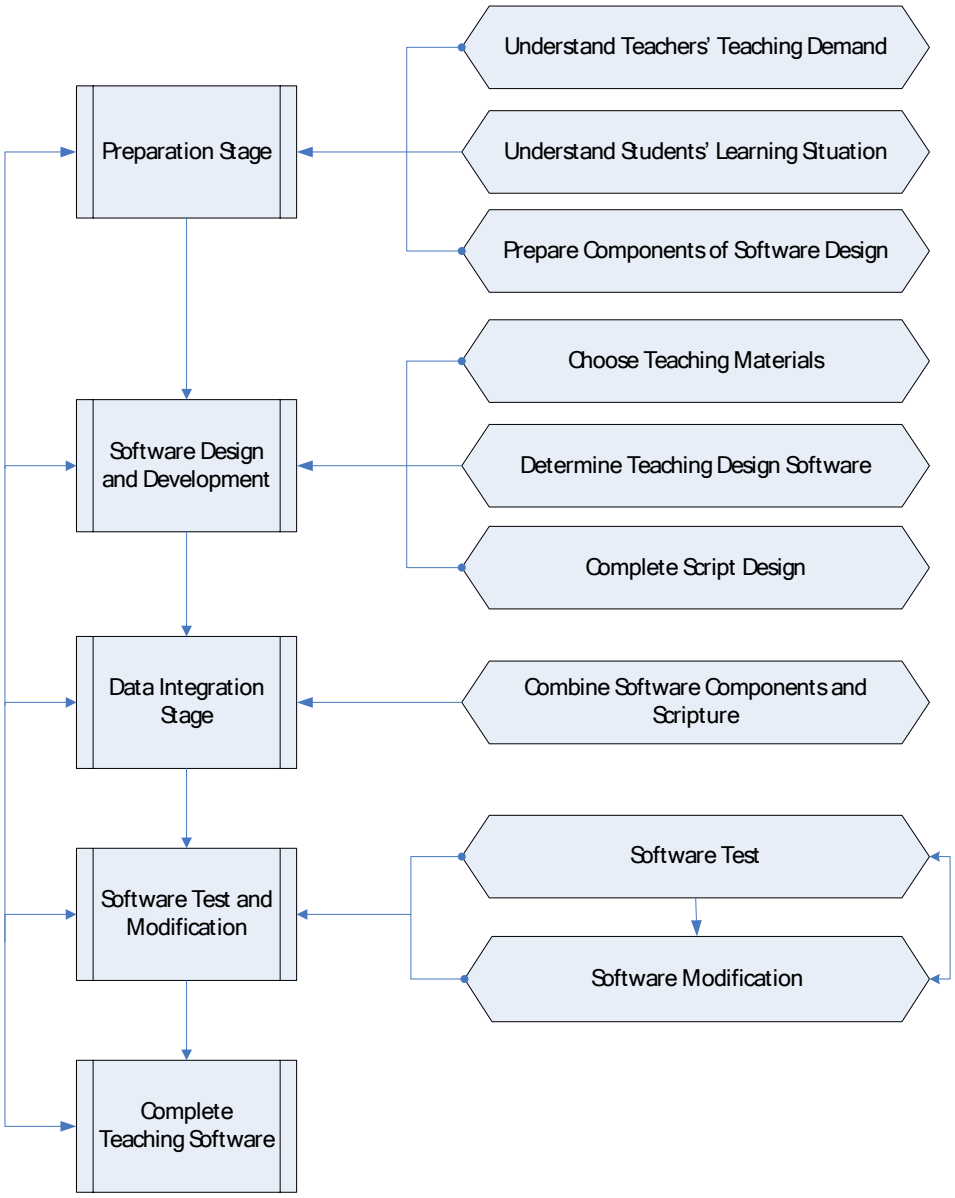

Fig. 2 The Flow Chart of CAMI Software Production

The Content of Chinese Musical Instrument CAMI Software

The Chinese Musical Instrument CAMI Software consists of six parts, including a brief introduction to Chinese musical instruments, the classification patterns of Chinese musical instruments, blowing and wind instruments, string instruments, psaltery instruments, and percussion instruments (as shown in Figure 3). In addition, under each type of Chinese musical instrument, its brief introduction, structure, performance, turning and compass, short story, and comparison are categorized and provided in the software (as shown in Figure 4). Figures 5 to 9 show the four sample

snapshots of the Chinese musical instrument CAMI software interfaces.

