UNIVERSITY OF OKLAHOMA

GRADUATE COLLEGE

THE EFFECTS OF COMPUTER-ASSISTED KEYBOARD TECHNOLOGY AND MIDI ACCOMPANIMENTS ON GROUP PIANO STUDENTS' PERFORMANCE ACCURACY AND ATTITUDES

A DISSERTATION

SUBMITTED TO THE GRADUATE FACULTY

in partial fulfillment of the requirements for the

degree of

Doctor of Philosophy

By

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Norman, Oklahoma
2007

UMI Number: 3284124

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A DISSERTATION APPROVED FOR THE
SCHOOL OF MUSIC

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ACKNOWLEDGEMENTS

This research project would not have been possible without the assistance of many people. Special thanks go to Nancy Barry and Barbara Fast for their encouragement, attention to detail, and endless support. The rest of the committee, Jane Magrath, Roland Barrett, and Ming Chao Gui, were tremendously helpful. Andrew Parr, Gene Moon, and Jennifer Weems generously sacrificed valuable time to assist in this study. Mason Conklin, Teresa Sumpter, and Janci Bronson were very instrumental in making the experiment run smoothly. I also have to thank Theo Joseph for the generosity of his expert knowledge and consultation in data analysis.

I would also like to dedicate this work to the memory of my father, Melecio Ajero. Both he and my mother, Obdulia Ajero, sacrificed so much of themselves to allow me to pursue my musical career. I am very thankful to my parents-in-law, Liu Changyou and Wu Jingfu, for being the greatest babysitters in the world.

Finally, I must credit my amazing wife, Gina, and my son, Antonio. Their love and willingness to stay with me provided the essential motivation for me to carry on through the whole process.

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ABSTRACT

THE EFFECTS OF COMPUTER-ASSISTED KEYBOARD TECHNOLOGY AND MIDI ACCOMPANIMENTS ON GROUP PIANO STUDENTS' PERFORMANCE ACCURACY AND ATTITUDES

This study investigated the effects of musical instrument digital interface (MIDI) accompaniment and computer-assisted instruction (CAI) technology on group piano students' performance accuracy and attitudes. Subjects ($N = 29$) in this quasi-experimental design were non-keyboard music major college students in four intact third semester piano classes. Two of the classes were assigned to a group that practiced with the Guide Mode on Yamaha Clavinova keyboards and MIDI accompaniment, while the other two classes were assigned to a group that practiced without the Guide Mode but with MIDI accompaniment.

Subjects' performances of two piano compositions were first recorded as pretests. Afterwards each class practiced the same two compositions with their respective treatment for two weeks in class. Subjects then recorded the two compositions as posttests. Three judges evaluated the pretest and posttest recordings for accuracy in pitch and rhythm. A Likert-type questionnaire investigated subjects' attitudes toward practicing with the Guide Mode and MIDI accompaniment.

The researcher compared the posttest scores to the pretest scores within subjects for significant differences in performance accuracy due to the treatment. Differences in pretest and posttest scores were also compared between the Guide

Mode group and the MIDI-only group. Four outliers were identified as possibly skewing the data. When the outliers were removed, the group that practiced with the Guide Mode ($n = 19$) demonstrated significantly better improvement in total pitch errors in comparison to the control group ($n = 10$), $p < .05$. No significant difference in rhythmic errors emerged between groups. Within groups, participants made significant improvement in overall accuracy from pretests to posttests.

Perceptions of MIDI accompaniments and the Guide Mode's effectiveness in helping students improve performance accuracy were generally positive. In open-ended responses, a majority of the participants from the Guide Mode group expressed that practicing with the Guide Mode was the most helpful part of the practice sessions. Students also reported that they made greater improvement when they practiced hands separately. Some subjects also stated that the use of MIDI accompaniments helped keep their rhythm steady. Other subjects believed that the use of technology had no effect on their performance.

Recommendations from the results include using CAI such as the Guide Mode to help group piano students improve in pitch accuracy during the early stages of learning new repertoire. After students feel comfortable with the pitches, practicing with MIDI accompaniments but without the Guide Mode may assist in the development of rhythmic continuity. However, teachers should not assume that the technology is an automatic way of improving piano performance. More time to practice with the technology outside of the classroom setting may be needed to observe any longer term effects on students' performance.

CHAPTER 1

INTRODUCTION

Introduction

The purpose of this study was to investigate the effects of CAI (Computer-Assisted Instruction) and MIDI (Musical Instrument Digital Interface) accompaniments on performance accuracy and attitudes in group piano students. Group piano programs at the college level for students majoring in music education, music theory, composition, applied music, and music history are designed to provide students with necessary keyboard skills such as sightreading, transposition, harmonization, improvisation, and performing repertoire of contrasting styles. According to Lancaster (1977), the needs of group piano students with varying abilities can be met more easily with instructional technology and media by increasing the efficiency in the classroom as well as the practice room.

Common media integrated into average-age piano method books and adult group piano textbooks includes digital audio CD and MIDI recordings of music on disks. These recordings usually include the piano part along with accompanying instruments. Most of these method books suggest using the MIDI disks as performance models. Kern, Keveren, Kreader, and Rejino (2005) stated that one benefit of using MIDI disks with students is having a model for a polished performance. In a review of MIDI accompaniment software, Davis (1997b) said of modeling with MIDI disks, "If music is a language, then imitation is a natural way to learn" (p. 46). Lancaster and Renfrow (2004) also advocated using MIDI disks as

performance models for musical elements. Other benefits of its use include promoting steadiness of tempo and providing musical interest.

Proponents of the use of MIDI sequences pointed out the advantages that this format has over other types of media such as audiotapes and audio CDs. Litterst (2003) stated that MIDI disks are advantageous over recordings on audiotape or CD because of the student's flexibility in setting an appropriate tempo with the MIDI file. In a MIDI environment, users have the versatility to change other elements of a sequence, such as transposing pitches, changing instruments, and adjusting dynamic levels, in order to enhance performance and practice. Authors of piano method books with MIDI disks frequently recommend that students practice by performing one hand at a time with the MIDI disk playing the other part. The MIDI sequences often have the right hand and left hand recorded on separate tracks so that the teacher or student can turn off the left hand, right hand, or extra parts.

Another possible benefit of using MIDI sequences in performance is that it simulates an ensemble environment for pianists. Since piano students often play solo repertoire, a common problem in piano students is the ability to perform with rhythmic continuity. Uszler, Gordon, and Smith (2000) state, "To experience rhythm is the core of listening to music as well as making it. Rhythm is a physical sensation, easier to feel than to describe" (p. 8). MIDI accompaniments can possibly create external rhythmic stimuli that can cultivate a greater awareness of pulse that might not as easily be communicated through the music notation by itself.

On the other hand, research on learning from media and technology has not found consistent results in favor of its use according to Clark (1983). He stated,

"…best current evidence is that media are mere vehicles that deliver instruction but do not influence student achievement any more than the truck that delivers our groceries causes changes in our nutrition…" (p. 445). So an investigation into the effects of instructional technology and media such as MIDI accompaniments and computer-assisted instruction would contribute to the few previous studies that have been done.

Some authors are also concerned about potential problems that arise while practicing with a MIDI accompaniment. The role of most MIDI accompaniments in piano methods and literature is often supplementary due to the fact that most of the compositions were originally written without any accompaniment. Traditionally, accompanists are supposed to follow the soloist. In the case of MIDI accompaniments, this relationship is reversed, and the soloist is actually following the accompaniment. While this may be beneficial to the learning process, it may also be a hindrance to musical or expressive independence. Uszler, Gordon, and Smith (2000) wrote, "A word of caution with regard to the use of MIDI accompaniments: Over-reliance on performing with accompaniments can, in one way, sabotage a student's listening skills" (p. 17). The authors were concerned that keyboard parts that were already pre-programmed into MIDI sequences could potentially cover up what a live pianist is contributing. However, this researcher believes these authors did not take into consideration that sequencers, such as the one built into the Yamaha Clavinova CVP-300 keyboards, allow pianists to mute the piano parts in MIDI files. They also stated, "It is best that these accompaniment discs and programs, therefore, be used as the culmination of perfecting a piece, rather than at the beginning of the

learning curve" (p. 17). The authors did not reference any previous research that would support their claims and suggestion. Therefore, more empirical research is needed to determine if MIDI accompaniments are a distraction to students before conclusions about their effects can be made.

MIDI accompaniments for piano are sometimes criticized for the rhythmic and instrumental additions that do not support classical style periods. They usually incorporate rhythm tracks which use a more contemporary pulse that differs in style with the solo part. Davis (1997a) commented, "Because accompaniment disks rely solely on the beat to maintain the ensemble, many accompaniments use popular styles with a steady drumbeat. This makes it harder to find accompaniments demonstrating a classical (or orchestral) style" (p. 49). Although the accompaniments may not fit stylistically with the solo part, the authors maintain that accompaniments may still contribute to students playing with a greater accuracy in rhythm and pitch.

Until recently, Computer-Assisted Instruction (CAI) has not been integrated into piano instruction. The early uses of CAI were limited to developing aural skills in students due to the limitations in the technology. Instructional programs improved with computers' enhancements such as faster microprocessors, better graphics, and superior sound quality. Software programs that take advantage of the capabilities of multimedia offer a stimulating, motivating, and interactive environment for students (Williams & Webster, 2006). CAI in piano study was limited to drill-and-practice of note and key identification activities. Presently, programs such as the *eMedia Piano and Keyboard Method* (2006) provide guided performance instruction using the latest technology. This includes full-motion video demonstrations, animated keyboards, a

digital recorder, and interactive feedback based on pitch and rhythmic errors. The MIDI capabilities of keyboards allow them to communicate with these CAI programs and work efficiently.

Keyboard technology has advanced from its infancy during the 1960s with the monophonic limitations of the Minimoog synthesizer keyboards. For the past twenty years, keyboards have utilized digital samples in order to replicate the sounds of acoustic musical instruments. Features such as weighted key action and built-in sequencers have become common in digital piano models found in college classrooms and practice rooms. The current Yamaha CVP-300 Clavinova keyboards incorporate CAI into their design with guide lights behind each key to visually cue pianists to depress the correct keys at a certain point in a composition. MIDI, CAI, and keyboard technology are merging into instruments that can facilitate piano performance, composition, and instruction.

Purpose Statement

The primary purpose of this study was to investigate the effects of computer-assisted instruction (CAI) keyboard technology when utilized with a MIDI accompaniment on the performance accuracy of college group piano students using a pretest/posttest design. A secondary purpose of this study was to survey the students' perceptions of practicing piano repertoire with the use of CAI keyboard technology and MIDI accompaniments.

Research Questions

The research questions focus on the effectiveness of keyboard technology based on the subjects' performance accuracy scores and their responses to the questionnaire.

Research Question No. 1: How do pitch accuracy test scores of participants practicing with MIDI accompaniments and with the Guide Mode compare to pitch accuracy test scores of participants practicing with MIDI accompaniments but without the Guide Mode?

Research Question No. 2: How do rhythm accuracy test scores of participants practicing with MIDI accompaniments and with the Guide Mode compare to rhythm accuracy test scores of participants practicing with MIDI accompaniments but without the Guide Mode?

Research Question No. 3: How do combined performance accuracy test scores (pitch + rhythm) of participants practicing with MIDI accompaniments and with the Guide Mode compare to combined performance accuracy test scores of participants practicing with MIDI accompaniments but without the Guide Mode?

Research Question No. 4: What are participants' perceptions regarding practicing with MIDI accompaniments?

Research Question No. 5: What are participants' perceptions regarding practicing with the Guide Mode?

Need for the Study

Few research studies have investigated the effects of the use of CAI keyboard technology and MIDI accompaniments on piano practice. Even though the

development of technologies applied to music education has been extensive throughout the music industry, research in the use of technology in music instruction has been limited (Higgins, 1992). The use of keyboard technology has expanded as more music schools implement advanced digital keyboards in their classes and practice rooms. This study will help teachers and administrators in selecting keyboard technology equipment and in making the most effective application of new technology in classroom teaching. Manufacturers of digital keyboards and related technology can also learn what functions are effective and what improvements can be made on future products. This study may ultimately benefit students by providing a guide to creating a piano laboratory environment that is conducive to their musical growth. If keyboard technology has positive effects on the accuracy of students' pitches and rhythms, then teachers can devote more class time to other aspects of performance such as technique and emotional expression.

Definitions of Terms

Accompaniment Tracks – Accompaniment tracks are defined as sequenced MIDI channels which include additional instruments that may provide harmonic textures, countermelodies, and percussive rhythmic accompaniments. Most commercial sequenced MIDI accompaniments for piano methods and textbooks contain one track for the left hand solo part, one track for the right hand solo part, and extra tracks on separate channels that serve as the supplementary accompaniment.

CAI – Computer-Assisted Instruction (CAI) refers to computer programs employed to aid teaching and learning processes. The Guide Mode with MIDI files on

the Yamaha CVP-300 Clavinova is considered to be Computer-Assisted Instruction (CAI).

Guide Mode – The Guide Mode is a function on the Yamaha Clavinova CVP-300 series that allows pianists to play along with a standard MIDI file and provides performers with a visual cue to play the correct keys. When the pianist does not depress correct keys, the MIDI accompaniment stops and guide lights behind the keys flash until the correct key is depressed.

Interactive or Intelligent Accompaniment – Intelligent accompaniment is defined as a computer program designed to sense the rhythmic pulse and dynamic level of a soloist. The program uses sequenced music files that follow the performer's tempo or dynamic changes. This results in a simulation of performing with a flexible human accompaniment. Examples include *Vivace,* which is currently known as *Smart Music* (2006)*,* and *Home Concert Xtreme* (2006). The Guide Mode on the Yamaha CVP-300 Clavinovas does not sense rhythmic pulse or key velocity data. Therefore, the use of the Guide Mode with MIDI files is not considered intelligent accompaniment. However, it can be classified as a type of Computer-Assisted Instruction (CAI).

MIDI – MIDI stands for Musical Instrument Digital Interface. MIDI is a protocol by which computers and musical instruments can communicate with one another.

MIDI accompaniment – MIDI accompaniment files are recorded digital music that can be played on computers and digital sequencers. Commercial MIDI accompaniments often have the piano parts recorded on separate tracks and additional

instruments as well. Their versatility is demonstrated by the ability to change the tempo and pitches independently from one another.

Pitch Errors – Pitch errors were defined as notes played on the wrong pitch, omitted notes, or notes that were repeated when they were not indicated.

Rhythmic errors – Rhythmic errors were defined as notes or rests that were not sustained at least half of the symbols' values and secondly, as notes or rests sustained longer than the symbols' values.

Sequence – A sequence is a recording created with MIDI software. It contains one or more recorded tracks that are playable on MIDI devices such as keyboards and computers.

Sequencer – A sequencer is either a hardware device or software program used to play back or record music in a standard MIDI file format. The tempo of a recording can be changed without altering the pitch. Tracks can also be edited or muted independently.

Standard MIDI File (SMF) or General MIDI (GM) – A standard MIDI file is a digitally recorded sequence of musical events capable of being reproduced on other MIDI-capable devices including instruments and computers. Dave Smith of Sequential Circuits proposed the first standard MIDI format in 1981. The first MIDI capable keyboards were introduced in 1983. The MIDI Manufacturers Association (MMA) approved a General MIDI (GM) standard in 1991. General MIDI defines a set of minimum standards among MIDI devices and instruments. Instruments that comply with these standards display a distinct General MIDI logo. General MIDI 2

standards were created in 1999 in order to add a larger palette of sounds to improve quality of General MIDI files (Williams & Webster, 2006).

Yamaha Clavinova CVP-300 Series – The Yamaha Clavinova CVP-300 Series is a line of digital pianos manufactured by Yamaha with weighted key action and MIDI capabilities. The built-in sequencer and the Guide Mode were the keyboard technologies utilized in this study. The sequencer can record and play back performances. These recordings can be saved either to the keyboard's built-in internal memory or to a 3.5-inch floppy diskette through a USB-connected external floppy disk drive.

Outline of Dissertation

This dissertation consists of six chapters. This chapter introduces the purpose and the need for the research study. The following chapter presents a review of the related literature. The third chapter explains the methods and procedures used in the experiment. The fourth chapter presents the results of the pretest and posttest performances. The fifth chapter reports the answers of participants' questionnaires measuring their perceptions of technology. The sixth chapter discusses the implications of the results and conclusions that can be made from the study.

Summary

Pitch and rhythmic accuracy are basic goals in piano instruction. The use of CAI and keyboard technology potentially can assist teachers with achieving this goal with their students. However, empirical research in the effects of CAI and keyboard technology on piano performance is scarce. This study may inform educators about the benefits of CAI and keyboard technology in piano students' performances. Once

educators understand how to use these new tools to benefit their instruction, they can focus on higher artistic goals with their students. Therefore, the purpose of this study was to investigate the effects of the Guide Mode and MIDI accompaniments on the performance accuracy and attitudes of college group piano students.

CHAPTER 2

LITERATURE REVIEW

Introduction

Histories of keyboard technology and computer-assisted instruction in music education are discussed in this chapter to provide a framework for the present study. Previous research on the integration of MIDI accompaniments and CAI in music instruction will also be examined. Other reviewed materials include literature relating to: practicing with other types of accompaniment, listening to aural models on audiotape and other media, skills involved in sight reading, and other techniques to improve accuracy in music performance.

History of Keyboard Technology

Electronics in music can be traced back to the 1920s. The Theremin, named after its creator Lev Sergeyevich Termen and introduced in 1920, was one of the first electronic music instruments. Maurice Martenot presented another monophonic electronic instrument in 1928, named the Ondes Martenot. After World War II, two major centers, the Nordwest deutscher Rundfunk in Cologne, Germany, headed by Karlheinz Stockhausen, and the Columbia-Princeton Electronic Music Center, began the first experiments in pure synthesis of electronic music. These centers focused primarily on using synthesizers for music composition. However, these earliest synthesizers were so large and expensive that their use was limited only to a few professional recording studios (Holland, 1984).

It was not until the 1960s that the development of solid-state electronic circuitry made synthesizers more accessible to the general public. Robert Moog marketed the first commercially available modular synthesizer in 1964. Moog worked with James Scott, William Hemsath, and Chad Hunt to develop the first small and relatively low-cost synthesizer called the Minimoog. The Minimoog was marketed to the public in 1970 and praised for its versatility in both recording studios and in live performances. The device was a monophonic synthesizer, capable of only producing one note at a time. However, as a melodic instrument, it offered the performer more expressive capabilities because of its ability to control pitch inflections (Holland, 1984).

During the late 1970s, Oberheim manufactured the first polyphonic keyboards that allowed more than one note to be played simultaneously. This generation of synthesizer keyboards was capable of generating up to sixteen different sounds at the same time. Possibly the greatest advancement in these instruments was the integration of digital sound synthesis technologies with computer technologies.

Sequential Circuits introduced the Prophet-5 in 1978. It was the first synthesizer to incorporate a microprocessor. The keyboards featured new programmable memory that eliminated the cumbersome task of users having to reprogram the synthesizer every time a sound needed to be changed (Renfrow, 1991). Chroma and Oberheim also produced the first keyboards to have interfaces that could connect and communicate with other keyboards. These interfaces predated the more popular MIDI protocol that began in the 1980s. Roland and Oberheim even developed digital music sequencers prior to the MIDI protocol being established.

However, without a universal language such as MIDI, using different brands of digital music instruments and sequencers together was not possible without expensive and arduous modifications (Rona, 1987).

During the 1980s, sales of electronic keyboards increased due to widespread use of these instruments by popular music artists. The prominent use of electronic keyboards in popular music appealed to many piano students. A major development in both keyboard and computer technology was the implementation of MIDI (Musical Instrument Digital Interface). In 1981, Dave Smith, President of Sequential Circuits, proposed a universal standard for communicating digital performance data between keyboards of different manufacturers. In 1983, The MIDI 1.0 specification was completed, and the first MIDI capable keyboards by Roland and Sequential Circuits were introduced. Other keyboard manufacturers such as Yamaha and computer manufacturers Apple and IBM soon followed suit and adopted MIDI technology. This allowed musical instruments and computers to interface despite being created by different companies (Renfrow, 1991).

Along with the development of MIDI, digital sampling technology significantly improved the quality and quantity of sounds that a digital keyboard was capable of producing. Sounds of acoustic musical instruments could be authentically replicated on digital keyboards. Performances on MIDI keyboards could be saved as MIDI data, including pitches, durations, key velocities, and pedal switches. MIDI data could easily be reproduced or manipulated due to their binary nature.

Keyboard technology has continued to advance through the 1990s and into the 21st century. Digital piano labs utilize high quality teacher control systems,

keyboards with digitally sampled sounds, sequencers, and computers interfaced with student pianos (Lyke, 1996). Common features found on digital pianos include graded hammer-actions to simulate the feel of an acoustic piano, built-in multi-track sequencers, banks of nearly a thousand sounds, auto-accompaniment styles that simulate a back-up band or orchestra for the pianist, and both internal hard drives and expandable external memory options to save performance data. Yamaha CVP-300 Clavinova keyboards have a built-in LCD screen that can display music notation of a MIDI file or performance. These keyboards also have guide lights behind each key to visually cue pianists to depress the correct keys at a certain point in a composition. The current generation of high-end digital pianos is essentially a hybrid of synthesizer keyboards and computers with software to assist piano performance, composition, and instruction. They are powerful tools for music educators to have in the classroom and to assist piano students in their practice routine.

It is common to find keyboards networked together in classrooms so that instructors have the flexibility of working with one student or multiple students at a time. Students can also be paired together for duets or connected to several students for larger ensemble playing. Future keyboard technology will likely continue to become even more sophisticated. Some of the higher-end models within the Yamaha Clavinova CVP-300 Series, such as the CVP-305 and CVP-307, can connect to the internet in order to download MIDI files or additional banks of sounds. The internet capabilities of these keyboards may foreshadow a movement toward distance learning in keyboard instruction for colleges, universities, public and private schools, and independent studios.

History of Computer-Assisted Instruction (CAI) in Music Education

In the 1950s, Computer-Assisted Instruction (CAI) evolved due in part to the behaviorist theories of B.F. Skinner and programmed instruction. One of the earliest computer systems used for CAI in music education was the PLATO (Programmed Logic for Automated Teaching Operations) system invented by Don Bitzer. Musical programmed instruction migrated to mainframe computer systems, such as PLATO, and computer-controlled tape recorders in the late 1960s. However, the use of computer-controlled tape recorders in automated music instruction produced mixed results because of the slow nature of the medium (Williams & Webster, 2006).

Early notable studies in CAI music instruction focused mainly on improving aural skills in music students. Kuhn and Allvin (1967) used an electronic organ and a pitch extractor interfaced with an IBM 1620 mainframe computer to generate a sight-singing training environment. Students sang melodic phrases into a microphone with a metronomic beat. After the computer analyzed each pitch within the performance, it would either move on to the next example or repeat the previous example based on the student's performance. The subjects used the CAI for one hour each week over a period of three weeks. Students who used the CAI demonstrated an increase in pitch awareness. They also reported high motivational levels and positive student-computer interaction from using the CAI program.

In 1974, Fred Hofstetter designed an automated instruction and research laboratory to develop ways to improve ear training and aural perception skills. GUIDO, an acronym for Graded Units of Interactive Dictation Operations, was designed as a complete ear training and music theory program for a Burroughs 6700

mainframe computer. The program was later converted to run on the PLATO system and ran through a network for subscribers to use at the University of Akron, Southern Illinois University at Carbondale, and the University of Nebraska at Omaha. The ear training section of the program covered intervals, chord qualities, and rhythms. The theory section covered scales, intervals, diatonic chords, transposition, and rhythms (Arenson & Hofstetter, 1983).

During the early 1980s, the feasibility and cost problems of implementing CAI widely into music education programs lessened with the breakthrough of personal computers such as the Apple II, Commodore PET, and TRS-80. The Apple II personal computer provided a platform to develop hundreds of CAI music software programs when used in conjunction with the Micro Music DAC card or the ALF three-voice analog synthesizer. The mid 1980s saw yet another advancement in CAI when MIDI devices were used together with the advanced Apple Macintosh and Commodore Amiga personal computers, bringing the quality and control of musical sound to a whole new level (Williams & Webster, 2006).

CAI often uses a drill-and-practice approach in developing students' skills. One example of this is a program that drills melodic intervals for students. If students identify the intervals correctly, then they move on to another set of questions. Feedback in drill-and-practice is usually short and often effective in improving specific skills in students.

Williams and Webster (2006) also identified a "flexible practice" approach utilized in CAI programs in music. This type of software allows students to choose the settings for a series of exercises that suit them best. Students in a large class

setting can work at their own pace and address weaknesses in skills that need reinforcement. This software environment often utilizes digital audio and MIDI to create a more meaningful musical experience.

Newer CAI programs utilize a more creative or exploratory approach to music education. In these environments, the focus is usually not on mastering a specific skill, but rather on creating music through composition or improvisation. An example of this type of CAI is Morton Subotnick's *Making Music* (1995) where young students explore the process of composing their own music but in a non-linear fashion.

With current commercial success of CAI programs in both independent studios and music school curricula, more studies on the effectiveness of these programs are needed. Research in this area is particularly pertinent to piano instruction of future music educators because the keyboard is widely utilized as an input device for many CAI music programs. Instruments in piano labs and practice rooms, such as the Yamaha Clavinova CVP-307, are now starting to incorporate computer-assisted functions built into the piano. Even though this technology is generally less expensive than the older mainframe systems, music teachers and administrators still have to consider the cost of implementing CAI programs and keyboard technology resources into the curricula. However, the technology can be a valuable resource for piano instructors when used in connection with a carefully conceived lesson plan.

Research on the Integration of MIDI Accompaniments in Performance

Given that the MIDI protocol between keyboards and computers has only been around since the early 1980s, no research studies prior to this period investigating the use of MIDI accompaniments in performance exist. However, there have been studies on the effects of live accompaniments and accompaniments on pre-recorded tape that may provide some insight into the nature of MIDI accompaniments.

Research demonstrates that practicing with non-MIDI accompaniments enhances performances by musicians. A study by Hamann and Banister (1997) concluded that the frequency of rehearsals between a non-keyboard instrumental soloist and accompanist positively affected adjudicator ratings at solo and ensemble festivals. In another experiment, Kantorski (1986) found that computer-generated accompaniment tones presented in unison pitches improved the intonation of advanced string players more than computer-generated accompaniment tones presented in thirds.

Watkins (1984) investigated the effect of a tape-recorded soloist on the ability of college group piano students to sight-read vocal and instrumental accompaniments while accompanying the tape. Even though her study was not with MIDI accompaniments, the treatment was a similar experience to playing with a MIDI accompaniment. Watkins concluded that accompanists played with significantly better rhythmic accuracy when practicing with a recorded soloist.

