Linking Different Cultures with Computers
A Study of Computer-Assisted Music Notation Instruction

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Abstract

Computer-Assisted Music Notation Instruction (CAMNI) is a self-educational software program designed and developed with HyperCard. It features linked multiple representation mode; graphical user interfaces (graphical index design and direct manipulation); and self-directed but computer-context-sensitive-guided learning environment (lesson navigation instructions, context-sensitive sound buttons, hidden navigation buttons, developing student's mental model of the program operation). With the application of HyperCard data folder, we also studied the cognition and learning procedure based upon the students' performance with the CAMNI system. The CAMNI was specifically designed for Chinese students who would like to study the staff notation whether or not they have background with the number notation. It can also be a helpful tool for Western musicologists and educators to study Chinese music notation systems.

1 Introduction

In China, the number notation system (Galin-Paris-Chavé method) has been used for almost eighty years since it was introduced by Li Shutong (1889-1940) who studied music and arts in Japan at the beginning of this century (1905-1910). Most music text books and song books have been published with the number notation. Today, the staff notation is the most popular notation system for all kinds of musical activities is the world. To some degree, using the number notation has obstructed cultural and musical exchanges between China and the West. Along with more and more cultural exchange programs between China and Western countries, it is becoming more urgent and necessary for Chinese people to learn the staff notation in order to understand and perform western music and also to be able to introduce Chinese music to Western people.

The primary purpose of this study was to investigate the feasibility of using computers to teach music notation (staff notation) to Chinese students. Based on the fact that many, but not all, Chinese students have number notation background, two versions of the CAMNI program have been designed and developed. Version One provides two music notation systems (staff notation and number notation) and Version Two provides only the staff notation system. Two different versions were compared for effectiveness. This study also focused on exploiting a new mode of computerized communication which relates today's computer technologies to the nature of human cognitive development. With the application of a HyperCard data folder, the researchers also studied the cognition and learning procedure based upon the students' performance with the CAMNI system.

2 Research Procedure

The CAMNI program had been designed, developed, tested, redesigned, and redefined for many times before the final study.

2.1 Sample and Research Design

This study was conducted on the campus of the University of Illinois at Urbana-Champaign from Fall semester 1990 to
Spring semester 1991. A total of 90 Chinese students and children participated in the study, which included a usability test, a pilot study for the final version software and the final experiment. The final study involved 83 Chinese students and children, divided into four experiment groups. Based on a pre-questionnaire, the sample was divided into two groups, group B1 with background in the number notation system, group B2 with knowledge neither of the number notation system nor of the staff notation system (nothing about music notation systems). Group B1 was randomly divided into two small groups; one assigned to use program Version One (B1T1), the other to use Version Two (B1T2). Group B2 was randomly divided into two small groups; one assigned to use Version One (B2T1), and the other to use Version Two (B2T2).

2.2 Materials
The staff notation system consisted of a great number of musical concepts. However, based upon the most modest goal that the students would be able to read a simple song after completing a course with computers, the following music concepts were selected as the most basic music foundation for beginning study: the staff, the "G" clef, the "F" clef, letter names of lines and spaces, ledger lines, notes (note head, stem, flag, beam), rests, note and rest values, accidentals, beat, tempo, tie, dotted notes, measure, bar line, meter, and meter signatures. (major scales and key signature were transferred to the second lesson)

2.3 Analysis of the Study
A one-factor ANOVA by rank (Kruskal-Wallis Test) was employed to see whether there was a difference of final score, time spent, and learning efficiency between those with background in the number notation and those without such a background regardless of the different treatments they received, gender, age, or previous computer experience. This study shows that the students who had number notation background did a significantly better job (p < 0.05) in learning the staff notation than the students without such a background. They reached higher achievements in the final test and spent less time in completing the program. As a result, the overall efficiency of their learning was higher than for those who didn't have the number notation background.

The same method was employed to see whether there was a difference of learning efficiency between those who received Version One and those who received Version Two regardless of their musical background. This study reveals that both versions of the program were effective since they shared the same pedagogical design, the same hypermedia system, the same user interface, as well as using the identical materials (selected musical contents). There was no significant difference found between using two versions of the program.

2.4 Conclusions
The final result shows that CAMNI is highly effective in teaching Chinese students and children the staff notation regardless of their musical background and computer experience. About 34% of the participants reached the full score in the final test. The average score was 22.47 out of 25, which means the subjects mastered 90% of the content that covered the basic staff notation knowledge. The average score for the retest was 22.32 out of 25, which shows that most subjects retained their understanding of the staff notation and grasped most concepts taught by CAMNI. It also proves that the final scores were reliable. An analysis of the post-questionnaire reveals that all the subjects enjoyed using the CAMNI program, 96% of the subjects wanted to continue studying music with computers, their attitudes toward Computer-Assisted Instruction (CAI) were positive. The self-directed but computer-context-sensitive-guided learning environment was warmly welcomed by most individuals despite different backgrounds both in music and with computers.
Exploring the Student's Learning Sequence

The CAMEI program was designed to automatically record the student's every action - either success or failure, repeat or jump - in a systematic fashion as s/he proceeded through the program. The student's learning process was completely documented in her/his data folder.

3.1 The Sequences of the Students' Learning Steps

To study the impact of hypertext applications on a student's learning sequences and patterns, and to better understand the student's cognitive processes, the students' learning steps were examined and analyzed. We randomly selected the data of five students who had no number notation background and the data of another five students who had no number notation background. Each action the student took with the CAMEI, such as clicking a button, reviewing a card, a field, answering a question, ... was considered as a learning step.

The multiple correlation coefficients of the sequence of learning steps for the students with number notation background was $\gamma = .92$. The multiple correlation coefficients of the sequence of learning steps for the students without music notation background was $\gamma = .77$. This study reveals that the students without music notation background produced less homogeneous learning sequences ($\gamma = .77$) with the CAMEI than students with number notation background.

Relatively, the students with number notation background produced more homogeneous learning sequences ($\gamma = .92$) with CAMEI.

Through the interview, we found that students who had no music notation background behaved with more curiosity about everything with the CAMEI and wanted to see all they had to learn first because they had no pre-established model (structure, concept) about the music notation systems. Many of them jumped first to the music examples to see how a song was written and represented by using the staff notation and what they were going to learn from the CAMEI. This discovery reminded the investigators that a good overall introduction to a new teaching/learning subject (in this study, the staff notation system) is a very important stage to a beginner. By providing an attractive introduction and an overall objective review to a student, s/he can get a big picture of the architecture of the entire lesson, so would have a better idea of where to start, and her/his motivation to learn would be evoked and stimulated.

The investigators hope that such analyses would yield valuable insights into the instructional processes involved in the development of musical skills and would provide important guidelines for future courseware design. Through analyses of the resulting data the investigators gained an understanding of each student's skills and how the students established and developed their user model with the CAMEI program. On the other hand, such analyses have also helped discover many design problems.

3.2 Summary

Individual instruction is one of the most significant features of Computer-Assisted Instruction (CAI). For reaching its full potential, a well-designed structure of hypermedia was proven as an effective approach. The true beauty of the application of hypermedia in CAI design is that it provides such an environment in which any individual (male, female, a college student, a grade school child, a person with or without previous music notation background, a person with or without previous computer experience), can experience her/his own learning process and form a unique learning sequence. One might find some similarity or common behaviors from a certain group of experimental subjects, but to apply those conclusions to different groups of the same population might not repeat the same findings and different conclusions might be drawn.

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