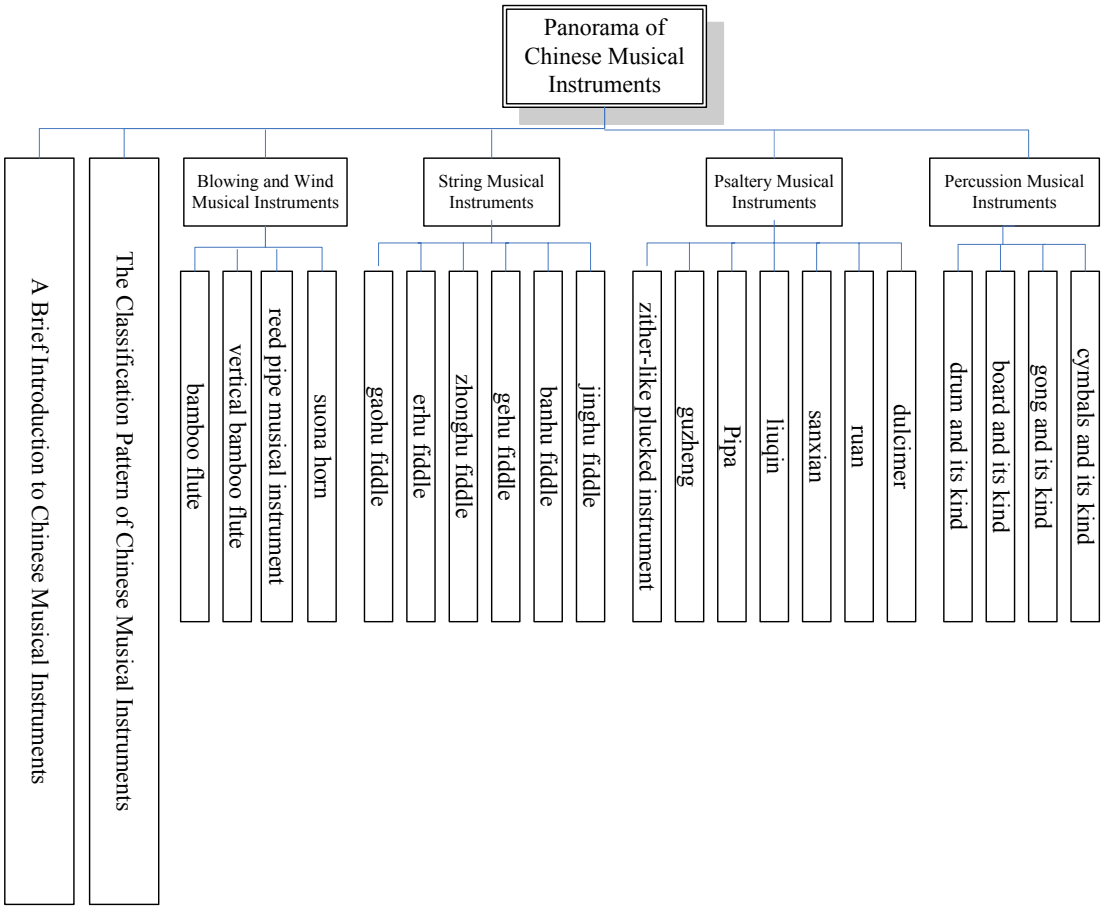

Fig. 3 The Structure of Chinese Musical Instrument CAMI Software

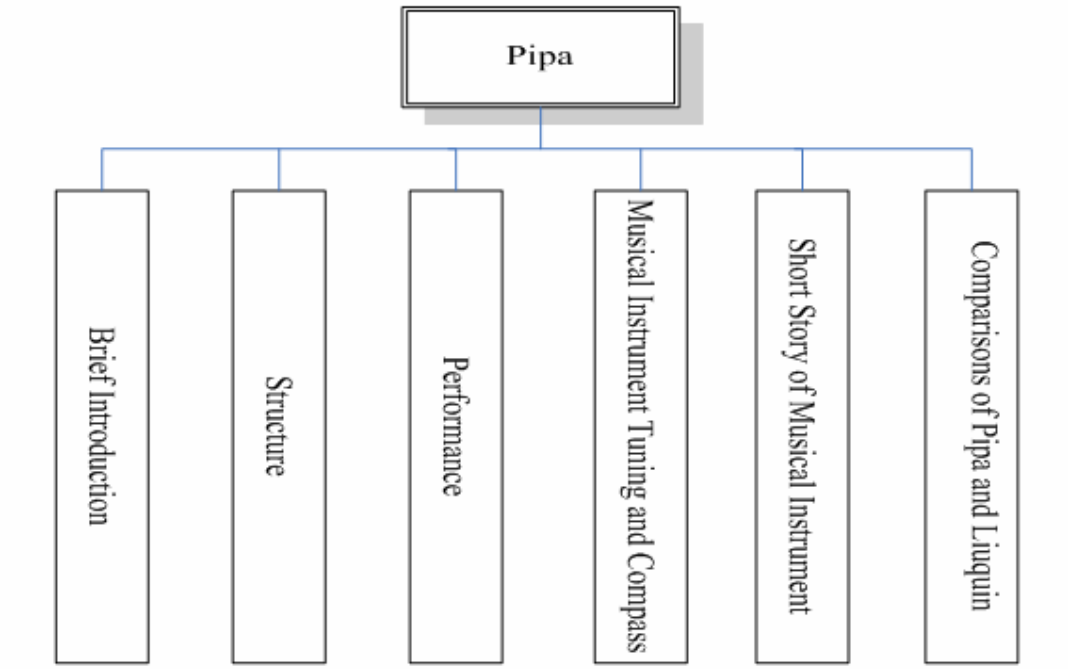

Fig. 4 The Content Structure of Pipa

Fig. 5 A Snapshot of the Chinese Musical Instruments Homepage

Figure 5 shows a snapshot of the Chinese musical instruments homepage, in which the swinging bamboo leaves act as background, and the musical instruments are placed in the foreground to highlight the subject. The little girl in the picture plays a role throughout the program in order to attract learners' attention and interest.

Fig. 6 The Page on the Structure of the Pipa

The buttons at the bottom of the page link to movie files, where users may view an entire musical performance.

Fig. 7 A Snapshot of the Story of Pipa

The vivid illustration can help the learner to enter into the situation of the story. The short story is titled “Art Contest on the Street.”

Fig. 8 A Snapshot of the Evaluation Page

Fig. 9 A Snapshot of the "Reorganizing Musical Instrument Room"

After practicing each musical instrument, the evaluation page can help teachers know how much students understand about Chinese musical instruments. Figure 8 shows a snapshot of the evaluation page. The evaluation page enables the teacher to assess if the learner fully understands the classifications of musical instruments. The "Musical Instrument Reorganization Room" page is designed to assess whether students could match the Chinese musical instruments and their names (as shown in Figure 9).

DATA ANALYSES AND DISCUSSION

Differences in Learning Achievement among Students

To understand whether the teaching materials designed for the experimental instruction were beneficial to the students in the "Learning Chinese Musical Instruments" appreciation courses, the results were analyzed by covariance (ANCOVA) to enable inference and further analyses.