Beeler (1995) investigated the effects of interval prestudy and MIDI accompaniments as a cue for rhythmic continuity on sight-reading achievement of

group piano students. Fifty students in four intact classes were assigned to four treatment groups: sight-reading with MIDI accompaniment, sight-reading with interval prestudy, sight-reading with a combination of interval prestudy and MIDI accompaniment, and sight-reading without any guided instruction or MIDI accompaniment. Sight-reading achievement was determined by pitch accuracy, rhythmic accuracy, total accuracy, and beat errors (a measurement for rhythmic continuity). The result was that participants who played with the MIDI accompaniment sight-read with significantly better rhythmic accuracy and continuity. Subjects who participated in structured interval prestudy exercises without MIDI accompaniment improved in pitch accuracy, but improvement in rhythmic accuracy was not affected.

Davis (2001) provided a descriptive analysis of dynamic (loudness) accuracy scores for college group piano students who practiced with four different types of MIDI accompaniment. The MIDI accompaniment conditions included: simple accompaniments with subtle dynamic contrasts, simple accompaniments with exaggerated dynamic contrasts, complex accompaniments with subtle dynamic contrasts, and complex accompaniments with exaggerated dynamics. Participants in the accompaniment groups improved only slightly more on average than participants in the control group that practiced with no MIDI accompaniment. Participants also completed an attitudinal questionnaire. In general, subjects believed MIDI accompaniments helped their rhythmic continuity as well as their dynamic expression. There was a significant positive correlation between adjusted gain scores and positive attitudes toward MIDI accompaniments. In fact, participants with a less

positive attitude toward MIDI accompaniments had noticeably less improvement in dynamic accuracy.

Betts and Cassidy (2000) conducted a study on the effects of different methods of developing harmonization and sight-reading skills on university group piano students. Although the effect of MIDI accompaniment was not a main purpose in their study, the use of MIDI accompaniment disks during class instruction was one of the variables. Group piano students in six intact classes were taught lessons in harmonization and sight-reading. Three classes were taught using MIDI accompaniments during harmonization exercises but without MIDI accompaniments during sight-reading. The other three classes were taught using MIDI accompaniments during sight-reading but without MIDI accompaniments during harmonization exercises. The researchers found no significant difference in sight-reading and harmonization scores between students using MIDI accompaniments during sight-reading and students using MIDI accompaniments during harmonization. The researchers advise that interpretation of these results should be viewed with caution since truly random assignment was not attainable. They recommended more research to investigate the effect of MIDI accompaniment disks particularly in the technology's potential for motivating and structuring practice outside the classroom setting.

Some recent research studies have compared the effects of practicing with MIDI accompaniments with other types of media. Benson (2002) conducted a study that analyzed the effects of various types of instructional media on group piano student performance and attitude. Subjects were instructed in one of three conditions:

use of MIDI sequenced recording, videotape, and multimedia computer presentations. A comparison of the different media utilized in each class yielded no significant difference in improving performance accuracy. This was true even for the control group that did not receive any instructional media. A possible explanation provided by the researcher was that she had her subjects split into too many different groups considering the low sample size ($N = 29$). All students appeared to learn regardless of the treatment. Although there were no significant differences in performance accuracy between groups, the group that listened to a MIDI recording as a model identified it as the aspect of practice that helped them the most.

Research on the Integration of CAI in Music Education

Earlier studies in the use of CAI in music education were focused on the effect of using it to teach fundamentals of music, theory, and aural skills. Investigations of computer-assisted instruction in these areas have demonstrated significant results in favor of CAI (Arenson, 1982; Bowman, 1984; Hofstetter, 1979; King, 1989; Lindeman, 1979). However, other studies found no significant effects of CAI in teaching fundamentals of music, theory, and aural skills (Hess, 1994; Von Feldt, 1971).

Placek (1974) tested the effectiveness of a CAI course for teaching selected behaviors in rhythm perception. The selected test group completed lessons in a CAI environment rather than attending elementary music classes for two weeks. The computer tracked the amount of time that the students spent on the program, the number of attempts that the students made, and the keys that the students pressed.

Students showed improvement in gain scores from a pretest to a posttest, but no percentages or significance levels were reported.

The following studies reported significant effects of CAI in music instruction. Hofstetter (1979) compared CAI in ear training to traditional classroom instruction for college freshman. He concluded that the experimental group learned harmonic dictation skills significantly better than students in the control group. Lindeman (1979) created a CAI program to teach rhythmic skills and concepts. The use of CAI was effective, and students also enjoyed being able to work at their own pace with the program. In a non-music major theory class, Arenson (1982) found a significant difference in achievement in favor of students assigned to use CAI compared to students assigned to complete traditional homework assignments.

King (1989) investigated the effects of CAI on seventh grade students studying music fundamentals. Commercial CAI programs supplemented traditional music instruction for the experimental group. The group that received treatment showed a higher level of achievement in note and clef identification and discriminating between major and minor. The CAI group also scored higher in rhythm discrimination and total scores.

Some studies reported no significant effects of CAI in music instruction. Buck (1991) conducted a study of elementary students using CAI in addition to attending regular general music classes. No significant difference in achievement emerged between the experimental group and the students who were instructed exclusively in a traditional manner. In a study involving non-music major college students, Jacobsen (1987) found CAI to be just as effective as traditional instruction

of note names, key signatures, and rhythm examples in a fundamentals of music class. On the other hand, studies on the TAP Pitch Master machine have demonstrated significantly better pitch discrimination for students who use the program (Brick, 1985; Smith, 1995).

A study by Von Feldt (1971) compared the teaching of musical concepts in a CAI program to the teaching of the same musical concepts in a standard classroom setting of seventh-grade general music students. The musical concepts covered in both settings included knowledge of the letter names of notes on lines and spaces on the treble and bass staff, note and rest values, accidentals, time signatures, barlines, repeat signs, and dynamic markings. The purpose of the study was to analyze how CAI compared with regular classroom instruction when teaching both high-achieving and low-achieving students. Von Feldt's findings showed that CAI instruction significantly improved the scores of the low-achieving students, but did not significantly improve the scores of high-achieving students. He concluded that CAI only required thirty percent of the time normally spent on regular classroom instruction, but CAI was just as effective as traditional classroom instruction.

CAI was also found to be as effective as a traditional approach in teaching basic note reading to elementary students in grades two through four (Isaak, 1989). However, no significant differences emerged between students who used the visual CAI with sound and students who used the same visual CAI without sound. Glass (1986) found that eighth-grade students who used a computer game to develop pitch-matching skills did not show a greater improvement than students who did not use the program.

Studies have also explored the effects of computer technology upon musical performance skills. A number of these investigations reported positive effects of using technology in improving performance. Middle school string students used a tutorial and drill program for fingering and pitch matching in a study by Eisele (1986). The students who used the program demonstrated significantly greater achievement than a control group that did not use the program.

Holland (1987) studied the effect of CAI music software programs on reading skills in high school students enrolled in beginner piano classes. The sample consisted of thirty students in grades nine through twelve. The experimental group used a computer with teacher-developed and commercial music theory software to improve vertical/horizontal reading skills of the grand staff. In addition to the software, the experimental group received supervised practice time at the keyboard. The control group also received supervised practice time at the keyboard, but worked on music theory assignments at their desks instead of the computer. The researcher used a written pretest and posttest to assess improvements in reading notes on the grand staff. Both groups also performed the same composition on the piano keyboard after the treatment period. Judges then evaluated the performances based on vertical/horizontal reading skills. No significant differences between the written pretest and posttests were found between the two groups. However, analysis of the scores from the performance tests revealed a significant difference in favor of the experimental group that used the theory software programs.

Hesser (1988) also conducted a study on the effectiveness of CAI in developing music reading skills at the elementary level. The large sample size

included one hundred third-grade students from two different schools. A pretest-posttest design compared two different methods of CAI reinforcement of music reading and a third control group of traditional reinforcement without CAI. The two different CAI methods included one group where students were scheduled for a weekly thirty-minute period to work in the computer lab. The other CAI method allowed students to choose to work at their own pace in the computer lab. Results indicated that the two methods of CAI reinforcement were more effective than traditional group reinforcement. The more structured CAI lab environment proved to be more successful than the less structured student-selected CAI lab environment. Although the study had a large sample size, there was no evaluation of reading skills in a performance situation. Both the pretest and posttest were written tests.

Other research studies did not report significant differences in the use of CAI on performance skills. In a study by Malave (1991), high school clarinet students that were assigned to 30-minute practice sessions with CAI over the course of ten weeks in addition to their traditional music class showed no significant difference in performance achievement in tone quality when compared to students who received instruction exclusively through the traditional music class. Codding (1986) also found that overall tuning accuracy was not significantly greater for beginning guitar students who were taught tuning skills through a combination of CAI and teacher instruction. Kassner (1992) used CAI on beginning band students in elementary school. There was no significant difference in performance between the control and experiment groups. However, student attitudes toward the program were positive and the rate of attrition from band class decreased.

Early studies of CAI in music instruction found it to be effective. Some investigations in its application in music theory and ear training revealed significant results in favor of CAI, but others found no significant difference in CAI in comparison to traditional teaching methods. In note reading and pitch matching, CAI was also effective. Investigations of the effects of CAI in music fundamentals, music reading, and development of performance skills produced mixed results. Some studies found significant differences in favor of CAI while others did not.

Most studies concluded that CAI could be more efficient in the delivery of instruction than traditional means. Some of the research regarding the effectiveness of CAI in music instruction found significant differences in favor of students who used CAI, but other studies have found no differences.

Research on Computer-Assisted Instruction (CAI) with MIDI

Some software programs are combining CAI technology with MIDI technology. Computers can deliver immediate performance feedback to a student or teacher because the binary nature of MIDI data in sequenced music is easy to analyze. Current computers have the ability to adjust parameters of a MIDI accompaniment instantaneously during a student's performance to create an interactive accompaniment. Examples of interactive accompaniment software include *Smart Music* (2002), formerly known as *Vivace*, and *Home Concert Xtreme* (2006). *Home Concert Xtreme* is aimed at pianists using standard MIDI files in conjunction with the program. *Smart Music* is a subscription service that offers a library of compositions with interactive accompaniments for instrumentalists. Since most of the repertoire with accompaniments is for non-keyboard instrumental soloists, most studies have

measured the effects of interactive accompaniments on non-keyboard instrumentalists rather than pianists.

Tseng (1996) ran a small qualitative case study with ten flute students who practiced with an intelligent digital accompaniment over the course of a semester. The software program was called *Vivace* but has since been renamed *Smart Music*. The researcher concluded that participants learned repertoire at an accelerated pace when practicing with the *Vivace* accompaniment. Participants' attitudes regarding the interactive digital accompaniment environment as a teaching tool were generally positive. The researcher reported that accompaniments provided the flute students with preparation for performances because of the concentration and focus on continuity that were demanded.

Snapp (1997) also performed a similar study on the uses and effectiveness of the *Vivace* Intelligent Accompaniment system, but with K-12 instrumental music students. Teachers reporting the use of intelligent digital accompaniment as a supplemental tool for solo and ensemble festival preparation indicated that their students tended to practice more and were therefore better prepared and more confident in their performances.

Sheldon, Reese, and Grashel (1999) investigated the effects of live accompaniment, intelligent digital accompaniment, and no accompaniment on performance quality in college-age instrumentalists. When comparing two performances within the different groups, performance ratings for the accompaniment groups declined while the group with no accompaniment showed improvement. The researchers speculated that the accompaniment groups' performance scores might

have declined because the performance procedures changed between treatment and testing. On the other hand, the group with no accompaniment played in their condition throughout the experiment. They also suggested more research in matching practice procedures with performance procedures. Despite the fact that there were no significant improvements in performance quality by participants using intelligent digital accompaniment, informal comments were mainly positive. Most of these participants stated that it was fun to use, and that it made practicing more enjoyable.

Literature on Sight Reading

Sight-reading is a skill often identified in research studies as being important for music majors. Therefore, literature on sight-reading was reviewed in order to gain insight into the learning process and techniques used to improve pitch and rhythm accuracy. The keyboard skills of sight-reading and harmonizing melodies for accompaniment purposes were ranked high in importance to music educators and performers surveyed in research studies (Buchanan, 1964; Graff, 1984; Lowder, 1983). The examination of popular class piano texts revealed various instructions for sight-reading or learning approaches to new compositions. These included playing and counting aloud, visually identifying melodic and rhythmic patterns before playing, "blocking" chords together by playing notes simultaneously rather than in the broken pattern in which the composition is written, and playing silently on the keys while reading, which is commonly referred to as "shadowing" (Hilley & Olson, 1998; Mach, 1996). Johnson (1964) also suggested shadowing as a preparatory procedure. He recommends going through the motions of playing the composition silently on the fallboard, or even silently on the keys, so that the performer may feel

the motions before actually playing. Kostka (2000) reported that students receiving instruction in error detection plus shadowing made significant improvements in pitch and rhythm accuracy.

In a study by Fincher (1983), one group of piano students played a melody by rote in a prestudy procedure while another group was taught with an analytical prestudy procedure. The group with the rote prestudy procedure made a significant improvement in the number of pitch and rhythmic errors. This may suggest that instruction through an approach such as listening to or playing along with a MIDI accompaniment could be beneficial in improving pitch and rhythmic accuracy in performance.

Literature on Modeling

When students practice with MIDI files, they have access not only to accompaniment tracks, but also to a recorded performance model of what they will be playing. A number of research studies have found the use of audio modeling to have a positive effect on performance (Dickey, 1991; Folts, 1973; Fortney, 1992; Rosenthal, 1984; Rosenthal, Wilson, Evans, & Greenwalt, 1988; Zurcher, 1972). Other studies have found that audio modeling was not effective (Anderson, 1981; Biggs, 1960; Hodges, 1974; Linklater, 1997).

In a study by Folts (1973), significant differences in performance were found in an experimental group of instrumentalists that practiced with a guided aural modeling tape and a control group that practiced with no model. Tests showed greater improvement in the group that practiced with the guided aural model. Dickey

(1992) also concluded that the use of a prepared tape as a model was an effective teaching strategy for both elementary students and college students.

Zurcher (1975) examined the use of an audio taped model for brass students practicing at home. The experimental group received tapes that included instructions, reminders, a metronome pulse, and model play-along performances of the lesson. The control group practiced without any tape or model. The tapes were effective in pitch discrimination, pitch matching, rhythmic discrimination, and time spent on practice, but tempo stability and fingering were not affected.

Anderson (1981) used tape-recorded models for home practice on sixth-grade clarinet students. The experimental group received an audiocassette of music exercises assigned to both groups while the control group practiced without an audiocassette. There were no significant differences between the groups in performance skill tests.

Biggs (1960) investigated the effects of aural models on the performance of undergraduate brass students. No significant difference was found between the control group and the experimental group. In a study by Fortney (1995), students with various learning styles received music instruction through an audio CD program. No significant differences in scores for students with different learning styles were present.

Hodges (1974) investigated the effects of recorded aural models on the performance achievement of beginner band students. An experimental group listened to audio taped models during rehearsals while the control group did not listen to models. No significant differences were discovered between the groups in the areas

of pitch accuracy, rhythmic accuracy, tempo stability, dynamics, and total performance.

Linklater (1997) also found no significant difference in performance or practice time between students using instrumental accompaniment tapes and those whose tapes included additional aural models of just the solo instrument. He also found that modeling videotapes seemed to help beginning clarinetists more than audiotapes on visual/physical aspects of playing. Even though this may seem obvious, these findings support the idea that adding a visual element to supplement an aural model may be ideal in teaching situations.

It is also documented that teachers who model more frequently and give more feedback are rated as more effective than those who do less (Siebenaler, 1997). Sang (1987) corroborated these findings in a study that found a correlation between strong teacher modeling skills and stronger student performances of instrumental music. However, she cautioned that the correlation does not necessarily mean causation.

Summary

A common finding in studies is the generally positive attitudes of subjects regarding the use of MIDI accompaniments in their practice (Benson 2002; Davis 2001; Sheldon, Reese, & Grashel 1999).

The research investigating the effects of accompaniments and CAI technology provide mixed results. Studies on the effects of CAI on piano students are sparse, particularly with students in group piano classes. In the area of modeling performance, many studies tend to agree that providing a model to students, whether it is a live performance, a recording on audiotape, a guided model, or a MIDI

accompaniment, improves musicians' performances (Dickey, 1992; Fincher 1983; Folts, 1973; Sang 1987; Siebenaler 1997; Zurker, 1975). However, other studies show no significance in providing a performance model on musicians' performances (Anderson, 1981; Biggs, 1960; Hodges, 1974).

The purpose of this study was to investigate the effect of MIDI accompaniments and CAI keyboard technology on performance accuracy of group piano students in an effort to add to the small amount of research in this area. Additionally, students' perceptions toward incorporating this type of technology in their practice were measured.

CHAPTER 3

PROCEDURES

Introduction

The purpose of this study was to investigate the effects of MIDI accompaniments and computer-assisted keyboard technology on the performance accuracy and attitudes of college group piano students. Subjects were placed in two groups (Guide Mode and MIDI accompaniment vs. MIDI accompaniment-only) in a quasi-experimental design. Gain scores in pretest to posttest performances of the Guide Mode group were compared to gain scores of the MIDI-only group that practiced the same compositions.

Subjects in the Guide Mode group answered a questionnaire [Appendix D] to determine their perceptions of the use of MIDI accompaniments and computer-assisted keyboard technology. Subjects in the MIDI-only group answered a similar questionnaire [Appendix E] to investigate their perceptions regarding the use of MIDI accompaniments and how helpful they believed CAI would have been in improving their performance accuracy scores.

The independent variable was whether or not the Guide Mode function on the keyboards was used. The dependent variables were the subjects' performance accuracy scores and their responses on the questionnaire regarding their perception of MIDI accompaniments and CAI keyboard technology.

Setting of the Experiment

This study was conducted at the University of Oklahoma during the Fall 2006 semester. The university's group piano program consists of a four-semester sequence for non-keyboard music majors. The classes traditionally meet twice a week in 50-minute class periods. The objectives of the group piano curriculum include proficiency in scales, arpeggios, chord progressions, harmonization, transposition, accompanying, score reading, and performance of solo repertoire. The experiment took place in two of the keyboard department's digital piano laboratory classrooms. Both labs contained identical models of Yamaha Clavinova CVP-300 Series digital keyboards that were capable of playing MIDI accompaniments with or without the Guide Mode function for each student.

Sample Groups

The subjects came from four intact group piano classes of undergraduate music majors ($N = 29$) from the University of Oklahoma. All classes were in the third semester of a four-semester group piano sequence. Students were placed into the piano classes based on their performances in entrance exams. Most students in Group Piano Level 3 successfully completed Group Piano Levels 1 and 2 or an equivalent proficiency. Two of the classes served as the Guide Mode group ($n = 19$) while the other two served as the MIDI-only group ($n = 10$).

Group Piano Level 3 students were employed due to their familiarity with fundamental keyboard skills and note reading. Students at this level should have passed out of Group Piano Level 2 with a repertoire level comparable to "Ecossaise in G Major" by Ludwig Van Beethoven. Course content at the beginning of the

semester started with material from *Alfred's Group Piano for Adults, Book 2* (Lancaster & Renfrow, 2004). Level 3 Group Piano students were also chosen because a large amount of commercial piano repertoire with MIDI accompaniments was appropriate for this group's reading level.

Selection of Piano Compositions

The researcher chose piano compositions that were within the performance ability of students in their third semester of group piano. However, the compositions should also have been challenging enough to show improvement from a pretest to a posttest performance. Another condition for the compositions was that they have active MIDI accompaniments which could potentially serve as motivation for students practicing with them. To fulfill these conditions, expertise in this area was sought. This researcher, in consultation with the Coordinator of Group Piano at the University of Oklahoma, selected the following compositions to be used in this study: *Allegro* composed by Dale Reubart [Appendix G] and *Presto* composed by George Benda and adapted by Fred Kern [Appendix H]. Both compositions represent a typical solo piano composition with MIDI accompaniment. They were selected from a collection of commercial MIDI files included with the *Home Concert Xtreme* (Timewarp Technologies, 2006) software program. This researcher, in consultation with the Coordinator of Graduate Music Education at the University of Oklahoma, decided that comparing two piano compositions could be useful in gaining more insight into the effects of MIDI accompaniments and CAI keyboard technology. The compositions were considered unfamiliar enough that participants probably had not played them prior to this study. Compositions in their current and previous textbooks

were avoided so that participants would not be able to practice the compositions outside the setting of the experiment.

Due to limited availability of facilities and potential participants, a pilot study was not performed. However, the researcher carried out the experimental procedures with one of his non-music major private students. Directions were clarified based upon this student's feedback. The student was also able to accomplish the tasks related to handling the equipment, using the CAI keyboard technology, and recording his performances to disk.

Equipment

Each participant played on a Yamaha Clavinova CVP-300 Series digital piano during the pretest, posttest, and in-class practice sessions. Every keyboard station had a set of headphones so that participants could practice and record compositions privately without hearing each other. Pretests and posttests were saved onto individual 3.5-inch floppy disks through the USB floppy disk drive attached to each Yamaha Clavinova. The MIDI accompaniments were standard MIDI files that were saved into the internal memory of each participant's Yamaha Clavinova and remained there for the duration of the experiment. The researcher made only minor changes to the MIDI files to make them compatible with the Yamaha Clavinovas. The right hand and left hand piano parts were not originally on MIDI channels 1 and 2 and needed to be transferred to these channels in order to work properly with the Yamaha keyboard's Guide Mode feature. Rhythms for the *Allegro* composition were also quantized to the smallest note value of a sixteenth note to display the notation properly on the Yamaha Clavinova's LCD screen. The paper scores for both

compositions were transcribed by the researcher to *Finale 2006* from the MIDI data in the sequenced accompaniments. The researcher, in consultation with the Group Piano Coordinator, added dynamic signs, articulation symbols, and suggested fingering.

The researcher recorded himself on video giving step-by-step instructions to the participants and instructors. These videos included tutorials on how to use the various functions on the Yamaha Clavinova digital pianos including how to record their performances and save them to a floppy disk. The videos were saved in an MPEG-4 Quicktime movie format and loaded onto the Apple iMac computers at the teachers' stations in the piano labs. The videos were stored in the iTunes music library. In addition to being a digital music player, the iTunes software program also functions as a digital video player. The videos were placed in a chronological order in playlists that facilitated the process of instructors displaying the video for the participants. The iMac computers were connected to stereo speakers that made the video audible to the participants. The video instructions were displayed through an LCD projector on a white Smart Board in full screen for the participants.

Orientation with Keyboard Technology

The experiment was conducted in nine class periods during the Fall 2006 semester. Instructors of the level 3 group piano classes monitored the participants. The researcher met with the instructors to train them how to run the instructional videos and other operational procedures. Paper copies of day-by-day instructions [Appendices J and K] were distributed to the instructors before the experiment. The researcher was not physically present to oversee the experimental period, but the

iMac computers in each lab also had broadband internet access and iChat video conferencing software installed. If a problem or emergency arose, instructors were able to "call" the researcher in Texas for any consultation via videoconference. However, no problems emerged, and video conferencing was not necessary.

Recruitment of participants occurred in the sixth week of the Fall 2006 semester during students' regularly scheduled piano class time. Their instructors played a video, prerecorded by the researcher, requesting students to participate in the study [Appendix B]. If students agreed to participate, they signed the informed consent form [Appendix C], and instructors proceeded to the orientation phase of the experiment. Students who did not agree to participate still went through the experiment as part of their in-class work to improve their reading skills. However, their results were not included in the final analyses. Students who were absent from any experiment sessions were allowed to make up a practice session prior to the next class period with their instructor. Results of participants who were unable to make up missed sessions were excluded from the data.

Each meeting with the participants occurred during the first fifteen minutes of their regularly scheduled class time. On Day 1, both the Guide Mode and MIDI-only groups watched a video demonstrating how to record a performance using the built-in sequencer on the Yamaha Clavinova keyboards. The monitors handed out floppy disks on which participants could record their piano performances. They were also given a paper copy of one short composition of easy difficulty entitled *Perfect Balance,* composed by Dennis Alexander [Appendix F]. This easy composition was

chosen so participants could focus on the task of simply recording their performance to a floppy disk.

On Day 2 of the orientation phase, the Guide Mode group watched a video demonstrating how to listen to a MIDI file in the internal memory of their keyboards. The participants listened to a MIDI sequence of *Perfect Balance* that included the solo piano part as well as accompaniment tracks. Paper copies of the composition were available to participants to look at while the MIDI file played over their headphones. They were instructed to listen to the recording once without playing on the keyboards. However, they were allowed to play silently on the surface of the keys, or "shadow" the keys, as they listened to the sequence as an aural model for performance. After listening to the MIDI sequence, participants watched another video demonstrating how to practice with a MIDI file using the Guide Mode. The participants then practiced *Perfect Balance* in Guide Mode in order to become familiar with the process. They practiced the composition with the right hand alone, the left hand alone, and then hands together.

The MIDI-only group also watched the video instructing them how to listen to a MIDI file on Day 2. Their instructor handed out a paper copy of *Perfect Balance* and asked them to listen to the MIDI file for an aural model. They proceeded to practice the left hand part, the right hand part, and then hands together with the MIDI accompaniment. Their teacher also instructed them how to adjust the tempo of the MIDI file. The use of the Guide Mode was the only variable that was not incorporated.

On Day 3 of the orientation, both participants from the Guide Mode and MIDI-only groups practiced the *Perfect Balance* composition for three minutes as they did on Day 2. They watched a video demonstrating how to record the piece to the floppy disk again to ensure that all participants were able to save the pretest and posttest without any technological errors.

Pretest

After the orientation, a pretest in performance accuracy with both groups was conducted prior to the treatment. A prerecorded video of the researcher delivered instructions to the participants detailing how to record themselves for the pretest. Participants recorded their playing while on headphones using the built-in sequencer on their Yamaha Clavinova digital pianos and saved them on a 3.5-inch floppy disk. The pretest required each participant to sight-read *Allegro* [Appendix G] and *Presto* [Appendix H]. Participants were allowed to examine each score for one minute before playing. All pretests were performed without MIDI accompaniment. The metronome marking on the scores displayed a quarter note equaling 84 beats per minute for *Allegro* and a quarter note equaling 170 beats per minute for *Presto*. These were also the default tempos of their respective MIDI files. However, participants were instructed to record their pretest performance at the minimum tempo of a quarter note equaling 50 beats per minute for the *Allegro* piece and a quarter note equaling 120 beats per minute for the *Presto* piece. The instructor played two measures of the metronome demonstrating the minimum tempo before recording, but the metronome was not active during the recording process. Instructors assisted their students only in the recording process. Pretest recordings on

floppy disks were collected by the instructors and delivered to the researcher at the conclusion of the experiment.

Treatment

The treatment procedure was patterned after suggestions made by authors who provide MIDI accompaniments in conjunction with their method books. The practice procedure was designed to follow common approaches in learning a new composition of music including practicing hands separately. Official treatment began on Day 5 of the experiment. Piano class instructors monitored all treatment days, but the researcher prepared the pre-recorded video instructions. Instructions for this first treatment day called for the participants to listen to the MIDI file of the first composition *Allegro*. This file contained both the left hand and right hand piano parts in addition to the extra instrumental accompaniment. A paper copy of the score for the *Allegro* composition was distributed to each participant. Participants listened to the file for one minute without playing along, but they were allowed to "shadow" the keys while the song file played over their headphones. Teachers and publishers commonly suggest this procedure for lessons and classes that utilize MIDI accompaniments.

After a quick video review of the Guide Mode functions, participants were prompted to practice the *Allegro* composition using Guide Mode for the remaining time of the 15-minute session. The video instructed them to practice just the left hand, just the right hand, and then both hands together. Participants had the freedom to practice independently at their own pace, but they were required to use the Guide Mode during this period.

The MIDI-only group followed the same procedure on Day 5. They also began with listening to the MIDI file of *Allegro* with the same instructions to "shadow" the keys while the song file played over their headphones. The only difference was that they practiced with the MIDI accompaniment without the Guide Mode during the 15-minute session.

On Day 6, the second day of treatment, procedures were the same as the previous day except that they practiced the *Presto* composition instead of the *Allegro* composition. The MIDI-only group again followed the same procedures as the Guide Mode group with the only difference being the omission of the Guide Mode.

On Day 7, the third day of treatment, the Guide Mode group was given five minutes to practice *Allegro* with the Guide Mode and another five minutes to practice *Presto* with the Guide Mode. The MIDI-only group was also given five minutes to practice *Allegro* without the Guide Mode and five minutes to practice *Presto* without the Guide Mode.

On Day 8, the fourth day of treatment, the video instructed the Guide Mode group to practice both compositions. During the 15-minute practice session, they were allowed to practice either composition using the MIDI accompaniment with the Guide Mode. Participants were also prompted to play through the pieces at least once without the MIDI accompaniment to match the performance conditions that were utilized in the posttest. The MIDI-only group also practiced both compositions during the 15-minute practice session. Participants in this group did not utilize any Guide Mode function, but were also prompted to practice each piece at least once without the MIDI accompaniment.

Posttest

On Day 9 of the experiment, all participants from the Guide Mode and MIDI-only groups performed a posttest on the two compositions, *Allegro* and *Presto*. Procedures for recording the posttests were similar to procedures used in the pretests. Instructors distributed paper copies of the score for each participant and the same floppy disks that were used to record the pretests. The participants had one minute to examine and practice the examples. This warm-up was not considered part of the treatment, as its only function was to reorient the participants with the compositions since they had not seen the music for at least two days. None of the posttests were played with MIDI accompaniments or other tools such as the Guide Mode. Participants were instructed to record their posttest performance at the minimum tempo of a quarter note equaling 50 beats per minute for the *Allegro* piece and a quarter note equaling 120 beats per minute for the *Presto* piece. The instructor played two measures of the metronome demonstrating the minimum tempo before recording, but the metronome was not active during the recording process. After posttests were completed, participants submitted the paper scores and floppy disks to their instructors.

Evaluation of Performances

A panel of three independent judges evaluated the recordings. The judges were instructors at the school of music of Stephen F. Austin State University. They were chosen due to their current and prior experience in teaching group and private piano at the collegiate level. A Yamaha Clavinova CVP-200 Series digital keyboard played the recordings of the pretests and posttests for the judges. The piano sounds

were identical to the CVP-300 Series, and transferring MIDI data from one instrument to another did not alter performances in any way. All pretest and posttest recordings were evaluated one at a time. The performances of participants from both the Guide Mode and MIDI-only groups were put in a random order and codified by the researcher before they were played for the judges. The random order of recordings was intentional to prevent judges from having any rating bias due to knowledge of whether a MIDI-only group pianist or Guide Mode group pianist performed the recording. The randomization also prevented judges from knowing whether the performance was a pretest or a posttest recording.

Each judge rated each performance using the same scoring sheet [Appendix I]. Errors were counted in pitch and in rhythm as defined in Chapter One [see under "Definitions"]. Performance time was recorded and judges added an error point for every ten seconds that performances went over one minute. The MIDI sequences at the minimum expected tempo lasted 48 seconds and 45 seconds for *Allegro* and *Presto,* respectively.

Before actual evaluation of performances, the researcher conducted an orientation session with the judges. The researcher defined what constituted a pitch error and a rhythm error according to this study. Judges then listened to several recordings of the compositions and rated them independently. Scoring sheets were compared and discussed until judges' ratings were deemed reliable. Judges had copies of the score for each piece to follow while listening to performances. They evaluated the recordings by marking the score when a pitch error or rhythm error occurred. Judges listened to each recording once for pitch errors and once for

rhythmic errors. They were allowed to hear any recording more than twice if necessary to judge it accurately. If there was a discrepancy between judges in error points greater than ten errors for any individual performance, all three judges re-evaluated the recording. Any re-evaluations occurred at a later time to prevent judges from being influenced by remembering a specific recording.

Interrater reliability was calculated using Cronbach's alpha and was found to be high. Reliability alphas for pitch errors, rhythmic errors, and total errors for *Allegro* were .97, .98, and .99. Reliability alphas for pitch errors, rhythmic errors, and total errors for *Presto* were .96, .93, and .96.

Questionnaire

Following the posttest, all participants from the Guide Mode group completed a questionnaire [Appendix D]. The survey was designed by the researcher to help determine the participants' perceptions of the compositions and CAI keyboard technology used in the experiment. The questionnaire also elicited information on the participants' background in piano study and in using MIDI and keyboard technology. The MIDI-only group completed a similar questionnaire [Appendix E]. Using grounded theory, three upper-class psychology student researchers at Stephen F. Austin State University read the participants' responses to summarize and identify recurring themes within each condition. These summaries were utilized to reduce bias and strengthen the validity of this researcher's interpretations of the affective nature behind the participants' answers.

Summary

This study investigated the effect that MIDI accompaniments and CAI keyboard technology have on performance accuracy of college group piano students. The study also assessed students' perceptions regarding the use of MIDI accompaniments and CAI keyboard technology in their piano classes. Group piano students performed two different piano compositions as a pretest. These performance tests did not use MIDI accompaniments or other computer-assisted technology and were saved to floppy disks. For the next four classes, students practiced these same two compositions in fifteen-minute sessions. One group practiced the two compositions utilizing MIDI accompaniments and the computer-assisted Guide Mode. The other group practiced the same two compositions with MIDI accompaniment but without the Guide Mode functions. Both groups performed the two compositions again with no use of MIDI accompaniments or computer-assisted technology. These performances were also saved on floppy disks.

Three independent judges listened to the pretests and posttests of each student. They judged all performances on pitch accuracy and rhythm accuracy. Mixed analyses of variance (ANOVA) with pretest and posttest scores as repeated measures were utilized to discover any significant interactions between the Guide Mode group and the MIDI-only group and any main effects from pretest to posttest within groups. The researcher also conducted t-tests to determine the nature of any main effects or significant interactions that emerged. A questionnaire was administered to assess subjects' perceptions regarding MIDI accompaniments and computer-assisted keyboard technology.

The following chapters will present the results of the test scores along with data analysis. A summary of the questionnaire responses will also be reported. The last chapter will summarize the results of the data analysis and discuss the implications of the outcomes.

CHAPTER 4

DATA ANALYSIS

Introduction

The purpose of this study was to investigate the effect of MIDI accompaniments and CAI keyboard technology on performance accuracy and attitudes of college group piano students. Overall, two separate sets of test scores (pretest vs. posttest) were compared with two groups (Guide Mode with MIDI accompaniment vs. MIDI accompaniment without Guide Mode). Mixed Analyses of Variance (ANOVAs) with pretest and posttest scores as repeated measures were conducted for the two compositions, *Allegro* and *Presto,* to determine if there were significant effects ($p < .05$) of the treatment. If significant effects emerged, then t-tests were used to explore the nature of these effects. Students' perceptions toward incorporating this type of technology in their practice were measured through analyses of their responses to the questionnaires. The researcher used the computer program, SPSS (Statistical Package for the Social Sciences), to calculate the results.

Identifying Outliers in the Data

During data analysis, the researcher identified four subjects that could potentially be outliers in the experiment. Outliers are traditionally defined as subjects whose scores are more than two standard deviations from the mean, but justification of removing outliers can be for other reasons. Huck and Cormier (1996) stated that a participant may make a conscious effort to sabotage the research, or may be acting from other motives. They recommended excluding outliers from a pool of data since

they can cause some statistical procedures to either exaggerate or understate a particular relationship between variables.

1. Subject 14 in the MIDI-only group appeared to have given up on the pretest of *Presto* halfway into the recording. This participant did finish the posttest, so improvements in pitch and rhythmic errors were uncharacteristically high.
2. Subject 15 in the MIDI-only group had high errors in the pretest of *Allegro* due to possible intentional mistakes. The judges of the recordings also shared this impression. This may have created an unusually high improvement in pitch and rhythmic errors from pretest to posttest. The posttest of *Presto* also exhibited a similar style of performance with intentional errors to the subject's performance on the pretest of *Allegro*. The subject also submitted a posttest recording that only lasted 15 seconds before stopping.
3. Subject 22 in the Guide Mode group performed the pretest of *Allegro* with no pitch errors and only six rhythmic errors. Thus, a case can be made that this created a ceiling effect for her performance on the posttest. According to this student's questionnaire, she also received six years of piano study prior to attending the university. The rest of the subjects reported that they either had no previous piano study or only one or two years. Although the assumption was that students in the group piano classes were of the same level, some students enroll in the classes with previous piano experience. The goal of the classes is to provide functional keyboard skills to students who major in music. While this student may have been more advanced in sight-reading a composition from a notated score, she may have been deficient in other areas

such as scales, arpeggios, harmonization, transposition, or improvisation. This might explain this participant's presence within this level of piano class.

4. Subject 31 in the MIDI-only group submitted a performance of the pretest of *Presto* that was only six seconds long. It is likely that this subject was not taking the experiment seriously and simply gave up. His survey response to the question, "What would have made the practice sessions more helpful?" was, "HA HA – had we been graded on it." The large amount of errors on the pretest created an unusually high amount of improvement to the posttest that would skew the data if it were included.

Since this experiment contained a small sample size, the researcher will first present the data with the outliers still within the data pool for the sake of comparison. Readers should interpret these results with caution due to the reasons stated earlier. Data with the outliers removed from the data set will then be reported. These findings will be presented at the end of this chapter.

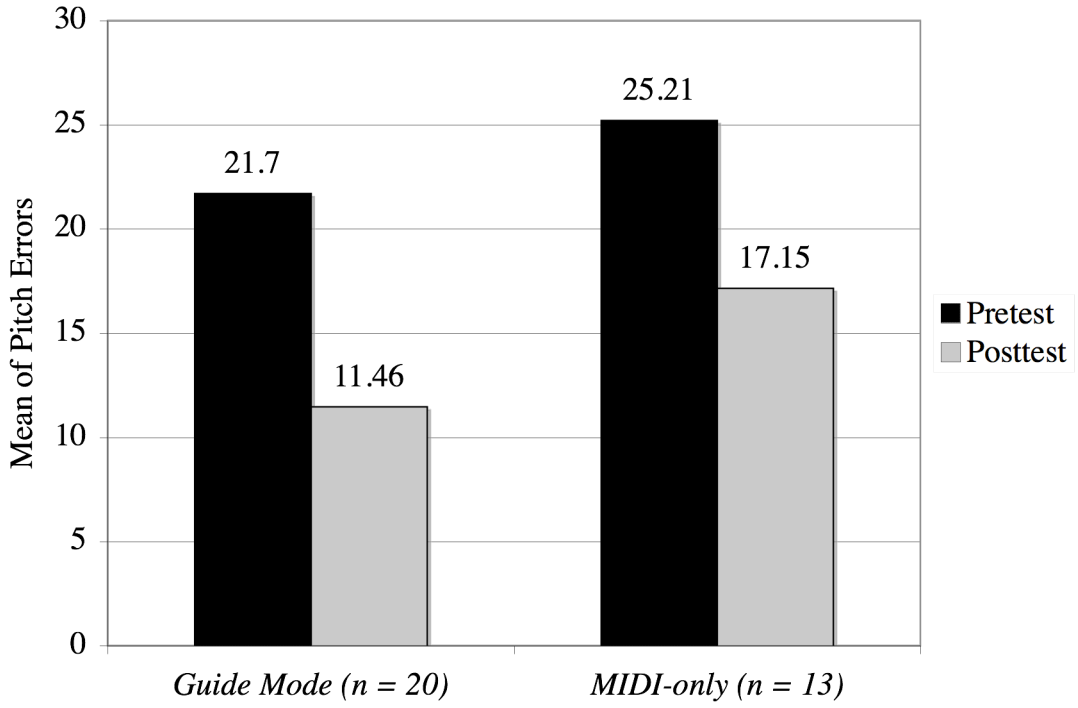
Pitch Accuracy

Research Question No. 1 reads as follows: *How do pitch accuracy test scores of participants practicing with MIDI accompaniments with the Guide Mode compare to pitch accuracy test scores of participants practicing with MIDI accompaniments without the Guide Mode?*

A 2 (pretest, posttest) x 2 (Guide Mode, MIDI-only) mixed ANOVA was conducted on *Allegro* pitch errors. There was a main effect for pitch errors within subjects, Pillai's Trace, F (1, 31) = 16.12, $p < .001$, with an observed power of .97, but no significant interaction between the Guide Mode and MIDI-only group was

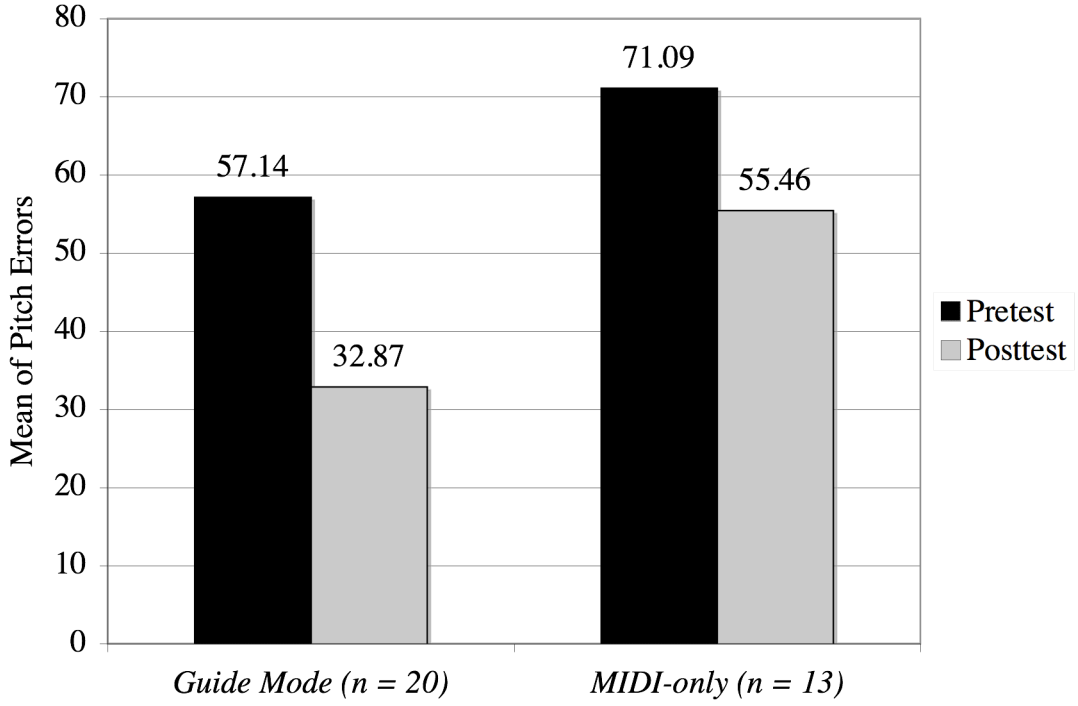
present, F (1, 31) = .229, p = .64, with an observed power of .08. A paired-sample t-test demonstrated that posttest pitch errors were significantly lower than pretest pitch errors for the Guide Mode group, t (19) = 4.14, p = .001, but not for the MIDI-only group, t (12) = 1.92, p = .079. [See Figure 1].

Figure 1
Allegro Pitch Errors (N =33)



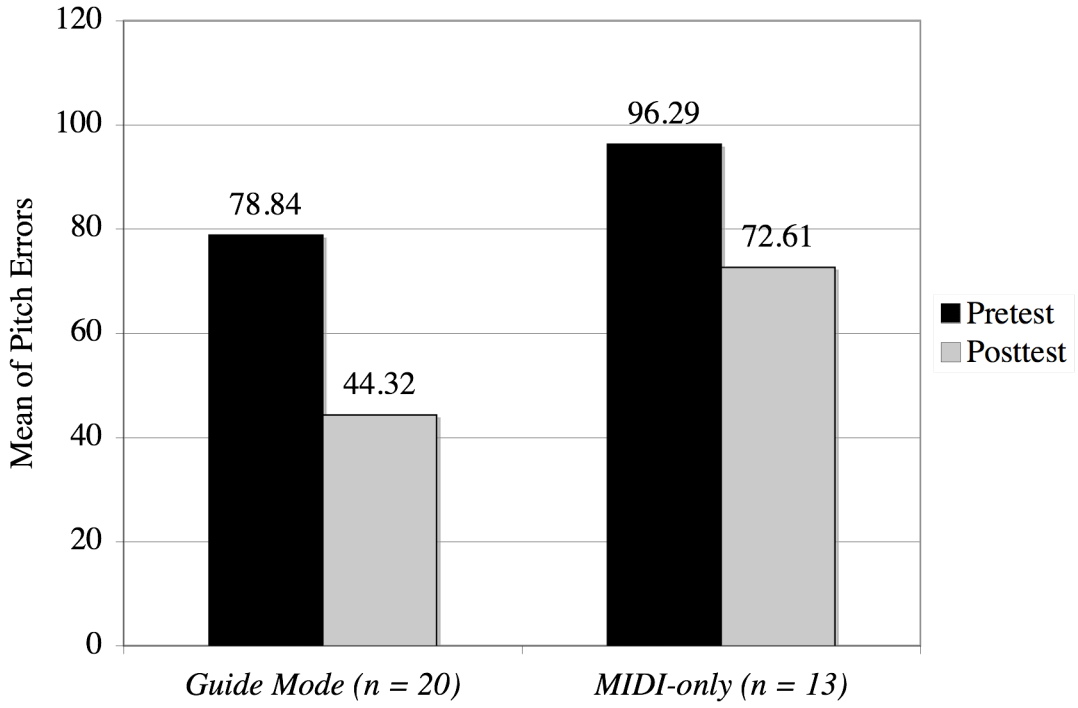
For *Presto*, there was a main effect for pitch errors within subjects, F (1, 31) = 10.88, p = .002, with an observed power of .89. However, no significant interaction between the Guide Mode and MIDI-only group was present, F (1, 31) = .51, p = .48, with an observed power of .11. A paired-sample t-test demonstrated that posttest pitch errors were significantly lower than pretest pitch errors for the Guide Mode group, t (19) = 4.70, p < .001, but not for the MIDI-only group, t (12) = 1.22, p = .246. [See Figure 2].

Figure 2
Presto Pitch Errors ($N = 33$)



When pitch errors were combined for both *Allegro* and *Presto,* a significant main effect for pitch errors within groups emerged, F (1, 31) = 19.09, $p < .001$, with an observed power of .99. However, no significant interaction between the Guide Mode and MIDI-only group was present, F (1, 31) = .66, $p = .42$, with an observed power of .12. A paired-sample t-test demonstrated that posttest pitch errors were significantly lower than pretest pitch errors for the Guide Mode group, t (19) = 5.51, $p < .001$, but not for the MIDI-only group, t (12) = 1.75, $p = .11$. [See Figure 3].

Figure 3
Combined Pitch Errors ($N = 33$)



Rhythm Accuracy

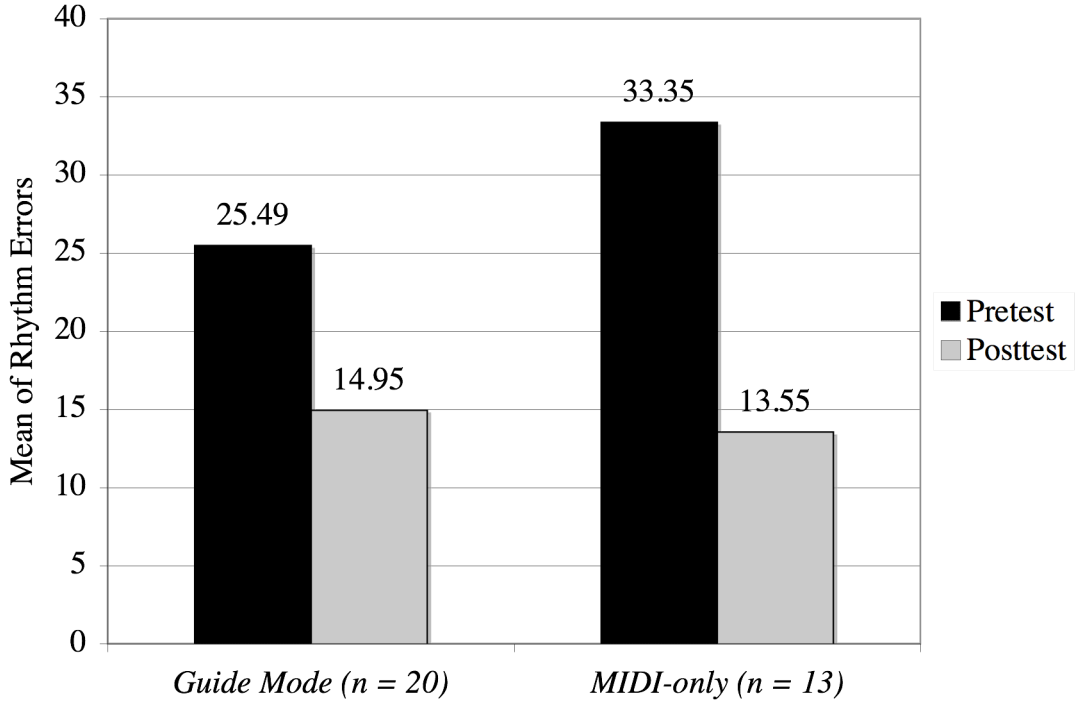
Research Question No. 2 reads as follows: *How do rhythm accuracy test scores of participants practicing with MIDI accompaniments with the Guide Mode compare to rhythm accuracy test scores of participants practicing with MIDI accompaniments without the Guide Mode?*

A 2 (pretest, posttest) x 2 (Guide Mode, MIDI-only) mixed ANOVA was conducted on *Allegro* rhythmic errors. A significant interaction, F (1, 31) = 6.27, p = .02, with an observed power of .68, between the two groups was present along with a main effect within groups for rhythmic errors, F (1, 31) = 67.34, $p < .001$, with an observed power of 1.0. A paired-sample t-test demonstrated that regardless of the treatment, posttest errors were significantly lower than pretest errors for both the

Guide Mode group, t (19) = 5.95, $p < .001$, and the MIDI-only group, t (12) = 5.34, $p < .001$.

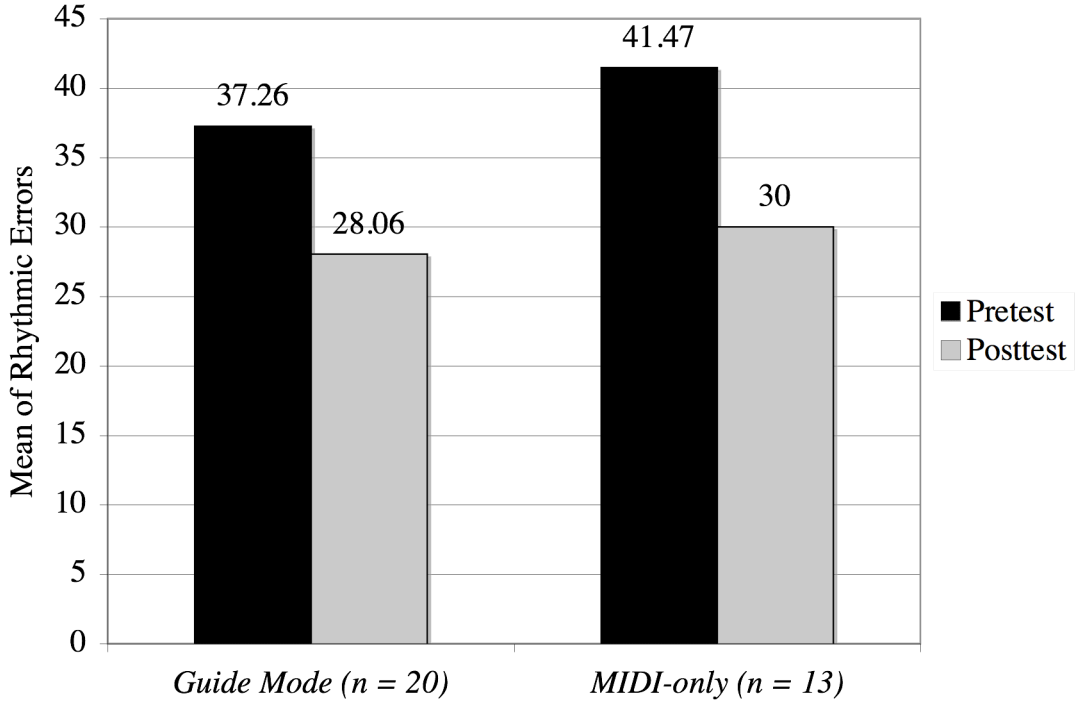
Further analysis of the interaction revealed the following: for the Guide Mode group, participants' pretest errors (M = 25.49, SD = 2.59) were greater than their posttest errors (M = 14.95, SD = 9.26). For the MIDI-only group, participants' pretest errors (M = 33.35, SD = 16.94) were also greater than their posttest errors (M = 13.55, SD = 11.49). However, an independent sample t-test in differences in rhythmic errors from pretest to posttest between groups showed a significant difference in favor of the MIDI-only group that practiced without the Guide Mode, t (31) = 2.50, $p < .018$. The MIDI-only group made fewer rhythmic errors on their posttest than the Guide Mode group despite making more rhythmic errors on the pretest than the Guide Mode group [See Figure 4]. However, it should be noted that the interaction between the Guide Mode group and the MIDI-only group was not present when the outliers were removed from the data set.