The results showed that there was a significant difference between CAMI and traditional instruction method in learning achievement in the appreciation courses. Furthermore, from post-comparisons shown in Table 3, we inferred that learning achievement (post-test scores) in the experimental group was significantly superior to that in control group. This result indicates that the CAMI that the experimental group received was more effective than the traditional instruction received by the control group.

Table 2 The ANCOVA of Post-Test Scores

Source of Variance	*SS*	*DF*	*MS*	*F*	*Sig.*
Covariance (Pre-Test Scores)	5033.801	1	5033.801	36.870	.000
Variance between Groups	679.565	1	679.565	4.977	.027
Error	30718.693	225	136.528		

Table 3 Post- ANCOVA Comparisons of Post-Test Scores

Post-Test Scores after Adjustment Average	Experiment Group (CAMI)	Control Group (Traditional Instruction Method)
		74.311
Mean	77.816	
Experimental Group (CAMI)	------	*
Control Group (Traditional Instruction Method)	*	------

*p<.05

The results were consistent with studies conducted by other scholars, such as Wu, 2007; Gao, 2007; Cheng, 2007; Carney & Levin, 2007; Ewers, 2004; Chan, Jones, Scanlon, & Joiner, 2006; Yang, Lay, Liou, Tsao, & Lin, 2006, Lee, 2007, Yenitepe & Karadag, 2003; Yusuf & Afolabi, 2010.

Results of the Learning Satisfaction Survey

After experimental instruction, we conducted a survey of "learning satisfaction" among the students of experimental group to understand their feelings toward the experimental instruction. The Likert 5-point scale was used in this study, in which the higher scores the students obtain, the more satisfaction with the experimental teaching they will be. The Learning Satisfaction Survey Questionnaire obtained .93 of Cronbach α.

The analysis showed that in the "teaching software interface and content design" category, 27.1% of the students felt that the narration by written words was not colloquial enough; 82.8% felt that the colors of the pictures of musical instruments were appropriate, clear and definite; the size of the pictures was rated as moderate. Most of the students were also satisfied with the sound effects in the musical instrument performance film, as well as the size of the pictures; 88.3% of the students agreed that the material content design of the software conformed to the goals of the learning curriculum.