Figure 4
Allegro Rhythmic Errors ($N = 33$)



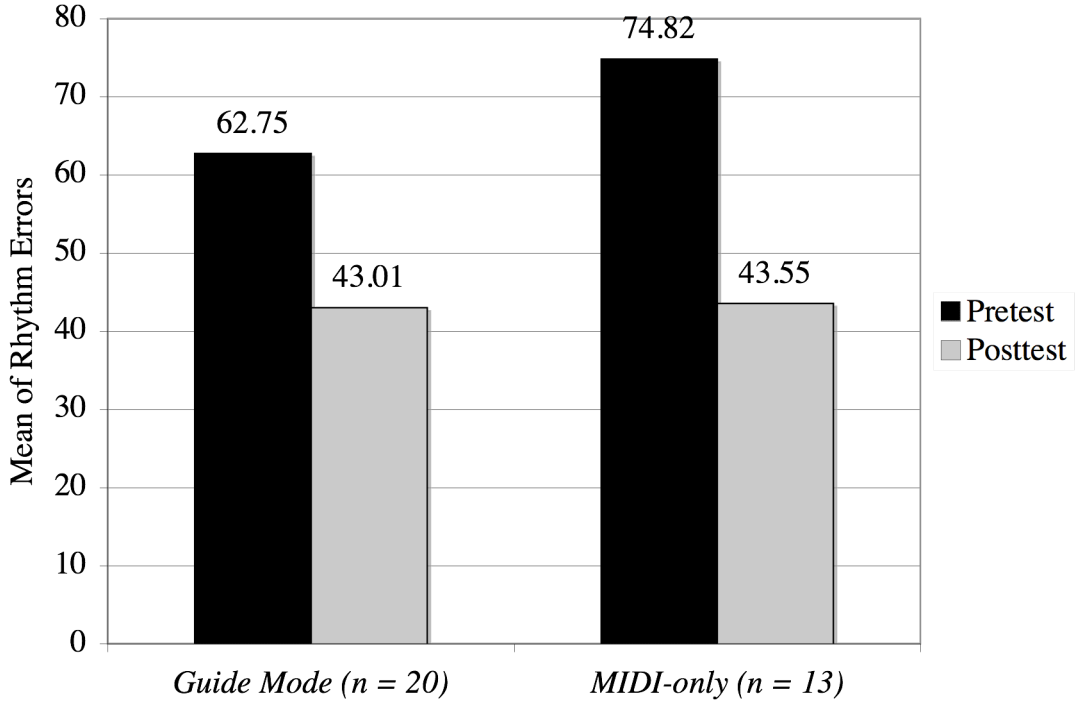
The same 2 x 2 mixed ANOVA was conducted on *Presto* rhythmic errors. There was a main effect for rhythmic errors, F (1, 31) = 18.90, $p < .001$, with an observed power of .99. However, no significant interaction between the two groups was present, F (1, 31) = .23, $p = .64$, with an observed power of .08. A paired-sample t-test demonstrated that regardless of the treatment, posttest rhythmic errors were significantly lower than pretest rhythmic errors for both the Guide Mode group, t (19) = 3.30, $p = .004$, and the MIDI-only group, t (12) = 2.83, $p < .015$. [See Figure 5].

Figure 5
Presto Rhythmic Errors ($N = 33$)



When rhythmic errors were combined for both *Allegro* and *Presto,* a significant main effect for rhythmic errors emerged within subjects, F (1, 31) = 62.11, $p < .001$, but no significant difference between the Guide Mode group and MIDI-only group was present. A paired-sample t-test demonstrated that posttest rhythmic errors were significantly lower than pretest pitch errors for the Guide Mode group, t (19) = 5.02, $p < .001$, and also for the MIDI-only group, t (12) = 5.92, $p < .001$. Although the difference in rhythmic errors from pretest to posttest was greater for the MIDI-only group, an independent samples t-test revealed that this was not statistically significant, t (31) = .81, $p = .08$. [See Figure 6].

Figure 6
Combined Rhythmic Errors ($N = 33$)



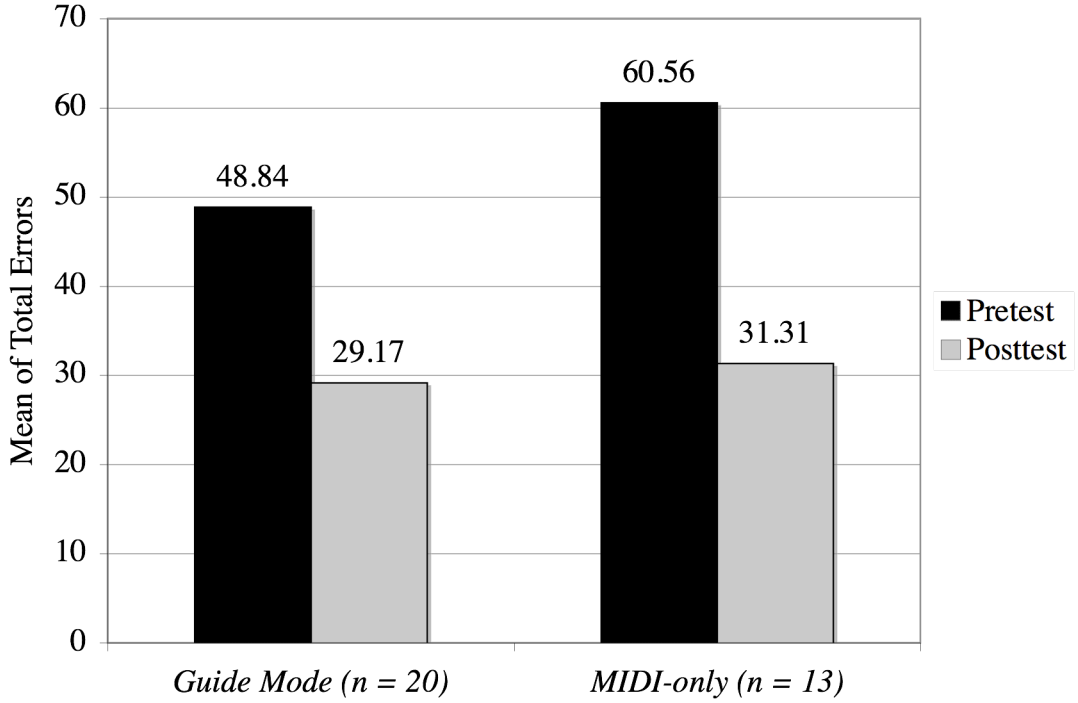
Total Performance Accuracy

Research Question No. 3 reads as follows: *How do combined performance accuracy test scores (pitch + rhythm + time penalty) of participants practicing with MIDI accompaniments with the Guide Mode compare to combined performance accuracy test scores of participants practicing with MIDI accompaniments without the Guide Mode?*

A 2 (pretest, posttest) x 2 (Guide Mode, MIDI-only) mixed ANOVA was conducted on *Allegro* total errors (pitch errors + rhythmic errors + time penalty). There was a main effect within groups for total errors, $F(1, 31) = 62.05$, $p < .001$, but no significant difference between the Guide Mode and MIDI-only group was present, $F(1, 31) = 1.08$, $p = .31$. A paired-sample t-test demonstrated that regardless of the treatment, posttest total errors were significantly lower than pretest total errors for

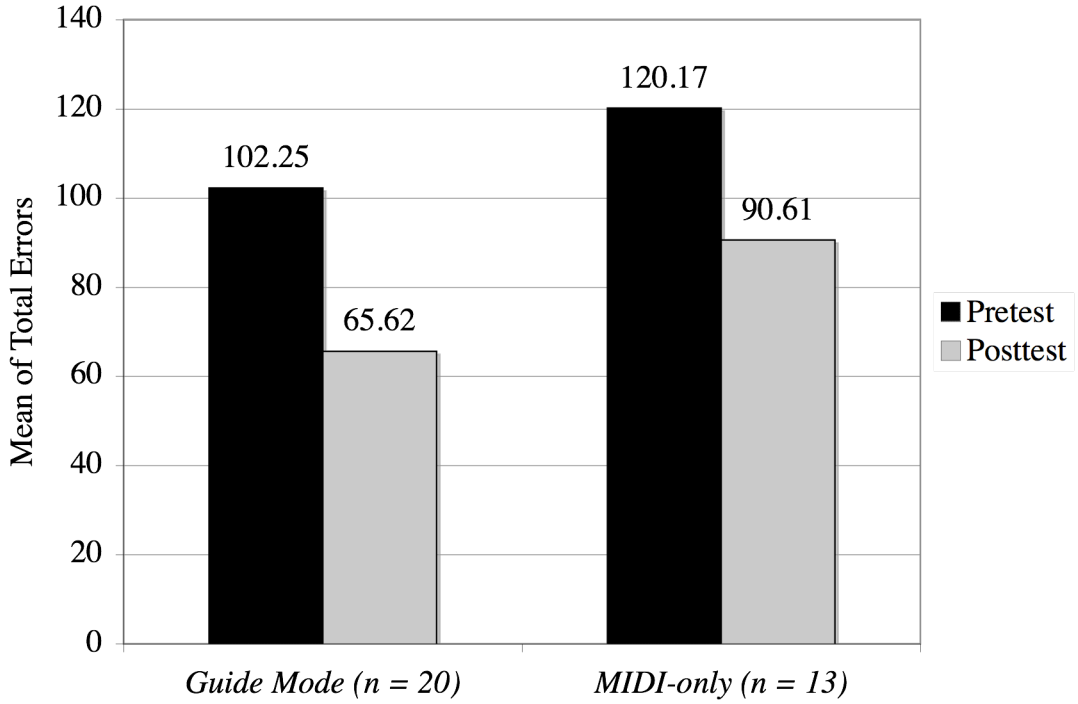
both the Guide Mode group, t (19) = 6.78, $p < .001$, and the MIDI-only group, t (12) = 4.59, $p = .001$. [See Figure 7].

Figure 7
Allegro Total Errors Including
Time Penalty ($N = 33$)



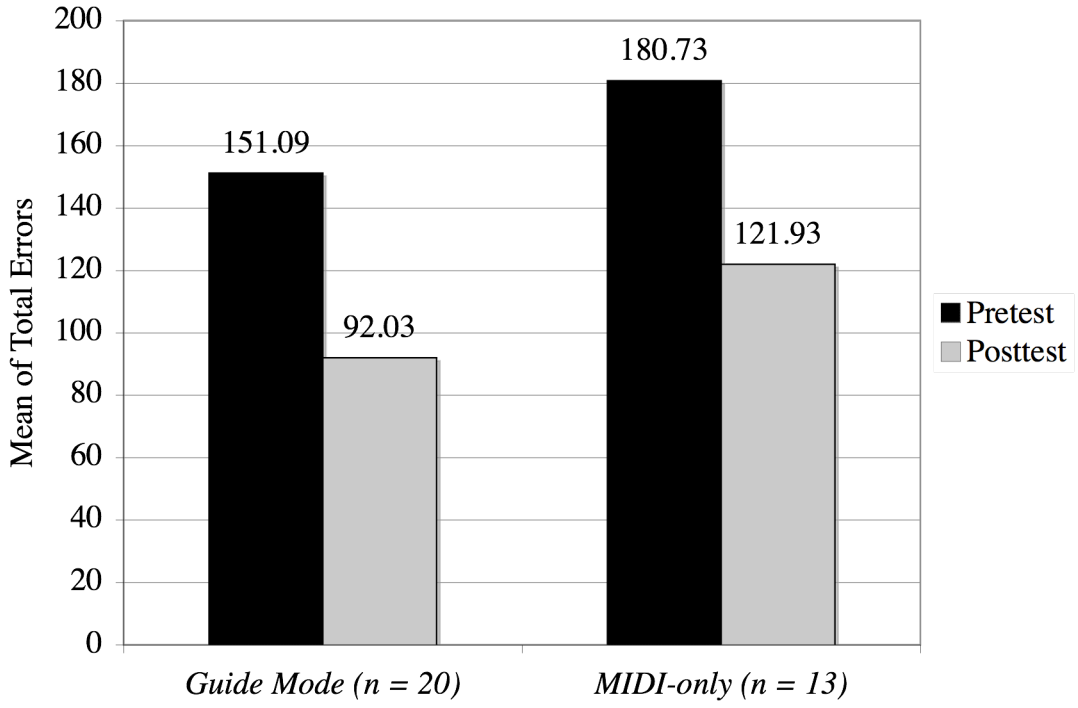
The researcher conducted the same 2 x 2 ANOVA on *Presto* total errors (pitch errors + rhythmic errors + time penalty). There was a main effect within subjects for total errors, F (1, 31) = 20.34, $p < .001$, but no significant interaction between the Guide Mode and MIDI-only group was present, F (1, 31) = .23, $p = .63$. A paired-sample t-test demonstrated that posttest total errors were significantly lower than pretest total errors for the Guide Mode group, t (19) = 5.65, $p < .001$, but not for the MIDI-only group, t (12) = 1.93, $p = .078$. [See Figure 8].

Figure 8
Presto Total Errors Including
Time Penalty ($N = 33$)



When total errors including time penalties were combined for both *Allegro* and *Presto,* a significant main effect for total errors within subjects was present, F (1, 31) = 52.67, $p < .001$, but no significant interaction between the Guide Mode and MIDI-only group was present. A paired-sample t-test demonstrated that posttest total errors were significantly lower than pretest total errors for the Guide Mode group, t (19) = 7.80, $p < .001$, as well as the MIDI-only group, t (12) = 3.56, $p = .004$. [See Figure 9].

Figure 9
Combined Total Errors Including
Time Penalty ($N = 33$)



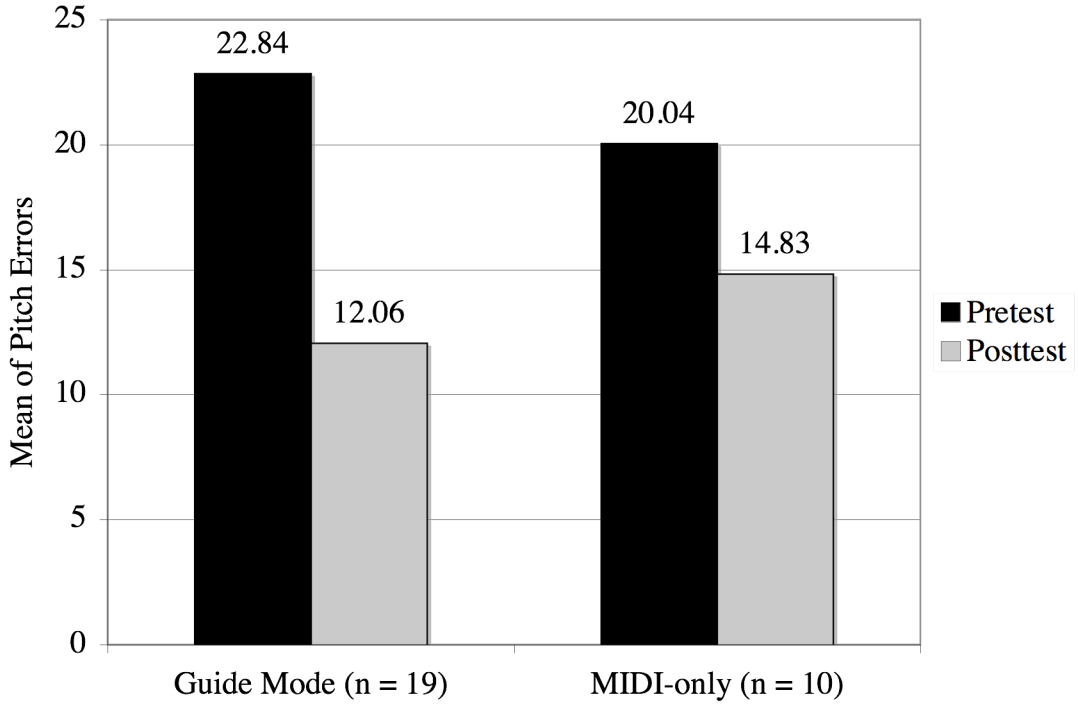
Differences in Data Without Outliers

In order to control for the possibility of biased results due to the outliers described above, data analysis procedures were performed with the outliers removed.

A 2 (pretest, posttest) x 2 (Guide Mode, MIDI-only) mixed ANOVA was conducted on *Allegro* pitch errors. There was a main effect for pitch errors, Pillai's Trace, F (1, 27) = 12.14, p = .002, with an observed power of .92. However, no significant interaction between the Guide Mode and MIDI-only group was present, F (1, 27) = 1.47, p = .24, with an observed power of .22. A paired-sample t-test demonstrated that posttest pitch errors were significantly lower than pretest pitch errors for the Guide Mode group, t (18) = 4.24, $p < .001$, but not for the MIDI-only group, t (9) = 1.27, p = .24. Further analysis of the differences between pretest and

posttest pitch errors between the Guide Mode and MIDI-only groups revealed no significant difference, t (27) = 1.21, p = .24. [See Figure 10].

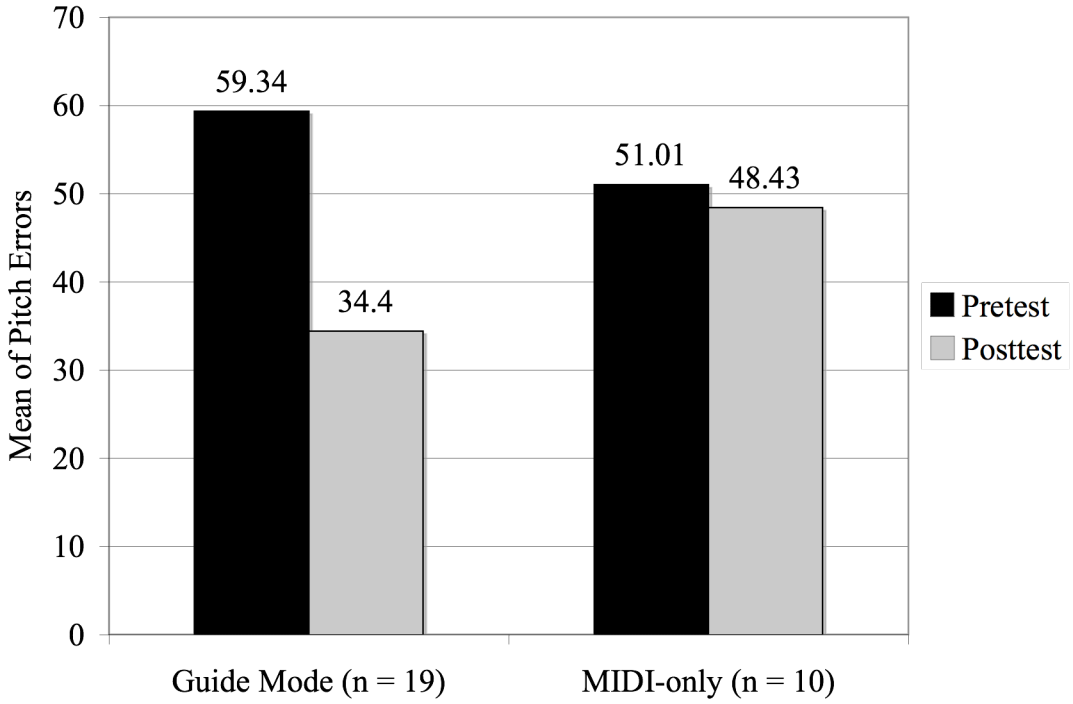
Figure 10
Allegro Pitch Errors (N = 29)



A 2 (pretest, posttest) x 2 (Guide Mode, MIDI-only) mixed ANOVA was conducted on *Presto* pitch errors. There was a significant interaction between the two groups, F (1, 27) = 7.45, p = .011, with an observed power of .75. A main effect for pitch errors within groups was also present, F (1, 27) = 11.28, p = .002, with an observed power of .90. A paired-sample t-test revealed that for the Guide Mode group, participants' pretest pitch errors (M = 59.34, SD = 26.13) were greater than their posttest pitch errors (M = 34.40, SD = 23.24), t (18) = 4.62, p < .001. However, for the MIDI-only group, there was no significant difference between participants' pretest pitch errors (M = 51.01, SD = 29.54) and their posttest pitch errors (M = 48.43, SD = 28.06), t (9) = .56, p = .59. Further analysis revealed a significant difference in

pitch improvement from pretest to posttest between the two groups in favor of the students using Guide Mode, t (27) = 2.73, p = .01. [See Figure 11].

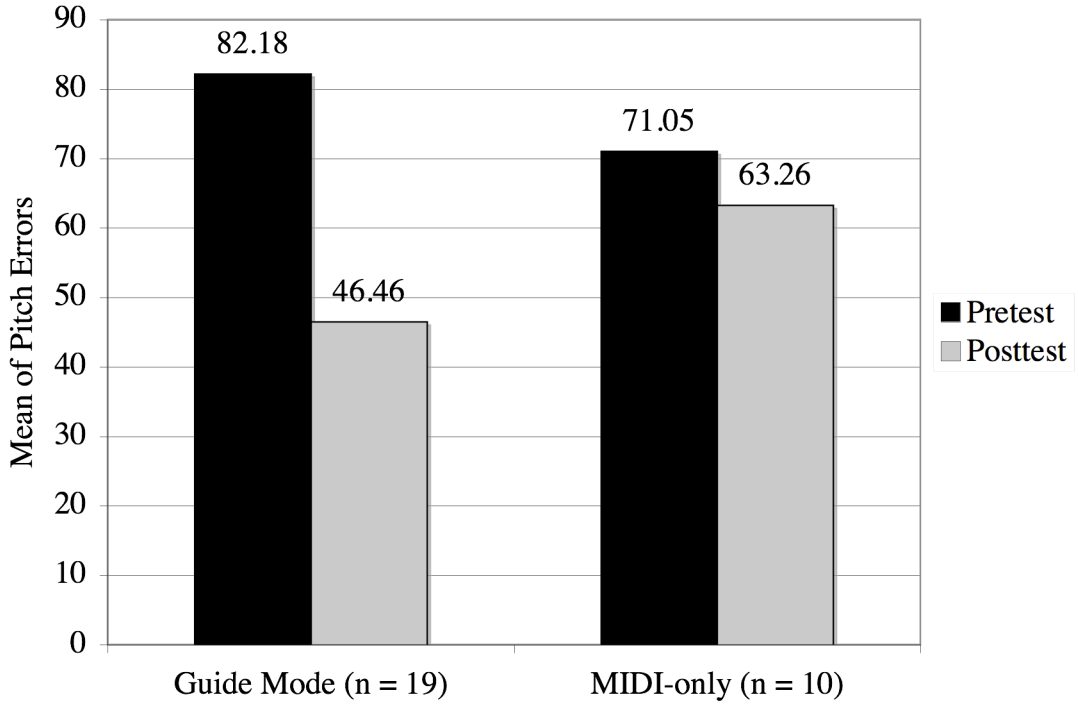
Figure 11
Presto Pitch Errors (N = 29)



When pitch errors were combined for both *Allegro* and *Presto,* a significant main effect for pitch errors within subjects was present, F (1, 27) = 18.07, p < .001, with an observed power of .98. A significant interaction between the Guide Mode and MIDI-only group emerged as well, F (1, 27) = 7.45, p = .011, with an observed power of .75. A paired-sample t-test demonstrated that posttest pitch errors were significantly lower than pretest pitch errors for the Guide Mode group, t (18) = 5.51, p < .001, but not for the MIDI-only group, t (9) = 1.14, p = .28. Further investigation of the interaction in the form of an independent samples t-test revealed that the combined difference of pitch errors for both *Allegro* and *Presto* was significantly

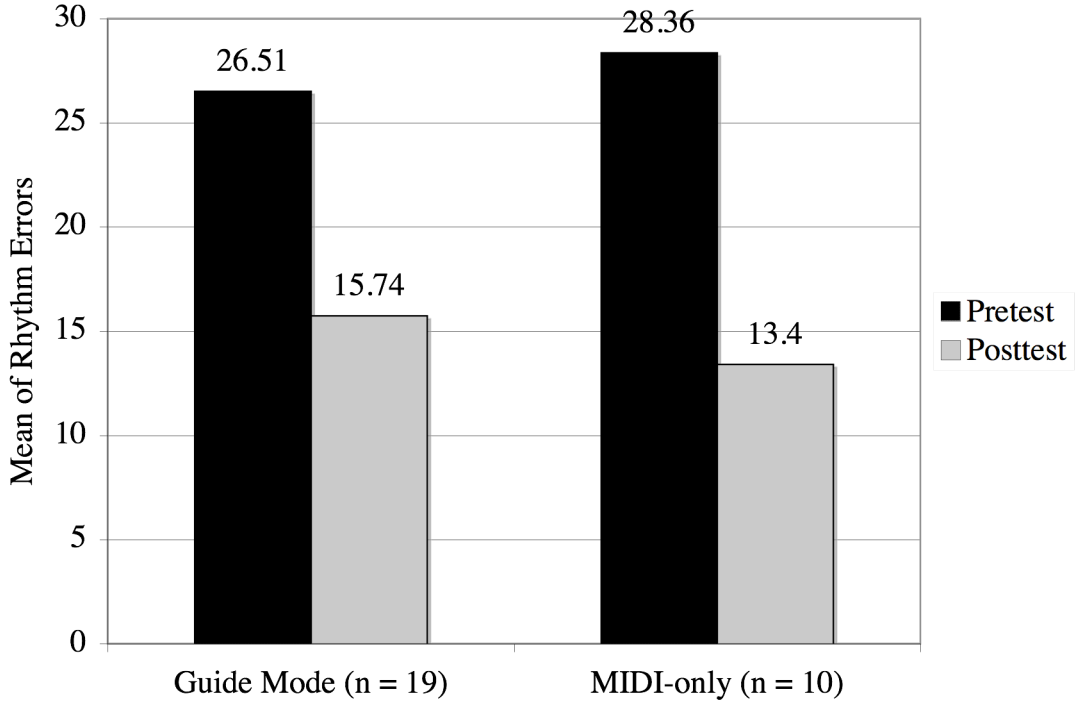
greater for the students that practiced with the Guide Mode, t (27) = 2.73, p = .01 [See Figure 12].

Figure 12
Combined Pitch Errors (N = 29)



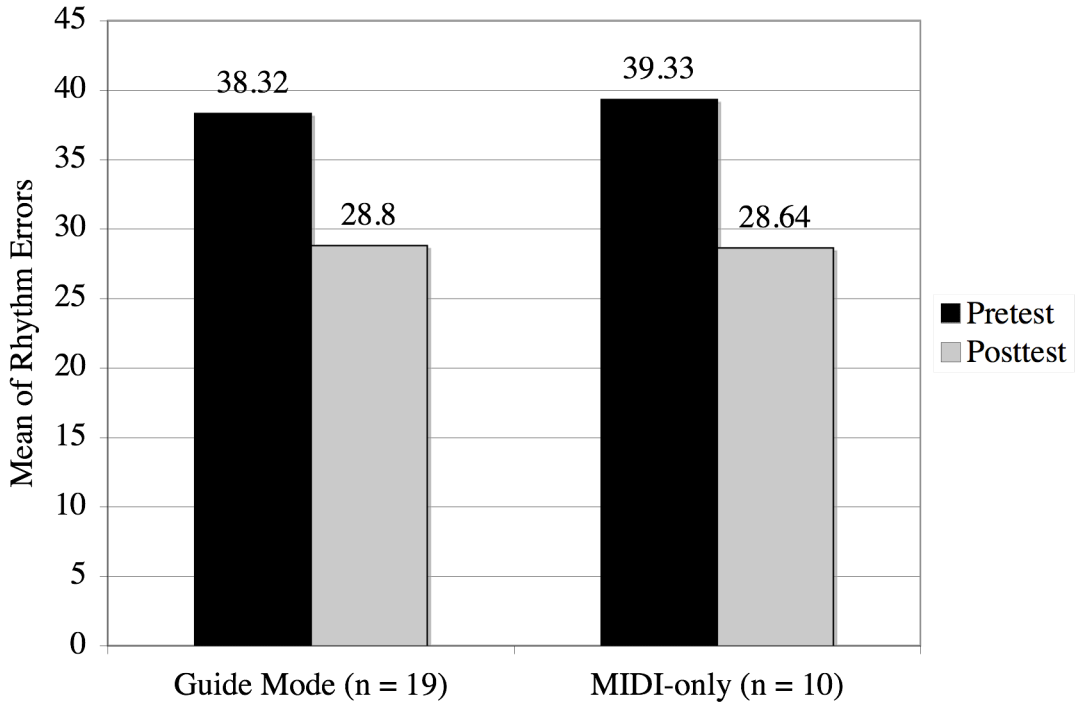
A 2 x 2 mixed ANOVA was also conducted on *Allegro* rhythmic errors. Although there was significant interaction when this procedure was run with all subjects including outliers, when the outliers were removed from the data set, there was no significant interaction between the MIDI-only group and Guide Mode group, F (1, 27) = 1.46, p = .24, with an observed power of .22. However, a main effect within groups for rhythmic errors remained, F (1, 27) = 55.71, p < .001, with an observed power of 1.0. Further analysis of this effect in the form of a paired-sample t-test revealed that all subjects, regardless of the use of the Guide Mode or not, made significant improvement in rhythmic errors in *Allegro, t* (28) = 7.40, p < .001. [See Figure 13].

Figure 13
Allegro Rhythmic Errors (*N* = 29)



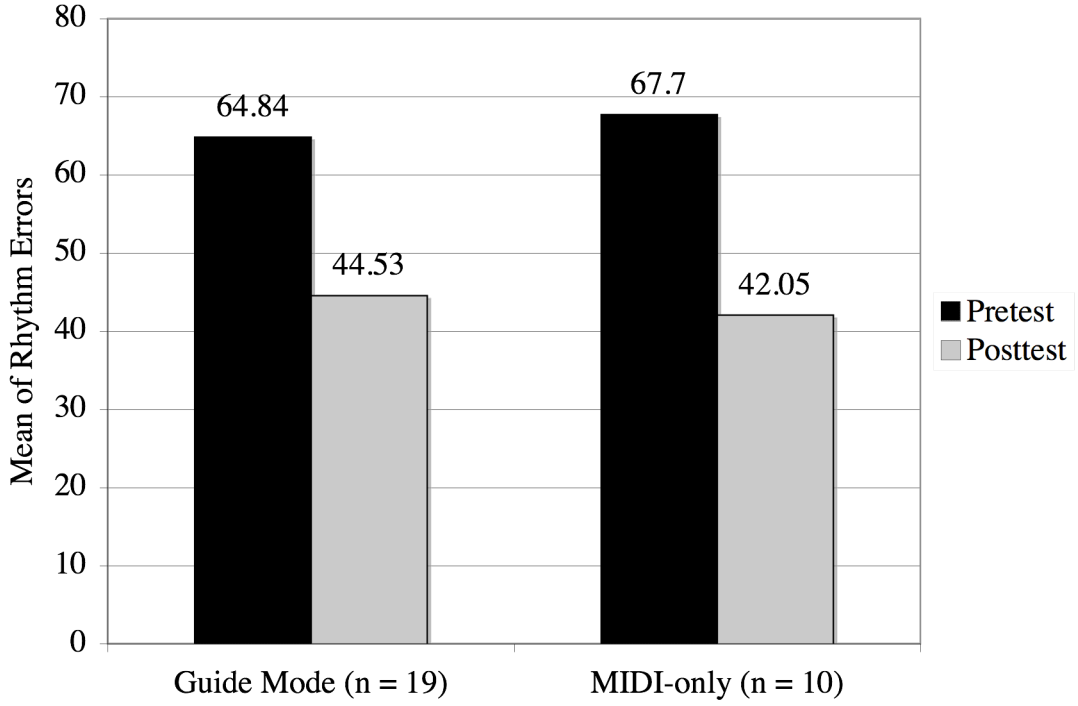
A 2 x 2 mixed ANOVA was conducted on *Presto* rhythmic errors. No significant interaction, F (1, 27) = 0.61, p = .81, with an observed power of .06, was present between the MIDI-only and Guide Mode groups, but there was a main effect within subjects for rhythmic errors, F (1, 27) = 18.26, p < .001, with an observed power of .98. A paired-sample t-test demonstrated that regardless of the treatment, posttest total errors were significantly lower than pretest total errors for both the Guide Mode group, t (18) = 3.27, p = .004, and the MIDI-only group, t (9) = 3.513, p = .01. [See Figure 14].

Figure 14
Presto Rhythmic Errors ($N = 29$)



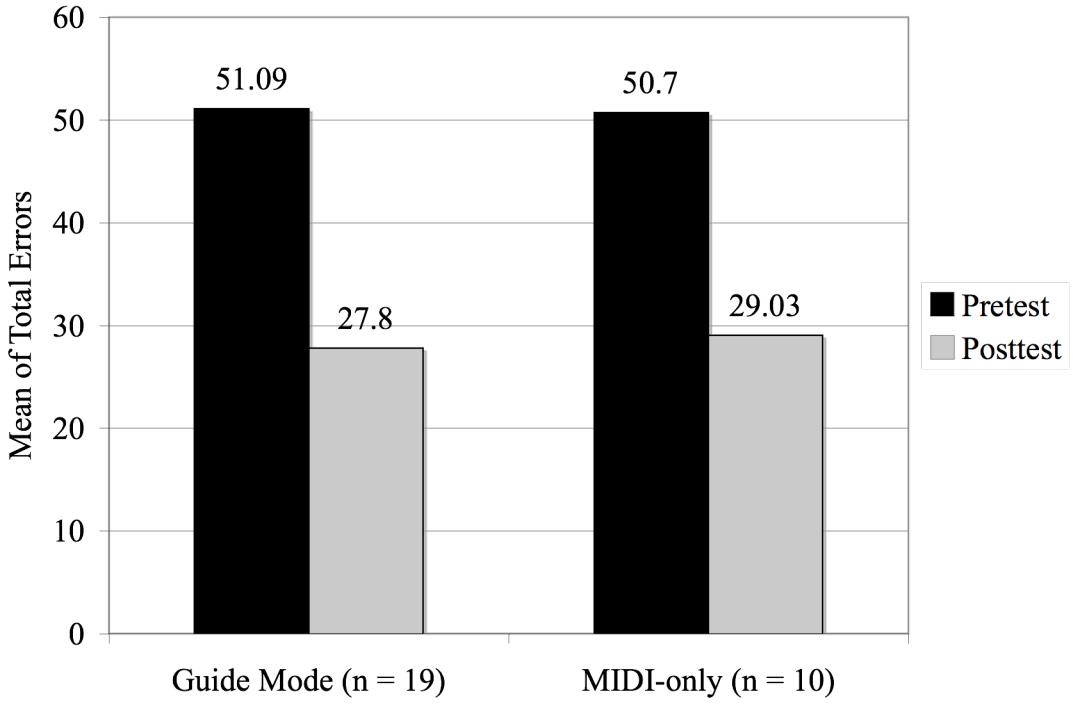
When rhythmic errors were combined for both *Allegro* and *Presto,* a significant main effect for pitch errors within subjects was present, F (1, 27) = 18.07, $p < .001$. No significant interaction between the Guide Mode and MIDI-only group was present. A paired-sample t-test demonstrated that posttest pitch errors were significantly lower than pretest pitch errors for the Guide Mode group, t (18) = 4.95, $p < .001$, and also for the MIDI-only group, t (9) = 5.03, $p = .001$. [See Figure 15].

Figure 15
Combined Rhythmic Errors ($N = 29$)



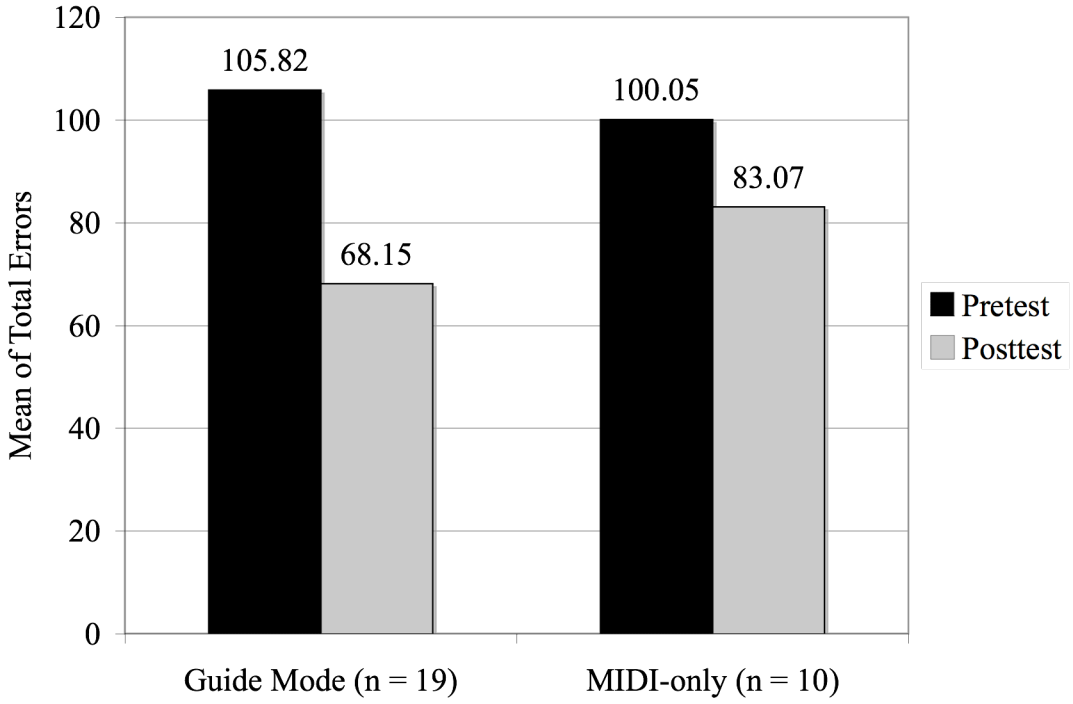
Another mixed ANOVA was conducted on *Allegro* total errors (pitch + rhythm + time penalty). No significant interaction, F (1, 27) = .08, p = .78, with an observed power of .06, was present between the MIDI-only and Guide Mode groups, but there was a main effect for total errors, F (1, 27) = 62.05, $p < .001$, with an observed power of 1.0. A paired samples t-test showed that both the Guide Mode group, t (18) = 6.91, $p < .001$, and the MIDI-only group, t (9) = 4.42, p = .002, made significant improvements from pretest to posttest [See Figure 16].

Figure 16
Allegro Total Errors Including Time Penalty
(N = 29)



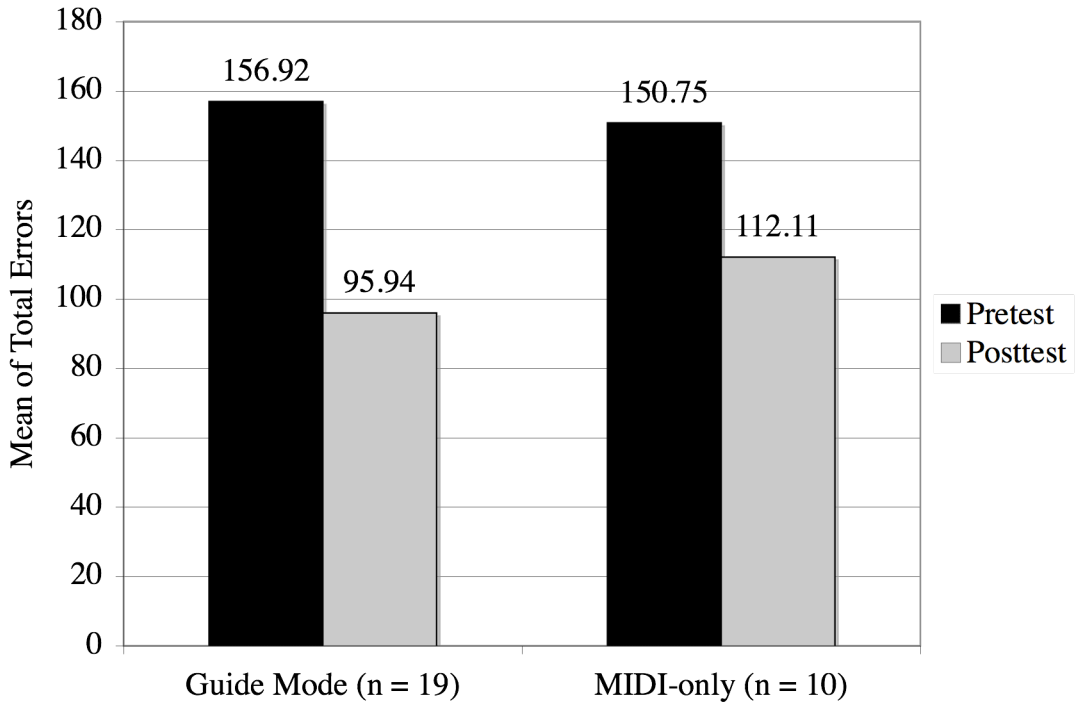
When total errors (pitch + rhythm + time penalty) were calculated for *Presto*, significant improvements from pretest to posttest were made in both the Guide Mode group, t (18) = 5.58, $p < .001$, and for the MIDI-only group t (9) = 2.73, $p = .023$. However, no significant interaction, F (1, 27) = 3.98, $p = .056$, was present between the Guide Mode and MIDI-only groups [See Figure 17].

Figure 17
Presto Total Errors Including Time Penalty
($N = 29$)



When total errors with time penalties were combined for both *Allegro* and *Presto,* a significant main effect for total errors within subjects was present, F (1, 27) = 67.06, $p < .001$, with an observed power of 1.0. A paired-sample t-test demonstrated that posttest pitch errors were significantly lower than pretest pitch errors for the Guide Mode group, t (18) = 7.90, $p < .001$, and also for the MIDI-only group, t (9) = 4.81, $p = .001$. However, no significant interaction between the two groups emerged, F (1, 27) = 3.37, $p = .08$, with an observed power of .43. [See Figure 18].

Figure 18
Combined Total Errors Including Time Penalty
(N = 29)



Summary

This chapter presented a comparative analysis of pitch, rhythm, and total errors for participants who practiced with the Guide Mode and for participants who practiced with MIDI accompaniments but without Guide Mode. The researcher identified four outliers. When the outliers were still in the data set (N = 33), no significant differences emerged except for rhythmic errors in *Allegro*. The MIDI-only group made significantly more improvement in rhythm than the Guide Mode group in *Allegro*. However, when the data were analyzed after removing the outliers (N = 29), no significant interaction between the two groups was present in rhythmic errors for *Allegro*. The removal of the outliers was justified for the following reason. Due to the small sample size, most of the statistics yielded a statistical power less

than the normally accepted .80. Results of data analysis of the sample size without outliers ($N = 29$) did not lower the statistical power considerably, and even in some cases raised the statistical power.

With the outliers removed, trends that emerged are as follows. Students who practiced with the Guide Mode improved significantly more than students who practiced without the Guide Mode in pitch errors from pretest to posttest for *Presto, p* = .01. In addition, the MIDI-only group showed no significant difference between their pretest pitch errors and posttest pitch errors in *Presto*. Although there was no significant interaction between the two groups in *Allegro* pitch errors, the Guide Mode group demonstrated improvement from pretest to posttest at a significant level, $p < .001$, while the MIDI-only group did not, $p = .24$. When differences in pitch errors were combined for both *Allegro* and *Presto*, students that practiced with the Guide Mode demonstrated significantly greater improvement compared to the group without Guide Mode, $p = .01$.

Contrary to the results when the outliers were still in the data set, no significant interaction between the MIDI-only group and Guide Mode group in rhythmic errors for *Allegro* emerged when the outliers were removed. Statistically significant main effects, $p < .05$, of rhythmic errors emerged for both groups for *Allegro* and *Presto* when comparing pretests to posttests. Posttest rhythmic errors were significantly less than pretest rhythmic errors when both compositions' rhythmic errors were combined.

When total errors with time penalties were combined for both *Allegro* and *Presto*, no significant interaction was present between the two groups. Within

groups, students made significant improvements from pretest performances to posttest performances, $p < .05$.

In summary, the Guide Mode group demonstrated significantly greater improvement in pitch accuracy for *Presto* but not for *Allegro*. However, there were no significant differences in rhythmic accuracy between the MIDI-only group and the Guide Mode group with both the *Allegro* or *Presto* compositions.

CHAPTER 5

RESULTS OF QUESTIONNAIRE

Introduction

The researcher devised a questionnaire [Appendix D] in order to investigate participants' perceptions toward the use of MIDI accompaniments and the Guide Mode in the experiments. Participants in the MIDI-only group replied to a slightly modified questionnaire [Appendix E] that omitted questions regarding their perception of the use of the Guide Mode since they did not use it.

The first section of the survey obtained demographic information including gender, major instrument, and previous piano experience. This section also included Likert-type items asking participants to rate their knowledge on MIDI technology and how often they have played with MIDI accompaniments and the Guide Mode prior to the study.

The second section of the survey prompted participants to rate the difficulty level and enjoyment level of both *Allegro* and *Presto*. Section three of the survey elicited participants' perceptions of playing with MIDI accompaniments and listening to the MIDI file as an aural model. The fourth section concentrated on participants' feelings about practicing with the Guide Mode. The MIDI-only group's survey asked how helpful they believed a CAI program such as the Guide Mode would have been in improving their performance accuracy. The fifth and final section included open-ended questions inquiring on what the participants felt was most helpful in the practice sessions and what could be done to improve them.

Calculating Perception Ratings

The majority of the questions of the survey were eight-point Likert-type items asking:

1. How effective was a certain type of practice with technology in improving performance accuracy
2. How much they enjoyed a certain type of practice with technology
3. How much they actually used a certain type of practice with technology

Negative ratings were interpreted as responses between "0" and "2". Ratings between "3" and "4" were neutral, and ratings between "5" and "7" were positive. Participants' responses were averaged together in order to measure their perceptions of technology as a whole. Outlier responses were not included in these results. T-tests compared differences in responses between the Guide Mode group and MIDI-only group.

Perceptions Regarding MIDI Accompaniments

Research Question No. 4: What are participants' perceptions regarding practicing with MIDI accompaniments?

When surveyed about the effectiveness of MIDI accompaniments in improving performance accuracy, overall responses were positive [see Table 1]. Perception of listening to the MIDI file as an aural model was rated slightly lower ($M = 4.76$, $SD = 1.55$) than other techniques of practicing with the MIDI accompaniments. A t-test revealed no significant differences between the MIDI-only group and Guide Mode group regarding their perception of the effectiveness of practicing with MIDI accompaniments.

Table 1
Responses of All Subjects ($N = 29$) on Effectiveness
of MIDI Accompaniments in Improving Performance Accuracy

Response Item	Mean	SD
Practicing the left hand with MIDI accompaniment	5.69	1.14
Practicing the right hand with MIDI accompaniment	5.66	1.17
Adjusting the tempo of the MIDI file	5.45	2.15
Listening to the MIDI file	4.76	1.55

8-point Likert scale, 0 = not helpful at all, 7 = very helpful

Responses to items regarding the enjoyment level of practicing with MIDI accompaniments were moderately positive [see Table 2]. A t-test revealed a significant difference between the groups in the enjoyment level of adjusting the tempo of the MIDI file, t (27) = 2.36, p = .03. The group that practiced with MIDI accompaniments and the Guide Mode had a neutral reaction to "Adjusting the tempo of the MIDI file" (M = 3.79, SD = 2.18) in comparison to the group that practiced with MIDI accompaniments and without the Guide Mode (M = 5.60, SD = 1.43) in rating the enjoyment level.

Table 2
Responses of All Subjects ($N = 29$) on
Enjoyment Level of Practicing with the MIDI Accompaniments

Response Item	Mean	SD
Practicing the left hand with MIDI accompaniment	4.69	1.56
Listening to the MIDI file	4.66	1.61
Practicing the right hand with MIDI accompaniment	4.59	1.62
Adjusting the tempo of the MIDI file	4.41	2.11

8-point Likert scale, 0 = no enjoyment, 7 = enjoyed very much

Participants rated their frequency of using MIDI accompaniments from neutral to moderately positive. Adjusting the tempo was rated slightly higher in frequency of use while listening to the MIDI file was rated slightly lower [see Table 3]. A t-test revealed no significant differences between the MIDI-only group and Guide Mode group regarding the frequency of practicing with MIDI accompaniments.

Table 3
Responses of All Subjects ($N = 29$) on
Frequency of Using MIDI Accompaniments

Response Item	Mean	SD
Adjusting the tempo of the MIDI file	5.00	2.45
Practicing the right hand with MIDI accompaniment	4.72	1.98
Practicing the right hand with MIDI accompaniment	4.72	1.98
Listening to the MIDI file	4.52	1.73

8-point Likert scale, 0 = never used, 7 = frequently used

Overall, perceptions of the enjoyment level and effectiveness of MIDI accompaniments on performance accuracy were moderately positive to positive. The only item that had a neutral reaction was the enjoyment level of adjusting the tempo of the MIDI file within the Guide Mode group practicing with the Guide Mode.

Perceptions Regarding Guide Mode

Research Question No. 5: What are participants' perceptions regarding practicing with the Guide Mode?

Means of response items were categorized by perception of the effectiveness of the Guide Mode in improving performance accuracy, enjoyment level of practicing

with the Guide Mode, and how frequently they practiced with the Guide Mode when given free time to practice.

When surveyed about the effectiveness of the Guide Mode in improving performance accuracy, participants' overall responses were positive [see Table 4]. Perception of practicing the left hand (M = 5.63, SD = 1.34) and right hand (M = 5.58, SD = 1.39) separately was slightly more effective in improving performance accuracy than practicing hands together (M = 5.05, SD = 1.81) when using the Guide Mode. Subjects had a more neutral perception (M = 4.58, SD = 2.46) on the effectiveness of the Guide lamps in improving their performance accuracy.

Table 4
Responses of Subjects (N = 19) on Effectiveness of Guide Mode in Improving Performance Accuracy

Response Item	Mean	SD
Practicing the left hand with Guide Mode	5.63	1.34
Practicing the right hand with Guide Mode	5.58	1.39
Practicing hands together with Guide Mode	5.05	1.81
Following the Guide lamps	4.58	2.46

8-point Likert scale, 0 = not helpful at all, 7 = very helpful

Responses to items regarding the enjoyment level of practicing with the Guide Mode were more neutral [see Table 5]. Following the Guide lamps was the survey item that received the most neutral response (M = 3.63, SD = 2.59) in rating enjoyment level.

Table 5
Responses of Subjects ($N = 19$) on
Enjoyment Level of Using Guide Mode

Response Item	Mean	SD
Practicing the left hand with Guide Mode	4.79	2.23
Practicing the right hand with Guide Mode	4.74	2.26
Practicing hands together with Guide Mode	4.32	2.21
Following the Guide lamps	3.63	2.59

8-point Likert scale, 0 = no enjoyment , 7 = enjoyed very much

As illustrated in Table 6, the mean of responses regarding the frequency of following the Guide lamps was the most neutral ($M = 3.89$, $SD = 2.44$) item. Practicing hands separately with the Guide Mode was used more frequently than practicing hands together according to participants' responses.

Table 6
Responses of Subjects ($N = 19$) on
Frequency of Using Guide Mode

Response Item	Mean	SD
Practicing the right hand with Guide Mode	5.16	1.89
Practicing the left hand with Guide Mode	5.00	1.83
Practicing hands together with Guide Mode	4.53	1.83
Following the Guide lamps	3.89	2.44

8-point Likert scale, 0 = never used, 7 = frequently used

Trends that emerged among the subjects who practiced with the Guide Mode included positive perceptions of the effectiveness of improving performance accuracy while practicing hands separately. The enjoyment level of practicing with the Guide Mode was rated neutrally. Attitudes regarding practicing hands together with Guide

Mode were less positive than practicing hands separately while use of the Guide lamps was perceived with a neutral attitude.

Additional Responses Made by Participants

In section five of the questionnaire, participants were asked for open-ended responses to these items:

1. What practice techniques helped during the practice sessions?
2. What would have made the practice sessions more helpful?
3. Please provide any other comments regarding how you feel about the use of technology during your practice sessions in this study.

Using grounded theory, three upper-class psychology student researchers at Stephen F. Austin State University read the participants' responses to summarize and identify recurring themes within each condition. These summaries were used to reduce bias and strengthen the validity of this researcher's interpretations of the affective nature behind the participants' answers.

In response to item one, the three student researchers recognized a trend in participants in the Guide Mode group identifying the use of the Guide Mode to be the most helpful technique in their practice sessions. Another prevailing theme in the Guide Mode group participants' responses to question one was practicing hands separately. The subjects also frequently stated that practicing hands separately in conjunction with the Guide Mode was the most beneficial part of their practice. Only one participant from the Guide Mode group responded indifferently to question one: "Just regular practicing – I did not feel that the MIDI technology affected it." Other

subjects identified listening to the MIDI file and the ability to slow the tempo as being beneficial.

Among the MIDI-only group, the dominant response to item one was that practicing hands separately was helpful in their practice. Only two of the subjects from the MIDI-only group specifically mentioned MIDI in their response to question one. One participant stated, "Playing with the MIDI was new and made me think musically how my part fit." Another participant responded that "practicing slowly along with the music (MIDI)" was helpful.

In response to item two (What would have made the practice sessions more helpful?), the three student researchers noticed widespread responses of "more time to practice" from a majority of both Guide Mode and MIDI-only group participants. Other answers included one subject from the Guide Mode group who wrote "I practice best on my own going at my own pace rather than forced practice in a classroom." Another subject from the Guide Mode group expressed a desire to have more feedback in determining an appropriate tempo to practice: "To understand whether we should slow the piece down and increase speed aiming at the marked tempo or just keep practicing at whatever tempo I liked." One participant stated, "The tools at hand really made a pretty ideal practice situation." In the MIDI-only group, one subject believed "focusing on one piece" would have improved performance results.

Item three in the final section of the questionnaire prompted participants to provide any other comments regarding how they felt about the use of technology during their practice sessions. The three student researchers noticed that a number of

subjects in the Guide Mode group had a positive attitude toward the use of technology as an aid in practice: "The technology really helps, even though having to retain the pieces in my fingers is tough." Another student remarked, "The MIDI recording helped me get the piece in my head. It was much easier to just walk in each day and nail the piece because of this." The strongest comment in support of the technology came from one student who stated, "I felt it was extremely helpful and fun. It made me want to practice the pieces." Another participant responded, "The technology made practice sessions easier and more fun." One subject wrote, "I think this technology will be/is extremely useful and should be utilized more, in particular being made available to practice with outside of class."

Some answers revealed very little if any perception of positive effects on students in the Guide Mode group. One participant stated, "I felt it was helpful but no more helpful than practicing alone on an acoustic piano." Another subject wrote, "I do not think it was much of a factor; it made it remotely more enjoyable to have accompaniment for the rather bland pieces." One student mentioned how the guide lamps helped to find the correct notes: "The guide lamps just made me hit that key without reading the score to figure it out." Another student expressed some frustration in using the Guide Mode with both hands: "One hand at a time with guide mode was very helpful, but using both was kind of a mess if you made a mistake. It was very difficult to get started again if you made a mistake, making the whole two-hand guide mode practice difficult. The one hand was very helpful, though."