The results in "satisfaction with CAMI" category showed that 90.1% of the students agreed that CAMI was more interesting than traditional narrative teaching approach. It was similar to Neo and Neo's (2004) findings, in which 88.6% of the students were favorable to the use of the software. In addition, 84.7% felt that, compared with traditional instruction, CAMI software made it easier to understand the basic concepts concerning Chinese musical instruments; 85.5% liked learning the teaching materials in the textbook using CAMI software instead; 82.8% were satisfied with CAMI as used by their teachers.

In evaluating the learning environment, 19.8% of the students felt that turning off the lights in the class for CAMI might make them sleepy; 72.9% said that they could see the contents shown on the screen clearly, while 9.9% did not agree; 88.3% agreed that they might pay more attention to footage shown on the computer than to writing on the blackboard; 89.2% felt that it was more efficient for a teacher to present material on a computer than on the blackboard.

Overall, most of the students agreed that, while learning Chinese musical instruments, using CAMI was better than traditional narrative teaching approach; in particular, CAMI would allow students to actually see and hear performances with the musical instruments. The results were consistent with studies conducted by Neo & Neo, 2003, Teoh & Neo, 2007, and Tam, Kan, & NG, 2010.

Results of the Structural Equation Model of Learning Satisfaction

The following section presents the analyses of the relationship of structural equation model (SEM) between variables concerning various aspects of the learning satisfaction questionnaire: software interface and content design, learning attitude, and self-awareness learning results. The results of the evaluation of the SEM of learning satisfaction are shown as follows.

Table 4 Overall Goodness of Fit Evaluation Index

1. Normal Theory Weighted Least Squares Chi-Square = 234.89 (P = 0.00)
2. Chi-Square/df=234.89 ÷ 149 = 1.58
3. Goodness of Fit Index (GFI) = 0.82
4. Adjusted Goodness of Fit Index (AGFI) = 0.77
5. Normed Fit Index (NFI) = 0.92
6. Incremental Fit Index (IFI) = 0.97
7. Non-Normed Fit Index (NNFI) = 0.96
8. Root Mean Square Error of Approximation (RMSEA) = 0.072

The goodness of fit index (GFI) in Table 4 shows that the chi-square value (P=0.00) has reached the statistical significance. The chi-square value is usually greatly affected by the number of samples, so scholars believe that we should not rely solely on this index (Huang, 2003). Because GFI = 0.82 and AGFI=0.77, neither are acceptable indices (>0.90). RMSEA is 0.072, indicating a moderate fit. The rest of indices, NFI=0.92, IFI=0.97, and NNFI=0.96, are significantly greater than the acceptable value of 0.90. Chi-Square/df=1.58 is also smaller than the standard value of 2. As a whole, the above indices mean that the model was a moderate fit.

The test of hypotheses is shown in Figure 10, below. The structural equation model shows that "software interfaces and content design" has positive and direct influence on "learning attitude" and "self-awareness learning results." Also, "learning attitude" has a positive and direct influence on "self-awareness learning results."

Note: ***<.001, **<.01, *<.05

Figure 10 The Structural Equation Model of Learning Satisfaction

Teacher Introspection

One of the purposes of this research was to develop a set of teaching software that would make it easier for a music teacher to teach a course on learning Chinese musical instruments; thus, developing teaching materials was one of key points in the study. We spent six months collecting and editing characters, pictures and audio/video materials. A computer company was commissioned to conduct follow-up production. During the production process, the research team regularly met for discussion with the computer engineer to produce a perfect finished product. Thus, once software was complete, we were very familiar with the teaching materials.

In the process of experimental instruction, we could not predict how the students would respond because we had never done this before. However, after the first week of teaching, comparing the control group and experimental group yielded significant differences. Class order was significantly better for the experimental group than for the control class, and teachers found it easier to control the tempo of the experimental class. After the second week of instruction, when the teachers were teaching introductions to the musical instruments, detailed structure, performance, tuning and so on, the timely presentation of materials and magnification of graphs made it easy for teachers to help their students understand various concepts pertaining to the instruments. Students' concentration times were also longer. The software

provided teachers with much help because the materials were complete, and the teacher can timely switch of the picture in order to avoid the troubles of material preparation and shifting between different teaching media, which made the flow of teaching smoother and saved time. Thus, the Chinese musical instruments CAMI software is a good tool for teachers. The voice, animation, picture, and films used by the software structured the teaching situation, triggered students' motivation to learn and made the construction of concepts easier.