After analyzing the MIDI-only group's answers, the three student researchers noticed that there were less positive responses toward technology in comparison to

the Guide Mode group. Two of the subjects felt that the use of technology was unnecessary and overdone. One stated, "Too much! A regular piano is fine!" The other subject wrote, "Using the technology almost seems like over-kill. At some points I shut off the MIDI and practiced each hand alone until I got it."

On the other hand, two of the participants from the MIDI-only group expressed positive reactions to the use of technology. One subject responded, "The MIDI accompaniment is helpful." The other subject stated, "It seems that these practice methods helped, but the goal tempo on Presto was far out of reach for the class." Another response illustrated one subject's irresolute perception of the technology due to the lack of experience with MIDI accompaniments in group piano classes prior to the study: "Throughout our experience with group piano we have rarely or never used the MIDI capabilities, so it is difficult to say if it is helpful or not on such a short term."

Summary

This chapter presented a descriptive view of the affective nature of the technology treatments on participants through their responses on the questionnaire. In Likert-type items, *Presto* was perceived as the more difficult composition, and subjects enjoyed practicing *Allegro* more than *Presto*. There were no significant differences in responses to Likert-type items between the MIDI-only group and Guide Mode group except for the item rating the enjoyment level of adjusting the tempo of the MIDI files. Overall, participants exhibited positive perceptions of the use of MIDI accompaniments in their enjoyment and effectiveness of improving performance accuracy. None of the technology used by the participants was rated

negatively. Participants' perceptions of the Guide Mode were generally positive. There was a trend in participants favoring practicing separate hands with the MIDI accompaniment and the Guide Mode over practicing hands together along with MIDI accompaniment and the Guide Mode.

Independent student researchers analyzed participants' responses to open-ended items on the questionnaire. A majority of the answers from the Guide Mode group identified the Guide Mode as helping them improve in their performances. The subjects also frequently stated that practicing hands separately in conjunction with the Guide Mode was beneficial. The participants in the MIDI-only group also identified practicing hands separately as being helpful.

A common opinion among subjects from both treatment groups was that more time to practice would have improved performance scores. Overall, the three student researchers noticed that there were less positive perceptions toward technology in the MIDI-only group when compared to the Guide Mode group. Students from the Guide Mode group generally had positive reactions regarding the motivational benefits of using technology. However, students in the MIDI-only group had mixed reactions to the use of technology.

CHAPTER 6

SUMMARY, DISCUSSION, AND RECOMMENDATIONS

Purpose of this Study

Computer-assisted instruction (CAI) and MIDI keyboard technology have the potential to enhance performance of group piano students. CAI programs, such as the Guide Mode on the Yamaha Clavinova CVP instruments, may be able to assist group piano students in learning repertoire. MIDI files of a composition can provide an aural model and may motivate the student to practice with the accompaniment. Piano teachers may benefit from knowing if practice with these types of instruments has an effect on students' attitudes and performance accuracy. The primary purpose of this study was to investigate the effect of computer-assisted instruction (CAI) keyboard technology when utilized with a MIDI accompaniment on the performance accuracy of college group piano students using a quasi-experimental pretest/posttest design. A secondary purpose was to investigate students' perceptions of the use of CAI and MIDI technology in this study.

Limitations

This study measured only pitch and rhythm accuracy. Other aspects considered important in musical performance such as proper technique, dynamic accuracy, and artistry were not evaluated in this study.

In order to control for the amount of time that participants had to practice with the two compositions, participants were limited to practicing *Allegro* and *Presto* only

during the assigned practice sessions during their regularly scheduled class time. Only short-term effects of practicing with the technology were investigated. The study did not measure long-term effects of the treatment on performance outside the experimental setting. A majority of the participants stated that more time to practice would have improved their performance.

Although students were previously placed into homogeneous classes, differences in their music reading levels were apparent due to diverse backgrounds. The goal of the classes was to improve functional keyboard skills, which is not limited to pitch and rhythm accuracy in performing solo repertoire. Consequently, some students with previous piano study may have been stronger in their music reading ability but weaker in other areas such as harmonization and transposition.

The Guide Mode is a limited type of computer-assisted instruction. It can provide instantaneous feedback on pitches that are played incorrectly by stopping the MIDI accompaniment and flashing a guide lamp behind the correct key to cue the student both aurally and visually. However, it does not provide direct feedback to the student in errors of rhythm, fingering, dynamics, and tempo.

Discussion of Test Results

In this section, results of the test scores are summarized and discussed. Due to the small sample size and variance in scores, results should be interpreted with caution. Definitive inferences should not be made from these data.

Research Question No. 1: How do pitch accuracy test scores of participants practicing with MIDI accompaniments and with the Guide Mode compare to pitch accuracy test scores of participants practicing with MIDI accompaniments but

without the Guide Mode? No significant difference, $p < .05$, was present between the MIDI-only group and Guide Mode group in pitch errors for *Allegro*. Analyses within the groups revealed a significant improvement in pitch errors on *Allegro* for the students who practiced with the Guide Mode, but not a significant improvement for the students who practiced without it. Furthermore, the Guide Mode group improved significantly in pitch errors from pretest to posttest for *Presto*, $p < .001$, but the MIDI-only group made no significant improvement.

When pitch errors were combined between both *Allegro* and *Presto*, the Guide Mode group made significantly greater improvement than the MIDI-only group. The observed mean difference of 35.72 combined pitch errors in the Guide Mode group was significantly better, $p = .01$, than the MIDI-only group's observed mean difference of 7.79 combined pitch errors from pretest to posttest. With the use of the Guide Mode being an independent variable between groups, it can be argued that it made a difference in pitch errors due to these outcomes. The results are consistent with other studies that found CAI programs to be effective in music instruction (Arenson, 1982; Bailey, 1990; Bowman, 1984; Brick, 1985; Hofstetter, 1979; Isaak, 1989; King, 1989; Lindeman, 1979) and also with studies supporting the positive effects of CAI specifically in performance skills (Eisele, 1986; Higgins, 1992; Holland, 1987). The effectiveness of the use of the Guide Mode in improving pitch accuracy is consistent with other studies that support the use of modeling in music instruction (Dickey, 1991; Folts, 1973; Fortney, 1992; Rosenthal, 1984, Zurcher, 1972). However, with a small sample size in this study, the results should not be

interpreted as giving conclusive evidence that the Guide Mode will ensure significantly greater improvement in pitch accuracy.

Research Question No. 2: How do rhythm accuracy test scores of participants practicing with MIDI accompaniments and with the Guide Mode compare to rhythm accuracy test scores of participants practicing with MIDI accompaniments but without the Guide Mode? No significant difference in rhythmic accuracy emerged between the Guide Mode group and the MIDI-only group. However, it should be noted that when the outliers were still in the data pool, a significant interaction between groups was present in *Allegro*, $p = .02$. Further analysis of the interaction revealed that the MIDI-only group made fewer rhythmic errors on their posttest than the Guide Mode group despite making more rhythmic errors on the pretest than the Guide Mode group. One reason for this may be that the Guide Mode's primary function is to assist in correcting pitches as opposed to rhythms. In fact, it can be argued that the Guide Mode may hinder rhythmic improvement and continuity because the MIDI accompaniment stops when a wrong pitch is played. However, one must be cautious in interpreting this type of result for the following reasons. This significant interaction included the outliers that could be exaggerating a relationship between the variables. Also when the same statistical procedure was conducted without the outliers, no significant interaction in rhythmic errors for *Allegro* was present.

However, regardless of whether outliers were included or not, both Guide Mode and MIDI-only groups made significant improvements in rhythm in both *Allegro* and *Presto* from pretests to posttests. Since both groups utilized MIDI

accompaniments in their practice, the accompaniments may have been a factor in the significant improvement in rhythmic errors by all participants. Nevertheless, further study to isolate this variable would need to be conducted.

Research Question No. 3: How do combined performance accuracy test scores (pitch + rhythm) of participants practicing with MIDI accompaniments and with the Guide Mode compare to combined performance accuracy test scores of participants practicing with MIDI accompaniments but without the Guide Mode? Participants who used the Guide Mode in practice made greater improvements in total errors when compared to participants who did not use the Guide Mode, but it was not at a statistically significant level, $p > .05$. Overall, participants in both groups made significant improvements in their total errors for *Allegro* and *Presto* combined. However, no significant differences between groups were present for total errors, so there was no conclusive evidence that the Guide Mode had an effect on overall performance accuracy. This is consistent with previous studies that found no significant evidence supporting the use of CAI in music instruction (Buck, 1991; Codding, 1986; Glass, 1986; Jacobsen, 1987; Kassner, 1992; Malave, 1991).

Results of this study were similar to Benson (2002) and Betts and Cassidy (2000) in that no significant differences occurred between groups using different types of technology, but improvement was made in performance regardless of the treatment. Benson's study also had a small sample size but had more than one treatment group. The results of the experiment by Sheldon, Reese, and Grashel (1999) showed that instrumentalists who practiced with different types of accompaniment declined in performance scores while the group that had no

accompaniment made improvements. This current study differs in that there was always improvement with MIDI accompaniment. However, the study by Sheldon, Reese, and Grashel theorized that the testing conditions did not match the experimental groups' treatment conditions because the tests contained no accompaniment. Perhaps the results of the current study may have been different if there was an accompaniment to play along with during the recording of the tests.

It is possible that the MIDI accompaniments and the Guide Mode were a hindrance in some cases with participants. The lack of rhythmic feedback in Guide Mode has already been discussed. Some subjects may not have been prepared to practice with the MIDI accompaniment even at the minimum expected tempo. Students might not have been aware that they should have been practicing at a slower tempo. Nonetheless, there were no significant differences between the Guide Mode group and MIDI-only group in rhythmic errors. However, all students using MIDI accompaniments made significant improvements in rhythm from pretest to posttest within groups. This suggests positive effects of MIDI accompaniments when compared to similar results in studies by Watkins (1994) and Beeler (1995). On the other hand, readers should not interpret it as conclusive evidence because of the lack of a true MIDI-only group that practiced without MIDI accompaniments. Further research on the effects of MIDI accompaniments is necessary.

Discussion of Questionnaire

In this section, results from the questionnaire [Appendix D & E] are discussed. Subjects responded to Likert-type items and open-ended questions so that

the researcher could assess the affective nature of the Guide Mode and MIDI accompaniments.

Research Question No. 4: What are participants' perceptions regarding practicing with MIDI accompaniments? In Likert-type items, there were no significant differences in attitudes regarding MIDI accompaniments between students who practiced with the Guide Mode and students who did not. In open-ended responses to the questionnaire, participants in the Guide Mode group made positive comments regarding the use of MIDI. One student stated, "Having the accompaniment kept my tempo more steady even after I had used it." Another student from the MIDI-only group mentioned, "The accompaniment was good to help maintain the tempo." One participant wrote, "Playing with the MIDI was new and made me think musically how my part fit." These results are in agreement with similar positive attitudes regarding MIDI accompaniments in studies by Davis (2001) and Sheldon, Reese, and Grashel (1999).

Observed affective responses to the use of MIDI included the perception that playing along with the accompaniments improved steadiness in rhythm and tempo. As stated earlier, one subject felt that his rhythmic continuity improved even after practicing with the accompaniment. Uszler, Gordon, and Smith (2000) wrote, "To experience rhythm is the core of listening to music as well as making it. Rhythm is a physical sensation, easier to feel than to describe" (p. 8). According to some of the participants' responses, the MIDI accompaniments provided useful external rhythmic stimuli for the repertoire that they were practicing. If piano students experience these

positive affects toward MIDI accompaniments, then teachers might consider incorporating them to establish rhythmic continuity.

It should also be noted that a number of students from the MIDI-only group did not mention specifically that MIDI was helpful in their practice. The majority of the MIDI-only groups simply stated that practicing hands separately was beneficial. The most negative responses came from students in the MIDI-only group. One student stated, "Using the technology almost seems like over-kill. At some points I shut off the MIDI and practiced each hand alone until I got it." Another participant wrote, "Too much! A regular piano is fine!" So in this research study, reactions to the use of MIDI accompaniments were mixed.

The MIDI-only treatment may be more useful after students are more comfortable with the pitches first. Uszler, Gordon, and Smith (2000) recommended, "It is best that these accompaniment discs and programs, therefore, be used as the culmination of perfecting a piece, rather than at the beginning of the learning curve (p. 17). In open-ended survey items, a majority of the students in the Guide Mode group identified their treatment as being beneficial. However, the majority of the MIDI-only group did not identify their treatment as being helpful. This may be due to the fact that with the limited time that students had to practice the compositions, the Guide Mode was seen as more effective in the early stages of learning the repertoire.

In Likert-type items, practicing with the MIDI accompaniments hands separately was rated higher in effectiveness and enjoyment level than practicing with the MIDI accompaniments with both hands and listening to the MIDI file. Students

may have experienced greater success in their practice sessions when playing one hand while the keyboard played the other hand. This also supports the recommendation of delaying the use of MIDI accompaniments until later in the process of learning repertoire.

Listening to the MIDI files as an aural model was rated lower on average than actually playing along with the MIDI accompaniment in Likert-type items. This contrasts with research by Siebenaler (1997) and Sang (1987) that suggested that having an aural model would be beneficial to students. Previous studies have found no significant effects in the use of audio modeling in music instruction (Anderson, 1981; Biggs, 1960; Hodges, 1974; Linklater, 1997).

However, in open-ended survey items, a number of students stated that hearing the MIDI file facilitated their learning of the compositions. The most notable response from a participant in the Guide Mode group was, "The MIDI recording helped me to get the piece in my head. It was much easier to just walk in each day and nail the piece because of this." Other subjects simply stated that "hearing the piece" was beneficial. So even though practicing with MIDI accompaniments should likely be utilized later in the process of learning repertoire, listening to the MIDI file during the early stages could prove to be useful for some students.

Research Question No. 5: What are participants' perceptions regarding practicing with the Guide Mode? A majority of the students identified the use of the Guide Mode as a tool that improved their performance accuracy. One student wrote, "I felt it was extremely helpful and fun. It made me <u>want</u> to practice the pieces." Another subject stated, "The technology made practice sessions easier and more fun."

Participants in studies by Tseng (1996), Snapp (1997), and Sheldon, Reese, and Grashel (1999) also responded positively to digital practice environments that were utilized. Band students in Kassner's (1992) study also had positive attitudes regarding the use of CAI.

Not all students responded positively to the use of the Guide Mode. One student thought that the technology was not much of a factor in his performance. Another student wrote, "I felt it was helpful but no more helpful than practicing alone on an acoustic piano."

In the current study, most students in the Guide Mode group believed that practicing hands separately with the Guide Mode was the most effective part of the treatment. In fact, two of the subjects expressed some frustration in using the Guide Mode with both hands. One subject remarked, "One hand at a time with guide mode was very helpful, but using both was kind of a mess if you made a mistake. It was very difficult to get started again if you made a mistake, making the whole two-hand guide mode practice difficult." The negative reaction towards practicing both hands in Guide Mode was likely a result of the difficulty in finding one's place in the score after making a pitch error. The guide lamps would cue the student as to what key they should play next, but knowing where that key is in relation to the notated score was possibly confusing to students. An electronic version of the score was capable of being displayed on the LCD screen of their digital pianos to show where the music stopped, but it was unlikely that the students utilized it since they had the paper score in front of them during the entire study.

Perceptions of the guide lamps were neutral. When asked what practice techniques helped during the practice sessions, one participant stated, "Using guide mode, but not looking at the lights, just playing the accompaniment at whatever tempo I could hands apart, moving to hands together." Attitudes regarding the guide lamps might be more positive with non-music majors who may be less advanced in reading music notation and might appreciate the additional visual aid of the guide lamps. A future study may wish to investigate the effect of practicing with the Guide Mode while having the digital score displayed exclusively on the LCD screen without a paper score. The use of the digital visual notation used in conjunction with the Guide Mode might provide a more true multimedia experience that may alleviate some of the confusion of finding where the MIDI file stopped.

Recommendations for Teachers

Due to the low sample size, results from the performance tests do not provide conclusive inferences for teachers. However, the answers from the questionnaire, especially the open-ended responses, may yield useful information that can benefit piano instructors. Based on the data, the following recommendations are presented:

1. *Use MIDI files as aural models of new repertoire for students particularly during the early stages of learning them.*
2. *Integrate CAI technology such as the Guide Mode during the early stages of learning repertoire to build up pitch accuracy.*
3. *Give students the opportunity to master each hand separately before practicing hands together with the Guide Mode.*

4. *Using the electronic score function might establish a stronger connection between the notation and what the students should be playing, especially while practicing hands together.*
5. *Incorporate MIDI accompaniments without the Guide Mode to establish rhythmic continuity later in the learning process after a student's pitch accuracy has reached a satisfactory level.*
6. *Teachers might avoid requiring students to practice with the Guide Mode or MIDI files. Reserve their use for students who may have a more positive attitude regarding the use of this type of technology.*

A number of participants reported positive experiences with the MIDI files. A common theme among responses was that the MIDI file as an aural model provided useful direction in how the students' practice should be approached. One participant stated, "The MIDI recording helped me to get the piece in my head. It was much easier to just walk in each day and nail the piece because of this." Hearing how the piece should sound can create a musical goal for the students to focus on.

Teachers may want to reserve use of the Guide Mode to address pitch accuracy during the early stages of learning new piano repertoire. Although the sample size was small, students who used the Guide Mode showed significant improvements in pitch accuracy for *Presto* and when pitch errors were combined for both compositions. A majority of the students also identified that the Guide Mode was the most helpful part of their practice sessions. The use of the Guide Lamps provided a visual cue as to what keys the students should have been playing. By itself, the Guide Lamps provided a type of rote instruction. Jacobson (2006) writes in

her book: “Rote learning requires the memorization of many small bits of information without necessarily making connections between them. It is sometimes the most effective way to begin piano instruction” (p. 23).

Practicing hands separately with the Guide Mode might be more beneficial during these early learning stages of practicing new repertoire. In this study, students sometimes lost their place when using the Guide Mode. A participant wrote, “One hand at a time with guide mode was very helpful, but using both was kind of a mess if you made a mistake. It was very difficult to get started again if you made a mistake, making the whole two-hand guide mode practice difficult. The one hand was very helpful, though.” Therefore, practicing hands together with the Guide Mode should be delayed until the students are comfortable with playing each hand separately.

For teachers who seek to develop note reading in students, the Guide Mode is probably best used in conjunction with the electronic score. Since the students in this study used a paper score, more attention was focused on the Guide Lamps and the MIDI accompaniment stopping when the student made a mistake. One participant stated, “The guide lamps just made me hit that key without reading the score to figure it out.” A future study might investigate the effects of the Guide Mode when used without the paper score but with focus on the electronic score. This type of treatment may help students make a better connection between the Guide Lamp instruction and the notes that they are reading. Bastien (1988) stated, “From the beginning it is essential to develop an ‘eyes on the page’ approach to reading. This will help to establish the correct habit of not looking down at the hands while playing” (p. 92).

There has been a concern in the related literature on possible adverse effects of CAI like the Guide Mode and smart accompaniments. Uszler, Gordon, and Smith (2000) stated, "Discs or programs that are sensitive to the player's tempo changes (slowing down or speeding up in accordance with what is played) can hinder, rather than foster, the development of a player's sense of continuity" (p. 17). Results from rhythmic accuracy scores showed no significant difference between the Guide Mode group and MIDI-only group. Both groups made significant improvements in rhythmic accuracy from pretests to posttests. So no evidence of either treatment being a hindrance in rhythmic continuity was present. The only negative comments regarding the Guide Mode included frustration from some students being unable to use it effectively while practicing hands together. The majority of students who used the Guide Mode identified it as being helpful.

Instructors should seek ways to motivate their students to practice, and the CAI technology may be one way to do this. The strongest testimony in support of this theory came from a student in the Guide Mode group that stated, "I felt it was extremely helpful and fun. It made me want to practice the pieces." Jacobson (2006) wrote, "Helping students enjoy the learning process sets the tone for successful piano study. When students learn how to solve technical and musical complexities, they will be motivated to continue practicing" (pp. 9-10).

In the questionnaire, a majority of the participants in both groups stated that more time to practice would have helped their performance. It appeared that some of the piano students were seeking alternative methods for achieving greater success in the little amount of time that they have to practice. One subject stated, "Throughout

our experience with group piano we have rarely or never used the MIDI capabilities, so it is difficult to say if it is helpful or not on such a short term. For me, finding time to practice has always been the make or break part of these courses."

Rather than using the Guide Mode with MIDI accompaniments only once or twice a week, students might benefit from using these instruments between classes in order to improve the efficacy of their practice time. Jacobson (2006) stated, "Students should be able to accomplish musical goals in a reasonable length of time. Students become discouraged if they do not progress in a timely manner" (p. 10). One participant wrote, "I think this technology will be/is extremely useful and should be utilized more, in particular being made available to practice with outside of class." If this type of technology is perceived as a way to improve efficiency in students' practice habits, then teachers should consider making these tools available not just in the classroom, but in the practice room as well.

On the other hand, teachers might avoid requiring students to practice with CAI and MIDI. Some of the students in this study reacted negatively to the use of MIDI accompaniments. One subject from the MIDI-only group stated, "Using the technology almost seems like over-kill. At some points I shut off the MIDI and practiced each hand alone until I got it." Another participant stated that the MIDI accompaniments were "helpful but no more helpful than practicing alone on an acoustic piano." Students who used the Guide Mode did not believe that the CAI technology hindered their performance, but some felt it had little if no effect. One subject stated, "I felt it was helpful but no more helpful than practicing alone on an acoustic piano." Another student wrote, "I do not think it was much of a factor…"

The MIDI-only treatment may be more useful after students become secure with playing the correct pitches first. Uszler, Gordon, and Smith (2000) support this by stating, "It is best that these accompaniment discs and programs, therefore, be used as the culmination of perfecting a piece, rather than at the beginning of the learning curve" (p. 17). Subjects in the MIDI-only group may have found it more difficult to keep up with the MIDI accompaniment during initial practice sessions, whereas participants in the group using the Guide Mode were capable of stopping and finding the correct pitches. Subjects reported positive attitudes regarding MIDI accompaniments as it related to maintaining rhythmic stability. One participant stated, "The accompaniment was good to help maintain the tempo." Another subject wrote, "The accompaniment kept my tempo more steady even after I had used it." One student even commented, "Playing with the MIDI was new and made me think musically how my part fit."

Recommendations for Further Research

The sample size of this study was very small, and the intact groups were likely too heterogeneous to draw any definitive conclusions regarding the effect of MIDI accompaniments and CAI on performance accuracy. This study also resulted in an uneven balance of subjects between the Guide Mode group (n = 19) and the MIDI-only group (n = 10). If possible, future studies might consider assigning subjects to respective treatment groups so that there are more similar amounts of participants in each group. Any replication of this study with a larger sample size and more randomization may produce varying and more significant results.

In the last section of the questionnaire, a majority of the participants agreed that more time to practice the compositions would have made the practice sessions more helpful. It is possible that the students may not have needed as much time to orient themselves with the keyboard technology because they had been using the piano lab since the beginning of the semester. Making the keyboards available to students outside of the classroom might have given any students who were uncomfortable with the technology the opportunity to get familiar with the keyboard functions. Limiting the pretest and posttest to just one composition may have alleviated the perception from subjects that they needed more practice time.

Rather than assigning specific tasks and amounts of time to practice with the Guide Mode, a future study might want to explore the effects of allowing students an indeterminate amount of time to practice with the CAI. In a previous study, participants in an experiment by Lindeman (1979) enjoyed having the ability to work at their own pace with a CAI program. Incorporating a more flexible practice regimen might allow students to adapt the technology to their own personalized practice habits rather than simply conforming to the directions given by the instructor. One subject even stated, "I practice best on my own going at my own pace rather than forced practice in a classroom."

One explanation for the inconsistency of posttest scores between compositions was the differences in their difficulty. *Allegro* had less shifts of hand position on the keyboard than *Presto*. In addition to being perceived as the more difficult composition, *Presto* had the distinction of being rated negatively in enjoyment level ($M = 2.21$, $SD = 1.71$) in comparison to *Allegro* ($M = 4.00$, $SD = 1.61$) on a 0-7

Likert-type scale. A follow-up study might consider using *Presto* as the sole composition to practice. Its difficulty could potentially avoid a ceiling effect that was demonstrated by at least one subject in this study.

There is a possibility that many of the students did not take the current study as seriously as this researcher had expected. A number of students either chose not to sign the IRB consent forms or dropped out of the study. There may have been a sense of resentment from students in participating in an activity that was not directly related to their evaluation in the class that they were registered. One of the subjects, who was removed as an outlier, even suggested on his questionnaire that he might have been more motivated to put in more effort if he was graded on his performances. A future study might consider recruiting volunteers to receive the treatment outside the context of a required group piano class.

Future researchers might consider being physically present to recruit participants rather than using pre-recorded videos. The researcher enlisted participants and delivered instructions only through pre-recorded videos. Since the researcher was not physically present to recruit subjects and to oversee the practice sessions, students might not have been as motivated to participate in the study.

A future experiment might explore using only the digital notation displayed on the LCD screen in the Guide Mode instead of a paper score. Some students were disoriented with where they were in the music when practicing with the Guide Mode. Emphasizing the expediency of the digital music notation on the LCD screen used in conjunction with the guide lamps and the Guide Mode might produce different

results. This is supported by a study by Linklater (1997), where clarinetists found visual and aural models of performance more effective than aural-only models.

Changing the testing conditions to allow participants to record their tests simultaneously with a MIDI accompaniment may produce different results, particularly in the area of rhythmic accuracy. Sheldon, Reese, and Grashel (1999) believed that if the testing conditions do not match the experimental groups' treatment conditions, then this could hinder subjects' performances. In addition, incorporating other types of CAI that provide feedback on rhythm and tempo into the treatment may make a difference in performance at the keyboard. This study was limited to CAI technology that provided instant feedback solely on pitch errors. When asked what would have helped them in their practice sessions, one participant stated, "To understand whether we should slow the piece down and increase speed aiming at the marked tempo or just keep practicing at whatever tempo I liked." A future study might test the effects of a CAI program that could assess a student's performance and provide immediate feedback as to what an appropriate tempo to practice would be. Further research investigating the use of MIDI accompaniments compared to a true control group without MIDI accompaniments would also provide more insight into its effects.

Conclusions

In this study, students who practiced with the Guide Mode and MIDI accompaniment showed significant improvement in pitch accuracy compared to students who practiced with only MIDI accompaniment. However, there were no

significant differences in rhythmic accuracy and total performance accuracy between the two groups.

A majority of participants from the Guide Mode group identified practicing with the Guide Mode to be the most effective part of the practice sessions. Since many subjects stated that practicing hands separately was effective, teachers might consider using this technique with the Guide Mode in the early stages of learning new repertoire. Although listening to the MIDI file was not rated highly in the Likert-type survey, some participants expressed their belief in its effectiveness as an aural model. Therefore, introducing a new composition by letting students listen to a MIDI file for modeling purposes may be beneficial. Some students remarked how the technology was both helpful and motivational in their performance. So teachers might explore making the technology more available even outside of the piano lab setting.

A number of students perceived that the accompaniments had a positive effect on their rhythmic continuity. So instructors might encourage their students to practice with MIDI accompaniments without CAI, but perhaps only after they have become comfortable with the pitches. Since all participants practiced with MIDI accompaniments during this study, more research is needed to isolate the true effects of this variable.

One cannot expect to rely upon MIDI accompaniments and CAI technology to improve performance alone, but it still may serve as a valuable tool in the learning process. Further studies could assist instructors in understanding effective ways of utilizing CAI and MIDI technology to improve functional keyboard skills for a growing number of students enrolled in group piano classes. Uszler, Gordon, and

Smith (2000) do not express concerns about technology replacing teachers. When used appropriately, implementation of technology that meets the pedagogical needs of teachers may provide valuable support for learners as well. In order to address students of varying learning styles, teachers may wish to consider using CAI keyboard technology and MIDI accompaniments as tools for facilitating the learning process for students, which in turn may motivate them to practice and lead to more successful piano study.

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APPENDIX A

LETTER TO GROUP PIANO INSTRUCTORS REQUESTING PERMISSION TO RECRUIT SUBJECTS

Dear Instructor,

I am currently working on a research study that explores the effect of MIDI keyboard technology on performance of group piano students. I am seeking piano students to take part in my study and would like to visit your class to recruit and test participants.

The purpose of the study is to determine how different types of MIDI keyboard technology affect performance accuracy and attitudes on group piano students.

During the sixth week of the semester, I will ask you to play a video for your classes asking for volunteers to participate in my study. You will then give each student two copies of the informed consent form. If the students agree, they should sign the form and keep one copy for themselves. After this, I would like you to play another set of videos that will walk the students through an orientation of the MIDI capabilities of their keyboards, including how to record their performances on a floppy disk. Please take the first 15 minutes of the next two classes to allow your students to participate in these orientation sessions.

After the orientation, students will be asked to record two short pieces on their keyboards. These performances will be saved as MIDI files onto a floppy disk, which you will distribute and collect for evaluation of performance accuracy of pitch and rhythm by independent judges. This should only take 15 minutes out of your class time.

For the next four classes, students will be asked to practice these two piano pieces for 15 minutes out of each class. After the two weeks, the students will be asked to perform the two piano pieces again and save them as MIDI files on the same floppy disk that they recorded their initial performances to be evaluated for performance accuracy in pitch and rhythm by independent judges. They will also fill out a demographic and attitudinal questionnaire at the end of this study. This questionnaire should take about 10 minutes to complete. The whole experiment will take place over the course of nine class periods.

Would you allow me to discuss this project with your students and to use part of your class time to have your students participate in this study? If so, please email me at marioajero@ou.edu by September 24. Thank you!

Sincerely,
Mario Ajero

APPENDIX B

SCRIPT FOR PIANO CLASS RECRUITMENT

Script for piano class recruitment

Greetings, piano class. My name is Mario Ajero. I am currently working on a research project investigating the use of MIDI keyboard technology in group piano classes. I would like to ask you to consider participating in this study.

The purpose of the study is to determine how different types of MIDI keyboard technology affect performance accuracy and attitudes on group piano students. If you agree to participate, you will be asked to perform two different piano pieces and save them as MIDI files on your keyboards.

The initial performances of the two piano pieces should take no longer than 15 minutes to complete. After you have recorded these two piano pieces, you will be asked to practice these same two piano pieces for 15 minutes out of each class for the next four classes. After these 4 practice sessions, you will be asked to perform the same two piano pieces again and save them as MIDI files on your keyboards. These pieces will not be graded as part of your course grade, but will assist you in practicing sight-reading, which will be a benefit to future exams. You will also be asked to fill out a demographic and attitudinal questionnaire at the end of this study. This questionnaire should take no longer than 10 minutes to complete.

Please consider taking part in this research study. At this time your instructor will hand out two informed consent forms that describe this study. If you have any questions about the study, feel free to email me at marioajero@ou.edu. Please read the informed consent form. If you agree to participate, sign one copy and submit it to your instructor today. You may keep one copy of the consent form for your own record.

Thank you!

APPENDIX C

INFORMED CONSENT FORM

INFORMED CONSENT FORM FOR RESEARCH BEING CONDUCTED UNDER THE AUSPICES OF

THE UNIVERSITY OF OKLAHOMA - NORMAN CAMPUS

INTRODUCTION: This study is entitled MIDI Keyboard Technology in College Group Piano. The person directing this project is Mario Ajero, and Dr. Nancy Barry is the faculty sponsor. This document defines the terms and conditions for consenting to participate in this study.

DESCRIPTION OF THE STUDY: The purpose of the study is to determine how different types of MIDI keyboard technology affect performance accuracy and attitudes on group piano students. You will be asked to perform two different piano pieces and to save them as MIDI files on your keyboards. For the next two weeks, you will practice these two pieces during 15-minute segments out of your regular class time. You will then be asked to perform the same two piano pieces and to save them as MIDI files on your keyboards. You will also fill out a demographic and attitudinal questionnaire at the end of the study. This questionnaire should take about 10 minutes to complete. The MIDI files that you record will be evaluated for their performance accuracy in pitch and rhythm by independent judges. Your names and their association with the MIDI files and questionnaire responses will only be known by the researcher and will be kept confidential.

RISKS AND BENEFITS: Benefits to society include gaining a better understanding of what types of MIDI Keyboard technology are effective in helping group piano students.

Risks for subjects include nervousness caused by performing pieces on the piano that will be recorded and judged for their performance accuracy.

COMPENSATION: You will not be reimbursed for your time and participation in this study.

CONDITIONS OF PARTICIPATION: Participation is voluntary. Refusal to participate will involve no penalty or loss of benefits to which the subject is already entitled. Furthermore, the participant may discontinue participation at any time without penalty or loss of benefits to which the participant is otherwise entitled. Your participation and performances will not have any positive or negative impact on your grade for this piano course.

CONFIDENTIALITY: Findings will be presented in aggregate form with no identifying information. Your names will only be known by the researcher and will be kept confidential.

CONTACTS FOR QUESTIONS ABOUT THE STUDY: Participants may contact Mario Ajero at marioajero@ou.edu or (936) 468-1389 or Dr. Nancy Barry at barrynh@ou.edu or 325-4146 with questions about the study.

For inquiries about rights as a research participant, contact the University of Oklahoma - Norman Campus Institutional Board (OU - NC IRB) at (405) 325-8110 or irb@ou.edu.

Signature of Participant	Date
Printed Name of Participant	Researcher Signature

APPENDIX D

BACKGROUND INFORMATION AND QUESTIONNAIRE FOR RESEARCH ON THE EFFECTS OF MIDI KEYBOARD TECHNOLOGY (GUIDE MODE GROUP)

MIDI Keyboard Technology Research Study
Questionnaire for Participants

Name: _____ Floppy Disk Number: _____

Instructor: _____

Section 1 - Background information

1. What is your gender? (Circle One) Male Female

2. Including this semester, how many semesters of group piano have you taken at the University of Oklahoma? _____

3. How many semesters have you taken group piano at another college-level institution?

_____

4. How many years of piano study do you have prior to entering college? _____

5. What is your major instrument? _____

6. How would you rank yourself in knowledge of MIDI technology?

No knowledge **Highly knowledgeable**

0 1 2 3 4 5 6 7

7. How often have you played with a MIDI accompaniment in your piano class prior to this research study?

Never used it **Used on regular basis**

0 1 2 3 4 5 6 7

8. How often have you used the Guide Mode (MIDI file does not continue until you play the correct pitches) in your piano class prior to this research study?

Never used it **Used on regular basis**

0 1 2 3 4 5 6 7

Section 2 - Opinions about the Piano Pieces

9. How difficult did you find Piano Piece #1 “Allegro”?

Very Easy **Very Difficult**

0 1 2 3 4 5 6 7

10. How much did you enjoy playing Piano Piece #1 “Allegro”?

No Enjoyment **Enjoyed It Very Much**

0 1 2 3 4 5 6 7

11. How difficult did you find Piano Piece #2 “Presto”?

Very Easy **Very Difficult**

0 1 2 3 4 5 6 7

12. How much did you enjoy playing Piano Piece #2 “Presto”?

No Enjoyment **Enjoyed It Very Much**

0 1 2 3 4 5 6 7

Section 3 - Perceptions of MIDI

For each survey item in this section, please respond on:

• How helpful you found this use of MIDI files in improving your performance accuracy

• How much you enjoyed using the MIDI files

• How much you actually used the MIDI files during the past two weeks

13. Listened to the MIDI files before practicing the pieces.

Not Helpful at All **Extremely Helpful**

0 1 2 3 4 5 6 7

No Enjoyment **Enjoyed It Very Much**

0 1 2 3 4 5 6 7

Never Used It **Used It Frequently**

0 1 2 3 4 5 6 7

14. Practicing the RH alone while the MIDI files.

Not Helpful at All **Extremely Helpful**

0 1 2 3 4 5 6 7

No Enjoyment **Enjoyed It Very Much**

0 1 2 3 4 5 6 7

Never Used It **Used It Frequently**

0 1 2 3 4 5 6 7

15. Practicing the LH alone while the MIDI files.

Not Helpful at All **Extremely Helpful**

0 1 2 3 4 5 6 7

No Enjoyment **Enjoyed It Very Much**

0 1 2 3 4 5 6 7

Never Used It **Used It Frequently**

0 1 2 3 4 5 6 7

16. Adjusting the tempo of the MIDI file.

Not Helpful at All **Extremely Helpful**

0 1 2 3 4 5 6 7

No Enjoyment **Enjoyed It Very Much**

0 1 2 3 4 5 6 7

Never Used It **Used It Frequently**

0 1 2 3 4 5 6 7

Section 4 - Perceptions of CAI

For each survey item in this section, please respond on:

• How helpful you found this use of Guide Mode in improving your performance accuracy

• How much you enjoyed using the Guide Mode

• How much you actually used the Guide Mode during the past two weeks

17. Practicing the RH alone while the MIDI keyboard plays the LH with the Guide Mode ON.

Not Helpful at All **Extremely Helpful**

0 1 2 3 4 5 6 7

No Enjoyment **Enjoyed It Very Much**

0 1 2 3 4 5 6 7

Never Used It **Used It Frequently**

0 1 2 3 4 5 6 7

18. Practicing the LH alone while the MIDI keyboard plays the RH with the Guide Mode ON.

Not Helpful at All **Extremely Helpful**

0 1 2 3 4 5 6 7

No Enjoyment **Enjoyed It Very Much**

0 1 2 3 4 5 6 7

Never Used It **Used It Frequently**

0 1 2 3 4 5 6 7

19. Practicing both hands simultaneously while in Guide Mode.

Not Helpful at All **Extremely Helpful**

0 1 2 3 4 5 6 7

No Enjoyment **Enjoyed It Very Much**

0 1 2 3 4 5 6 7

Never Used It **Used It Frequently**

0 1 2 3 4 5 6 7

20. Looking at the Guide Lamps (lights behind the keys would prompt you to play correct keys).

Not Helpful at All **Extremely Helpful**

0 1 2 3 4 5 6 7

No Enjoyment **Enjoyed It Very Much**

0 1 2 3 4 5 6 7

Never Used It **Used It Frequently**

0 1 2 3 4 5 6 7

Section 5 - Other Comments:

21. Do you feel your performance improved with these practice sessions? (Circle One)

YES **NO**

22. What practice techniques do you think helped during the practice sessions?

_____

_____

_____

23. What would have made the practice sessions more helpful?

_____

_____

_____

24. Please use this space to provide any other comments regarding how you feel about the use of technology during your practice sessions in this study.

_____

_____

_____

_____

APPENDIX E

BACKGROUND INFORMATION AND QUESTIONNAIRE FOR RESEARCH ON THE EFFECTS OF MIDI KEYBOARD TECHNOLOGY (CONTROL GROUP)

MIDI Keyboard Technology Research Study
Questionnaire for Participants

Name: _____ Floppy Disk Number: _____

Instructor: _____

Section 1 - Background information

1. What is your gender? (Circle One) Male Female

2. Including this semester, how many semesters of group piano have you taken at the University of Oklahoma? _____

3. How many semesters have you taken group piano at another college-level institution?

_____

4. How many years of piano study do you have prior to entering college? _____

5. What is your major instrument? _____

6. How would you rank yourself in knowledge of MIDI technology?

No knowledge **Highly knowledgeable**

0 1 2 3 4 5 6 7

7. How often have you played with a MIDI accompaniment in your piano class prior to this research study?

Never used it **Used on regular basis**

0 1 2 3 4 5 6 7

8. How often have you used the Guide mode (MIDI file does not continue until you play the correct pitches) in your piano class prior to this research study?

Never used it **Used on regular basis**

0 1 2 3 4 5 6 7

Section 2 - Opinions about the Piano Pieces

9. How difficult did you find Piano Piece #1 “Allegro”?

Very Easy **Very Difficult**

0 1 2 3 4 5 6 7

10. How much did you enjoy playing Piano Piece #1 “Allegro”?

No Enjoyment **Enjoyed It Very Much**

0 1 2 3 4 5 6 7

11. How difficult did you find Piano Piece #2 “Presto”?

Very Easy **Very Difficult**

0 1 2 3 4 5 6 7

12. How much did you enjoy playing Piano Piece #2 “Presto”?

No Enjoyment **Enjoyed It Very Much**

0 1 2 3 4 5 6 7

Section 3 - Perceptions of MIDI

For each survey item in this section, please respond on:

• How helpful you found this use of MIDI files in improving your performance accuracy

• How much you enjoyed using the MIDI files

• How much you actually used the MIDI files during the past two weeks

13. Listened to the MIDI files before practicing the pieces.

Not Helpful at All **Extremely Helpful**

0 1 2 3 4 5 6 7

No Enjoyment **Enjoyed It Very Much**

0 1 2 3 4 5 6 7

Never Used It **Used It Frequently**

0 1 2 3 4 5 6 7

14. Practicing the RH alone with the MIDI accompaniment.

Not Helpful at All **Extremely Helpful**

0 1 2 3 4 5 6 7

No Enjoyment **Enjoyed It Very Much**

0 1 2 3 4 5 6 7

Never Used It **Used It Frequently**

0 1 2 3 4 5 6 7

15. Practicing the LH alone with the MIDI accompaniment.

Not Helpful at All **Extremely Helpful**

0 1 2 3 4 5 6 7

No Enjoyment **Enjoyed It Very Much**

0 1 2 3 4 5 6 7

Never Used It **Used It Frequently**

0 1 2 3 4 5 6 7

16. Adjusting the tempo of the MIDI file.

Not Helpful at All **Extremely Helpful**

0 1 2 3 4 5 6 7

No Enjoyment **Enjoyed It Very Much**

0 1 2 3 4 5 6 7

Never Used It **Used It Frequently**

0 1 2 3 4 5 6 7

Section 4 - Perceptions of CAI

For each survey item in this section, please rate how helpful the following applications of CAI technology would have been in improving your performance accuracy.

17. Using the Guide mode (restricts the MIDI file from going forward until you play the correct notes) with the MIDI accompaniment (extra tracks) ON.

Would not have been helpful **Would have been very helpful**

0 1 2 3 4 5 6 7

18. Using the Guide Lamps (lights behind the keys would prompt you to play correct keys).

Would not have been helpful **Would have been very helpful**

0 1 2 3 4 5 6 7

Section 5 - Other Comments:

19. Do you feel your performance improved with these practice sessions? (Circle One)

YES **NO**

20. What practice techniques do you think helped during the practice sessions?

_____

_____

_____

21. What would have made the practice sessions more helpful?

_____

_____

_____

22. Please use this space to provide any other comments regarding how you feel about the use of technology during your practice sessions in this study.

_____

_____

_____

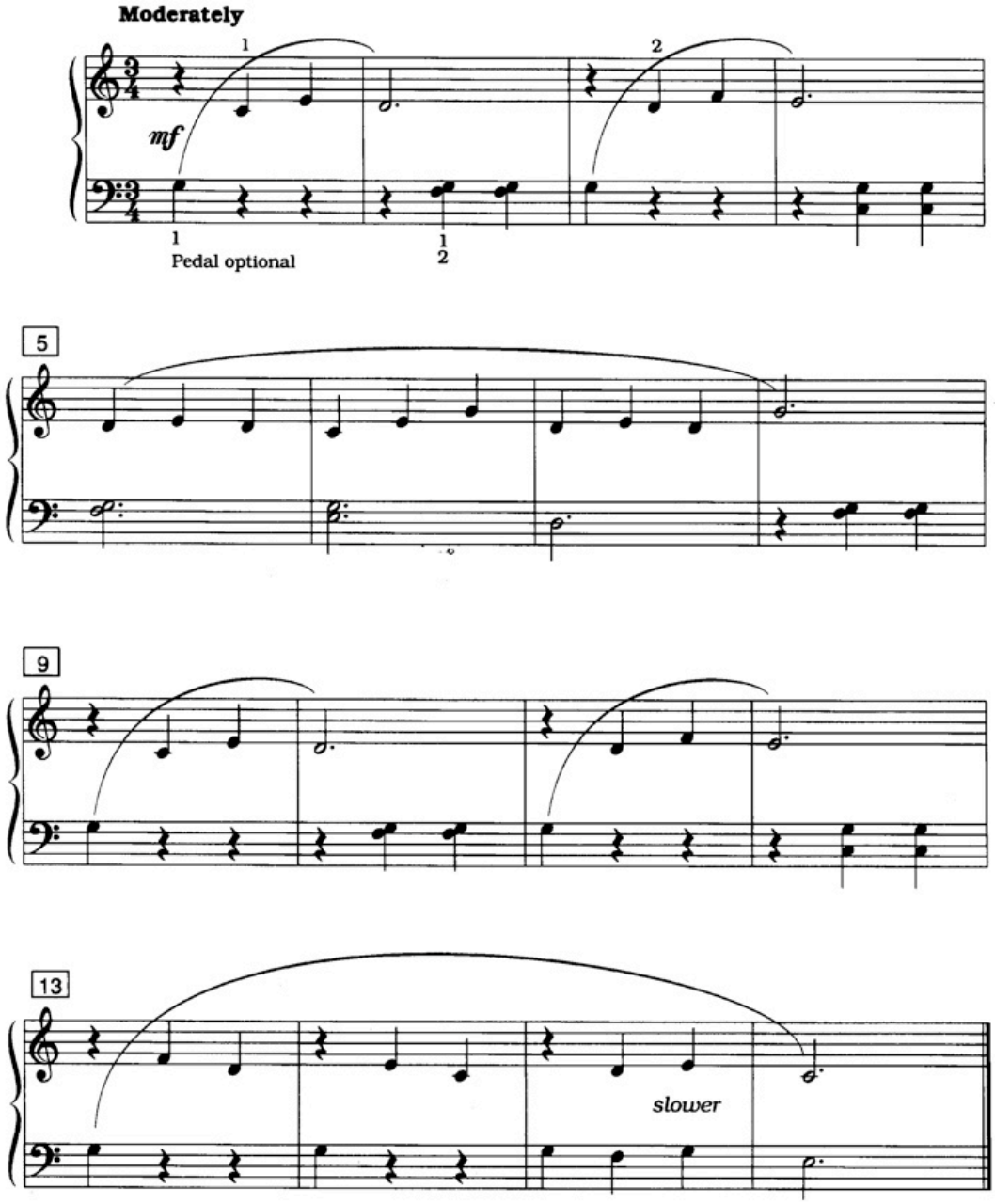
_____

_____

APPENDIX F

PERFECT BALANCE PIANO SCORE
(ORIENTATION COMPOSITION)

PERFECT BALANCE



PERFECT BALANCE
(as found in Just for You)
By DENNIS ALEXANDER
© MCMLXXXIX by ALFRED PUBLISHING CO., INC. (Print)
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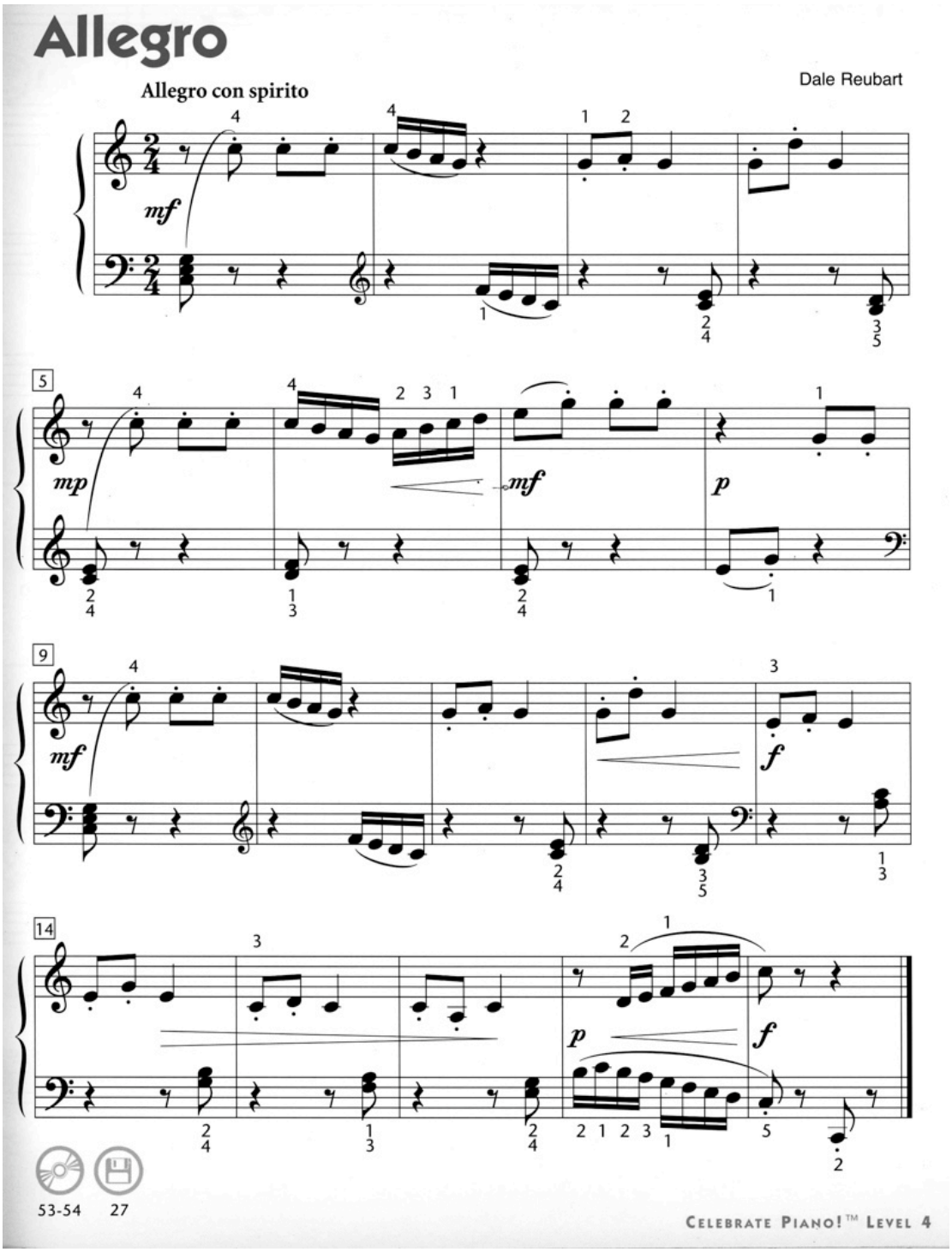
APPENDIX G

ALLEGRO PIANO SCORE



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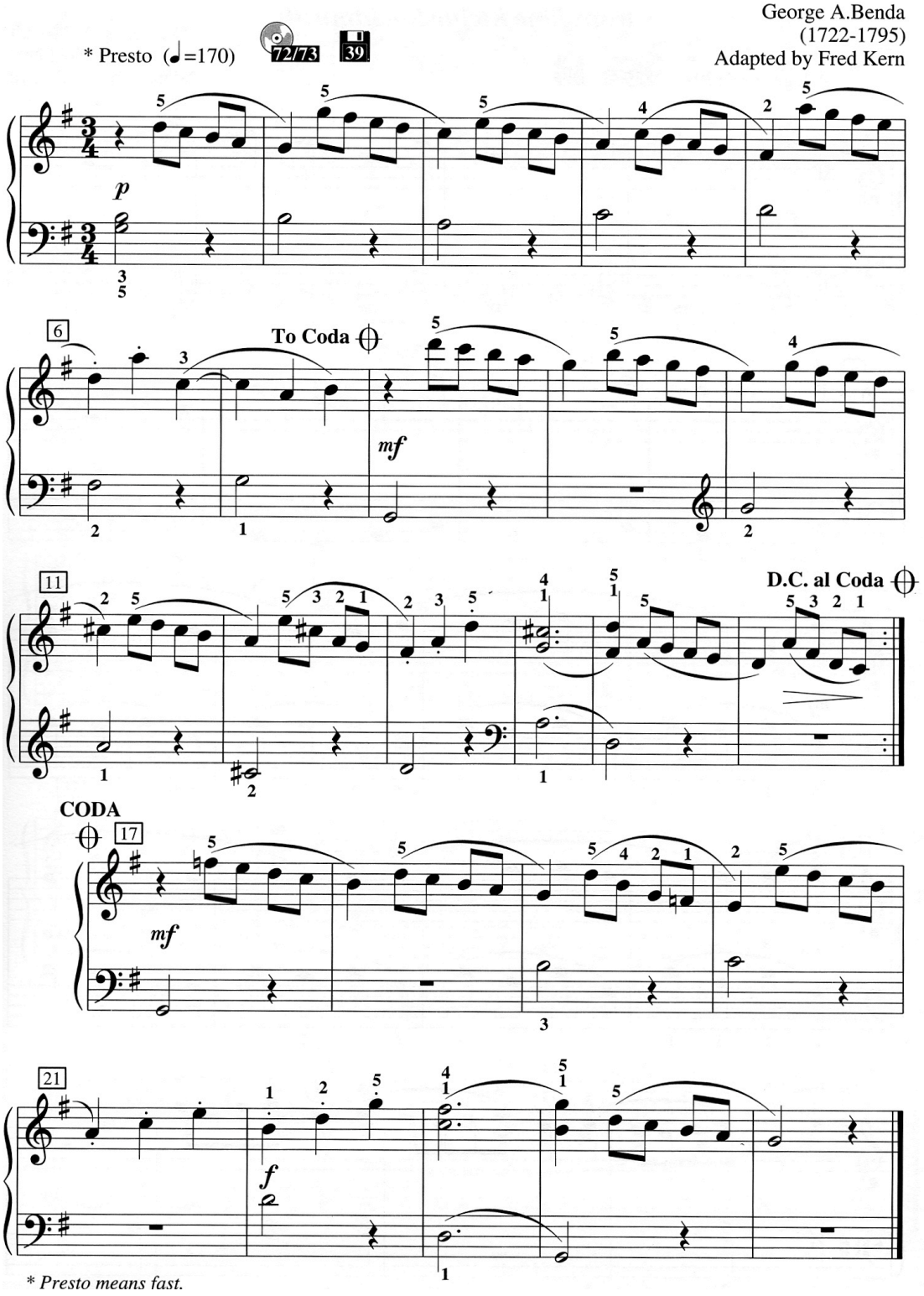
APPENDIX H

PRESTO PIANO SCORE

Presto

George A.Benda
(1722-1795)
Adapted by Fred Kern



** Presto means fast.*

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APPENDIX I

SCORING SHEET FOR JUDGES

SCORING SHEET

Adjudicator's Name: _____

Piece (Circle One): *Allegro* *Presto*

Recording Number: _____

Category	No. of Errors
Pitch	_____
Rhythm	_____
Subtotal	_____

Time of performance (in seconds) _____

Tempo Penalty _____
(Assign 1 point for every 10 seconds above 60 seconds)

TOTAL ERRORS _____
(Subtotal + Tempo Penalty)

APPENDIX J

DIRECTIONS FOR INSTRUCTORS IN GROUP A
(GUIDE MODE GROUP)

DIRECTIONS FOR GROUP PIANO (A)

- Make sure every student sits at the SAME KEYBOARD through the experiment.
- Have students turn OFF keyboards and turn them back ON while holding the top C key at the start of each class to reset keyboards to their default settings.
- For every class, use iTunes on the iMac to play the instructional videos.
    - Turn on the stereo in the media cabinet.
        - If you're in CMC 009, make sure it is set to AUX output so that the sound from the iMac comes through the speakers.
        - If you're in CMC 008, make sure the stereo is set to PHONO, and the MLC-100 has the following buttons: Monitor>Input & Demo>Output.
    - Turn on the projector. You can control the video using the Smart Board, but the mouse is probably more reliable.
    - You will find a folder called Group Piano A in the iTunes Source sidebar.
    - Expand that folder to reveal playlists for Day 1 through Day 9.
    - For each corresponding day, play through the videos as instructed below.