CONCULSION AND RECOMMENDATIONS

Conclusion

After synthesizing the analyses mentioned above, the conclusions are as follows:

1. The CAMI software is better than the traditional instruction method in producing learning achievement in students taking the music appreciation course "Learning Chinese Musical Instruments."
2. Students pointed out that the CAMI software interfaces were user friendly and were able to attract their interests. In addition, the design of the content and structure is suitable for learning in-class and after-class because it can clearly present various concepts regarding Chinese musical instruments.
3. Students had a positive view on the use of the CAMI teaching strategy in their courses, according to the results of the learning satisfaction questionnaire. Most of students identified with the static pictures, the effects of the performance films, the design of the teaching material and the software structure. The majority of students pointed out that the CAMI was more attractive and interesting than traditional instruction. They said the CAMI enhanced their learning achievement during the course on learning Chinese instruments.
4. The structural equation correlation of "software interfaces and content design" and "learning attitude" with "self-awareness learning results" has reached statistical significance, indicating that there was a positive structural correlation with "self-awareness learning results." The analyses of path effects also showed that the better "software interfaces and content design" is, the more it could positively enhance students' "learning attitude" and further enhance their "self-awareness learning results."
5. From students' achievement, classroom records and the results of teachers' introspection after the experimental instruction, most students possessed positive views on the use of the CAMI teaching strategies in the course, and the CAMI software for Chinese musical instruments used in the study is a good tool for teachers. The voice, animation, picture, and films used by the software structured the teaching situation, triggered students' motivation to learn and made learning concepts easier.

Recommendations

1. The Design of Teaching Software

(1) Concise Words on a Single Page Making Key Points Easy to Present.

Considering the richness of the contents, we integrated too much writing material into the software. After the experimental instruction period, we found that the students thought it was not easy to learn Chinese musical instruments through the CAMI, and the teachers were obsessed by too many words on a single page. Therefore, software designers should consider how to design software that concisely and clearly describes content.

(2) Enhancing Interaction with Teaching Software

Because the teaching software designed by the study emphasizes use by the teacher, there is space for improvement in the design for interaction between the software and the students. We recommend that research and development of teaching software should focus on the effects of interaction between the software and students. Students could receive immediate feedback through the medium of teaching software and experience an increased interest in learning. We also hope that the software could be transferred onto a CD or put on the Internet for students to study by themselves for practice before class and review after class.

(3) Add Explanation of Melody and the Introduction of Instrumental Ensembles

Because the producer of the teaching software emphasized the introduction of a single musical instrument and was limited by manpower and funding, the software did not include an explanation of melody or the introduction of instrumental ensembles. We recommend that this material is added to make the contents more complete.

(4) Present the Principle of Sound Production by Musical Instruments

From the learning satisfaction survey questionnaire, we learned that it is difficult for students to understand the principle of sound production by musical instruments. We speculated that the principle of sound production is difficult to express by oral reports or pictures. We could use animations to demonstrate how the air flow makes the air vibrate in a musical instrument, how stringed instruments produce sound through bowing or finger picking the strings, or how the sound is conducted through the instrument. Percussion instrument vibration and sound could also be explained. Thus, students would have in-depth understanding of the principle of sound production by musical instruments.

2. Teaching

(1) Adopting a Diversified Teaching Pattern

The teaching pattern should be limited to particular, frequently used teaching patterns or customs. In addition to

traditional narrative teaching approach, teachers should open their minds and accept new teaching methods and different musical performance methods. The results of the study showed that in the course on learning Chinese musical instruments, students are more successful with the CAMI than with traditional narrative teaching approach. Therefore, not only can students benefit from the adoption of the CAMI, but teachers also are able to attain feelings of satisfaction from the CAMI.

(2) Teachers Should Interact with Students in the Classroom

Using the CAMI allows teachers to present rich, diversified contents. However, if teachers are not careful, they may forget to interact with students and simply play the role of the voiceover that is only responsible for reporting on the materials presented by the software. In this way, students' concentration and learning interest would also be reduced, and they would experience learning fatigue. Even when there is well-produced software, it would not be helpful for teaching. Therefore, construction of a warm atmosphere in the class and good interaction between the teacher and students are the keys to successful teaching.

3. The Administrative Cooperation of Schools

To have rich and diversified music instruction, the installation in specialized classrooms with internal equipments, such as computers, a fixed single-beam projector (which features bright illumination and produces a clear picture without needing to turn off the lights), a large screen, stereo hi-fi equipment and so on, should be a basic requirement. A good environment for learning music will enhance the learning results.

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