Day 1:

1. Give out 2 copies of Informed Consent Form to each student.
2. Play **Ajero Dissertation Video 1** (Introduction to Study)
3. If students agree to participate, ask them to sign it and return one copy to you. They may keep one for their own records.
4. Give one floppy disk to each participant along with one paper copy of the score for "Perfect Balance" (Make sure the floppy disk label corresponds with the students' keyboard number.)
5. Play **Ajero Dissertation Video 2** (Recording a Performance)
6. After Video 2 is done, tell students to put themselves on headphones, push the REC button, and start recording themselves sight-reading through "Perfect Balance". Remind students to not stop playing or recording even if they make a mistake.
7. Inform students not to push any other buttons or keys after they have completed recording themselves.
8. After all students are done recording, go ahead and play **Ajero Dissertation Video 3** (Saving the Performance to Floppy Disk).
9. Assist any students who need help saving their performance to the floppy disk.
10. Collect all floppy disks from students and copies of "Perfect Balance" piece.

Day 2:

1. Tell students to turn off keyboard and then to turn it back on while holding the top C key to reset the keyboard to its default settings.
2. Distribute copy of "Perfect Balance" to students and play **Ajero Dissertation Video 4** (Listening to the MIDI file and following with the paper score).
3. Give them 30 seconds to listen to the song on headphones.
    a. Inform the students not to play along, but simply to listen to it.
    b. Students are allowed to "shadow" the keys as the song file plays.
4. After 30 seconds, tell students to take headphones off and then play **Ajero Dissertation Video 5** (Practicing Left Hand alone in Guide Mode).
5. Tell students to put headphones on and give students 1 minute to practice the Left Hand in GUIDE Mode. Remind them to NOT push the REC button, button to just use the PLAY/PAUSE button.
6. Tell students to take headphones off and play **Ajero Dissertation Video 6** (Practicing Right Hand alone in GUIDE mode).
7. Tell students to put headphones on and give students 1 minute to practice the Right Hand in GUIDE Mode.
8. Tell students to take headphones off and play **Ajero Dissertation Video 7** (Practicing both LH and RH in GUIDE mode).
9. Tell students to put headphones on and give students 1 minute to practice both hands in GUIDE Mode.

Day 3:

1. Tell students to turn off keyboard and then to turn it back on while holding down the top C key to reset it to its default settings.
2. Tell students to push the "Song Select" button and to select the song "Perfect Balance" which is in the User Tab, inside the folder "PERFECT".
3. Distribute a paper copy of the "Perfect Balance" piece to each student.
4. Tell students to put headphones on and give students 3 minutes to practice with the GUIDE mode as was instructed on Day 2. Feel free to troubleshoot any technical problems that students may encounter.
5. Tell students to take headphones off.
6. Distribute each student's floppy disk that they recorded on Day 1. Make sure they use the same disk.
7. **IMPORTANT**: Before Playing Video 9, tell students to turn keyboards OFF and then turn them back on again while holding down the top C key to reset it to its default settings.
8. Play **Ajero Dissertation Video 9** (Record "Perfect Balance" piece)
    a. PAUSE the video at 1:47 (Video will tell you when to pause. You can push the Space Bar or use the mouse)
    b. Tell students to put on headphones and begin recording the piece
9. Commence with **Ajero Dissertation Video 9** after students are done recording.
10. Assist students in saving their recording to their floppy disk. The video should have explained the process in good detail.
11. Collect floppy disks and the paper scores.

Day 4:

1. Distribute floppy disks and paper scores of "Allegro" to all students.
2. Play **Ajero Dissertation Video 10** (Recording "Allegro" for the first time).
3. After video, play the metronome at the minimum tempo of a quarter note = 50 for a reference and then stop it.
    a. Signal to students to begin recording one sight-reading of the piece "Allegro".
    b. Assist any students in recording if necessary.
    c. Recording should take no longer than 1-2 minutes.
    d. Make sure students do NOT practice piece any further after recording.
4. After all students are done recording, play **Ajero Dissertation Video 11** (Saving "Allegro" to the floppy disk).
    a. Assist any students in saving their performance of Allegro as "A1" on their floppy disk.
5. Collect paper scores of "Allegro" and distribute "Presto" to all students.
6. ***IMPORTANT:** Tell students to turn off keyboard and then to turn it back on to reset it to its default settings.
7. Play **Ajero Dissertation Video 12** (Recording "Presto" for the first time").
8. After video, play the metronome at the minimum tempo of a quarter note = 120 for a reference and then stop it.
    a. Signal to students to begin recording one sight-reading of the piece "Presto".
    a. Assist any students in recording if necessary.
    b. Recording should take no longer than 1-2 minutes.
    c. Make sure students do NOT practice piece any further after recording.
9. After all students are done recording, play **Ajero Dissertation Video 13** (Saving "Presto" to the floppy disk).
    a. Assist any students in saving their performance of Allegro as "P1" on their floppy disk.
10. Collect paper scores of "Presto" and floppy disks from all students.

Day 5:

1. Tell students to turn off keyboard and then to turn it back on while holding down the top C key to reset it to its default settings.
2. Distribute the paper score for the piece "Allegro".
3. Play **Ajero Dissertation Video 14** (Listening to MIDI file of "Allegro").
4. Instruct students to follow instructions on the video.
    a. *NOTE: The folder entitled -MARIO should be in the USER Tab, but it might not necessarily be Button A as is stated in the video.
    b. Assist any students who need help finding the MIDI file
5. After video, give students 1 minute to only listen to the piece. Tell them that they may "shadow" the keys (silently play on top of the keys) as they listen.
6. Play **Ajero Dissertation Video 15** (Practicing "Allegro" in GUIDE Mode).
7. After video, allow students to practice for the rest of the 15-minute period in GUIDE Mode.
    a. Remind them to try each suggestion given in the video.
    b. They should not use the REC button, but only the Play/Pause and Stop buttons in GUIDE Mode.
    c. IMPORTANT: Tell students that they are allowed to slow down or speed up the tempo of the MIDI file to whatever is comfortable by pressing the Tempo -/+ buttons. (This instruction was not included in the video.)
    d. If students get disoriented on where they are in the song, they may push to SCORE button to see where they are by referencing the bouncing ball. (This instruction was also not included in the video.)
    e. They of course are allowed to turn the Left Hand, Right Hand, and Extra Tracks off as necessary.
    f. Inform them that they will have another opportunity to practice this piece after today.
    g. Students are allowed to write on the paper score if they wish.
8. Collect paper scores of "Allegro".

Day 6:

1. Tell students to turn off keyboard and then to turn it back on while holding down the top C key to reset it to its default settings.
2. Distribute the paper score for the piece "Presto".
3. Play **Ajero Dissertation Video 16** (Listening to MIDI file of "Presto").
4. Instruct students to follow instructions on the video.
    a. *NOTE: The folder entitled -MARIO should be in the USER Tab, but it might not necessarily be Button A as is stated in the video.
    b. Assist any students who need help finding the MIDI file
5. After video, give students 1 minute to only listen to the piece. Tell them that they may "shadow" the keys (silently play on top of the keys) as they listen.
6. Play **Ajero Dissertation Video 17** (Practicing "Presto" in GUIDE Mode).
7. After video, allow students to practice for the rest of the 15-minute period in GUIDE Mode.
    a. Remind them to try each suggestion given in the video.
    b. They should not use the REC button, but only the Play/Pause and Stop buttons in GUIDE Mode.
    c. IMPORTANT: Tell students that they are allowed to slow down or speed up the tempo of the MIDI file to whatever is comfortable by pressing the Tempo -/+ buttons. (This instruction was not included in the video.)
    d. If students get disoriented on where they are in the song, they may push to SCORE button to see where they are by referencing the bouncing ball. (This instruction was also not included in the video.)
    e. They of course are allowed to turn the Left Hand, Right Hand, and Extra Tracks off as necessary.
    f. Inform them that they will have another opportunity to practice this piece after today.
    g. Students are allowed to write on the paper score if they wish.
8. Collect paper scores of "Presto".

Day 7: (NO VIDEO)

1. Tell students to turn off keyboard and then to turn it back on while holding down the top C key to reset it to its default settings.
2. Distribute paper scores of "Allegro" to all students.
3. Instruct students to load up the song, "Allegro".
    a. ***REMINDER**: Tell them to push SONG SELECT. It is located in the folder entitled -MARIO in the USER Tab.
    b. Assist any students who need help finding the MIDI file.
4. Give students 5 minutes to practice the piece with MIDI accompaniment and the GUIDE Mode.
    a. Assist any students who may have trouble accessing features of the GUIDE Mode.
    b. If students get lost, they may push the SCORE button to find where they are in the song.
5. Collect paper scores of "Allegro" and distribute paper scores of "Presto"
6. Tell students to turn off keyboard and then to turn it back on while holding down the top C key to reset it to its default settings.
7. Instruct students to follow instructions on the video.
    a. ***REMINDER**: Tell them to push SONG SELECT. It is located in the folder entitled -MARIO in the USER Tab.
    b. Assist any students who need help finding the MIDI file
8. Give students 5 minutes to practice the piece with MIDI accompaniment and the GUIDE Mode.
    a. Assist any students who may have trouble accessing features of the GUIDE Mode.
    b. If students get lost, they may push the SCORE button to find where they are in the song.
9. Collect paper scores of "Presto"

Day 8:

1. Distribute paper scores for both “Allegro” and “Presto”.
2. Play **Ajero Dissertation Video 20** (Free practice of both pieces).
3. After video, allow students to practice on both pieces for 15 minutes.
    a. Remind them that they may use the MIDI files with the Guide Mode but also should practice the pieces at least once without any MIDI accompaniment in preparation for the posttest.
    b. Students may write on paper scores if they wish.
    c. Assist any students if they have any difficulty with the MIDI keyboard technology only.
4. Collect paper scores of both pieces at the end.

Day 9:

1. Distribute paper scores of "Allegro" and floppy disks
    a. Make sure the floppy disks are the same disk that the students used in the first recording.
2. Play **Ajero Dissertation Video 21** (Recording last performance of "Allegro").
3. After video, play the metronome at the minimum tempo of a quarter note = 50 for a reference and then stop it.
    b. Signal to students to begin recording one sight-reading of the piece "Allegro".
    c. Assist any students in recording if necessary.
    d. Recording should take no longer than 1-2 minutes.
    e. Make sure students do NOT practice piece any further after recording.
4. After all students are done recording, play **Ajero Dissertation Video 22** (Saving "Allegro" to the floppy disk).
5. Instruct students to follow directions on the video.
6. Assist any students who need assistance saving their performance with the title "A2".
7. After the video, collect paper scores of "Allegro and distribute paper scores of "Presto".
8. Play **Ajero Dissertation Video 23** (Recording last performance of "Presto").
9. After video, play the metronome at the minimum tempo of a quarter note = 120 for a reference and then stop it.
    f. Signal to students to begin recording one sight-reading of the piece "Allegro".
    g. Assist any students in recording if necessary.
    h. Recording should take no longer than 1-2 minutes.
    i. Make sure students do NOT practice piece any further after recording.
10. After all students are done recording, play **Ajero Dissertation Video 24** (Saving "Presto" to the floppy disk).
11. Instruct students to follow directions on the video.

12. Assist any students who need assistance saving their performance with the title “P2”.
13. Collect floppy disks and paper scores of “Presto”.
14. Distribute questionnaire to students and ask them to fill it out.
15. Collect questionnaires at the end of study.

APPENDIX K

DIRECTIONS FOR INSTRUCTORS IN GROUP B (CONTROL GROUP)

DIRECTIONS FOR GROUP PIANO (B)

- Make sure every student sits at the SAME KEYBOARD through the experiment.
- Have students turn OFF keyboards and turn them back ON at the start of each class to reset them to their default settings.
- For every class, use iTunes on the iMac to play the instructional videos.
    - Turn on the stereo in the media cabinet.
        - If you're in CMC 009, make sure it is set to AUX output so that the sound from the iMac comes through the speakers.
        - If you're in CMC 008, make sure the stereo is set to PHONO, and the MLC-100 has the following buttons: Monitor>Input & Demo>Output.
    - Turn on the projector. You can even control the video using the Smart Board, but the mouse is probably more reliable.
    - You will find a folder called Group Piano B in the iTunes Source sidebar.
    - Expand that folder to reveal playlists for Day 1 through Day 9.
    - For each corresponding day, play through the videos as instructed below.

Day 1:

1. Give out 2 copies of Informed Consent Form to each student.
2. Play **Ajero Dissertation Video 1** (Introduction to Study).
3. If students agree to participate, ask them to sign it and return one copy to you. They may keep one for their own records.
4. Give one floppy disk to each participant along with one paper copy of the score for "Perfect Balance" (Make sure the floppy disk label corresponds with the students' keyboard number.)
5. Play **Ajero Dissertation Video 2** (Recording a Performance)
6. After Video 2 is done, tell students to put themselves on headphones, push the REC button, and start recording themselves sight reading through "Perfect Balance". Remind students to not stop playing or recording even if they make a mistake.
7. Inform students not to push any other buttons or keys after they have completed recording themselves.
8. After all students are done recording, go ahead and play **Ajero Dissertation Video 3** (Saving the Performance to Floppy Disk).
9. Assist any students who need help saving their performance to the floppy disk.
10. Collect all floppy disks from students and copies of "Perfect Balance" piece.

Day 2:

1. Tell students to turn off keyboard and then to turn it back on while holding the top C key to reset the keyboard to its default settings.
2. **IMPORTANT**: Tell students to turn OFF the Guide Lamps:
    a. Push the Direct Access button
    b. Push the Guide Button
    c. Look on the LCD screen and turn the Guide Lamp to OFF (this is done by pushing the button next to it which is the C button)
3. Distribute copy of "Perfect Balance" to students and play **Ajero Dissertation Video 4** (Listening to the MIDI file and following with the paper score).
4. Give them 30 seconds to listen to the song on headphones.
    a. Inform the students not to play along, but simply to listen to it.
    b. Students are allowed to "shadow" the keys as the song file plays.
5. NO VIDEO in this next segment. Instruct students to practice with MIDI file playing.
    a. Do NOT use the REC button, but just press PLAY/PAUSE.
    b. Students may adjust the tempo to what is comfortable by pressing the Tempo -/+ buttons
    c. Give the students a couple minutes to practice the Left Hand alone with the MIDI file.
    d. Give the students a couple minutes to practice the Right Hand alone with the MIDI file.
    e. Give the students a couple minutes to practice both hands with the MIDI file.
6. Collect the paper copy of "Perfect Balance".

Day 3:

1. Tell students to turn off keyboard and then to turn it back on while holding the top C key to reset it to its default settings.
2. Distribute a paper copy of the "Perfect Balance" piece to each student.
3. Tell students to put headphones on and give students 3 minutes to practice the piece trying to achieve accuracy in pitch and rhythm.
4. Tell students to take headphones off.
5. Distribute each student's floppy disk that they recorded on Day 1. Make sure they use the same disk.
6. **IMPORTANT**: Before Playing Video 9, tell students to turn keyboards OFF and then turn them back on again while holding down the top C key to reset it to its default settings.
7. Play **Ajero Dissertation Video 9** (Record "Perfect Balance" piece).
    a. PAUSE the video at 1:47 (Video will tell you when to pause. You can push the Space Bar or use the mouse)
    b. Tell students to put on headphones and begin recording the piece.
8. Commence with Video 9 after students are done recording.
9. Assist students in saving their recording to their floppy disk. The video should have explained the process in good detail.
10. Collect floppy disks and the paper scores.

Day 4:

1. Distribute floppy disks and paper scores of "Allegro" to all students.
2. Play **Ajero Dissertation Video 10** (Recording "Allegro" for the first time).
3. After video, play the metronome at the minimum tempo of a quarter note = 50 for a reference and then stop it.
    a. Signal to students to begin recording one sight-reading of the piece "Allegro".
    b. Assist any students in recording if necessary.
    c. Recording should take no longer than 1-2 minutes.
    d. Make sure students do NOT practice piece any further after recording.
4. After all students are done recording, play **Ajero Dissertation Video 11** (Saving "Allegro" to the floppy disk).
    a. Assist any students in saving their performance of Allegro as "A1" on their floppy disk.
5. Collect paper scores of "Allegro" and distribute "Presto" to all students.
6. ***IMPORTANT:** Tell students to turn off keyboard and then to turn it back on to reset it to its default settings.
7. Play **Ajero Dissertation Video 12** (Recording "Presto" for the first time").
8. After video, play the metronome at the minimum tempo of a quarter note = 120 for a reference and then stop it.
    a. Signal to students to begin recording one sight-reading of the piece "Presto".
    b. Assist any students in recording if necessary.
    c. Recording should take no longer than 1-2 minutes.
    d. Make sure students do NOT practice piece any further after recording.
9. After all students are done recording, play **Ajero Dissertation Video 13** (Saving "Presto" to the floppy disk).
    a. Assist any students in saving their performance of Allegro as "P1" on their floppy disk.
10. Collect paper scores of "Presto" and floppy disks from all students.

Day 5:

1. Tell students to turn off keyboard and then to turn it back on while holding down the top C key to reset it to its default settings.
2. Distribute the paper score for the piece "Allegro".
3. Play **Ajero Dissertation Video 14** (Listening to MIDI file of "Allegro").
4. Instruct students to follow instructions on the video.
    a. *NOTE: The folder entitled -MARIO should be in the USER Tab, but it might not necessarily be Button A as is stated in the video.
    b. Assist any students who need help finding the MIDI file
5. **IMPORTANT**: Tell students to turn OFF the Guide Lamps:
    a. Push the Direct Access button and then push the GUIDE Button
    b. Look on the LCD screen and turn the Guide Lamp to OFF (this is done by pushing the button next to it which is the C button)
6. After video, give students 1 minute to only listen to the piece. Tell them that they may "shadow" the keys (silently play on top of the keys) as they listen.
7. Play **Ajero Dissertation Video 18** (Practicing "Allegro" with MIDI accompaniments).
8. After video, allow students to practice for the rest of the 15-minute period in with MIDI accompaniment.
    a. Remind them to try each suggestion given in the video.
    b. They should not use the REC button, but only the Play/Pause and Stop buttons during practice.
    c. IMPORTANT: Tell students that they are allowed to slow down or speed up the tempo of the MIDI file to whatever is comfortable by pressing the Tempo -/+ buttons.
    d. They of course are allowed to turn the Left Hand, Right Hand, and Extra Tracks off as necessary.
    e. Inform them that they will have another opportunity to practice this piece after today.
    f. Students are allowed to write on the paper score if they wish.
9. Collect paper scores of "Allegro".

Day 6:

1. Tell students to turn off keyboard and then to turn it back on while holding down the top C key to reset it to its default settings.
2. Distribute the paper score for the piece "Presto".
3. Play **Ajero Dissertation Video 16** (Listening to MIDI file of "Presto").
4. Instruct students to follow instructions on the video.
    a. *NOTE: The folder entitled -MARIO should be in the USER Tab, but it might not necessarily be Button A as is stated in the video.
    b. Assist any students who need help finding the MIDI file
5. **IMPORTANT**: Tell students to turn OFF the Guide Lamps:
    a. Push the Direct Access button and then push the GUIDE Button
    b. Look on the LCD screen and turn the Guide Lamp to OFF (this is done by pushing the button next to it which is the C button)
6. After video, give students 1 minute to only listen to the piece. Tell them that they may "shadow" the keys (silently play on top of the keys) as they listen.
7. Play **Ajero Dissertation Video 19** (Practicing "Presto" with MIDI accompaniments).
8. After video, allow students to practice for the rest of the 15-minute period in with MIDI accompaniment.
    a. Remind them to try each suggestion given in the video.
    b. They should not use the REC button, but only the Play/Pause and Stop buttons during practice.
    c. IMPORTANT: Tell students that they are allowed to slow down or speed up the tempo of the MIDI file to whatever is comfortable by pressing the Tempo -/+ buttons.
    d. They of course are allowed to turn the Left Hand, Right Hand, and Extra Tracks off as necessary.
    e. Inform them that they will have another opportunity to practice this piece after today.
    f. Students are allowed to write on the paper score if they wish.
9. Collect paper scores of "Presto".

Day 7: (NO VIDEO)

1. Tell students to turn off keyboard and then to turn it back on while holding down the top C key to reset it to its default settings.
2. Distribute paper scores of "Allegro" to all students.
3. **IMPORTANT**: Tell students to turn OFF the Guide Lamps:
    a. Push the Direct Access button and then push the GUIDE Button
    b. Look on the LCD screen and turn the Guide Lamp to OFF (this is done by pushing the button next to it which is the C button)
4. Instruct students to load up the song, "Allegro".
    a. ***REMINDER**: Tell them to push SONG SELECT. It is located in the folder entitled -MARIO in the USER Tab.
    b. Assist any students who need help finding the MIDI file.
5. Give students 5 minutes to practice the piece with MIDI accompaniment.
    a. Assist any students who may have trouble accessing the MIDI file.
6. Collect paper scores of "Allegro" and distribute paper scores of "Presto"
7. Tell students to turn off keyboard and then to turn it back on while holding down the top C key to reset it to its default settings.
8. Instruct students to follow instructions on the video.
    a. ***REMINDER**: Tell them to push SONG SELECT. It is located in the folder entitled -MARIO in the USER Tab.
    b. Assist any students who need help finding the MIDI file
9. Give students 5 minutes to practice the piece with MIDI accompaniment.
    a. Assist any students who may have trouble accessing the MIDI file.
    b. If students get lost, they may push the SCORE button to find where they are in the song.
10. Collect paper scores of "Presto"

Day 8:

1. Distribute paper scores for both “Allegro” and “Presto”.
2. Play **Ajero Dissertation Video 20** (Free practice of both pieces).
3. **IMPORTANT**: Tell students to turn OFF the Guide Lamps:
    a. Push the Direct Access button and then push the GUIDE Button
    b. Look on the LCD screen and turn the Guide Lamp to OFF (this is done by pushing the button next to it which is the C button)
4. After video, allow students to practice on both pieces for 15 minutes.
    a. Remind them that they may use the MIDI accompaniments but also should practice the pieces at least once without any MIDI accompaniment in preparation for the posttest.
    b. Students may write on paper scores if they wish.
    c. Assist any students if they have any difficulty with the MIDI keyboard technology only.
5. Collect paper scores of both pieces at the end.

Day 9:

1. Distribute paper scores of "Allegro" and floppy disks
    a. Make sure the floppy disks are the same disk that the students used in the first recording.
2. Play **Ajero Dissertation Video 21** (Recording last performance of "Allegro").
3. After video, play the metronome at the minimum tempo of a quarter note = 50 for a reference and then stop it.
    a. Signal to students to begin recording one sight-reading of the piece "Allegro".
    b. Assist any students in recording if necessary.
    c. Recording should take no longer than 1-2 minutes.
    d. Make sure students do NOT practice piece any further after recording.
4. After all students are done recording, play **Ajero Dissertation Video 22** (Saving "Allegro" to the floppy disk).
5. Instruct students to follow directions on the video.
6. Assist any students who need assistance saving their performance with the title "A2".
7. After the video, collect paper scores of "Allegro and distribute paper scores of "Presto".
8. Play **Ajero Dissertation Video 23** (Recording last performance of "Presto").
9. After video, play the metronome at the minimum tempo of a quarter note = 120 for a reference and then stop it.
    a. Signal to students to begin recording one sight-reading of the piece "Allegro".
    b. Assist any students in recording if necessary.
    c. Recording should take no longer than 1-2 minutes.
    d. Make sure students do NOT practice piece any further after recording.
10. After all students are done recording, play **Ajero Dissertation Video 24** (Saving "Presto" to the floppy disk).
11. Instruct students to follow directions on the video.

12. Assist any students who need assistance saving their performance with the title “P2”.
13. Collect floppy disks and paper scores of “Presto”.
14. Distribute questionnaire to students and ask them to fill it out.
15. Collect questionnaires at the end of study.

APPENDIX L

REPRINT AUTHORIZATION FOR *PERFECT BALANCE*

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REPRINT AUTHORIZATION LETTER

July 11, 2007

Mario Ajero
Coordinator of Class Piano and Pedagogy
Stephen F. Austion State University
Box 13043 SFA Station
Nacogdoches, TX 759862-3043

Re: *Perfect Balance (as found in Just for You, Book 1) (405)*

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APPENDIX M

REPRINT AUTHORIZATION FOR *ALLEGRO*

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July 13, 2007

Mario Ajero
Coordinator of Class Piano and Pedagogy
Stephen F. Austin State University
Box 13043 SFA Station
Nacogdoches, TX 75962-3043

Dear Mario Ajero,

Thank you for your email on July 9, 2007 requesting permission to use the following work in your dissertation entitled " The Effects of Computer-Assisted Keyboard Technology and MIDI Accompaniments on Group Piano Students Performance Accuracy and Attitudes":

- "Allegro," by Dale Reubart, from *Celebrate Piano!, Lesson and Musicianship Level 4*, by Cathy Albergo, J. Mitzi Kolar, and Mark Mrozinski

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Terri Anne Moses
Communications Coordinator
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APPENDIX N

REPRINT AUTHORIZATION FOR *PRESTO*

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July 26, 2007

Mario Ajero
Stephen F. Austin State University
Box 13043 SFA Station
Nacadoches, TX 75962-3043

RE: **Presto**
Music by George Benda
Arranged by Fred Kern
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By Mario Ajero