The Efficacy of Computer-Based and Tape-Recorded Assistance in Second-Semester Freshman Ear-Training Instruction.

Janet Claire Garton

Louisiana State University and Agricultural & Mechanical College

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Garton, Janet Claire

THE EFFICACY OF COMPUTER-BASED AND TAPE-RECORDED ASSISTANCE IN SECOND-SEMESTER FRESHMAN EAR-TRAINING INSTRUCTION

The Louisiana State University and Agricultural and Mechanical Col. Ph.D. 1981

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THE EFFICACY OF COMPUTER-BASED AND TAPE-RECORDED
ASSISTANCE IN SECOND-SEMESTER FRESHMAN
EAR-TRAINING INSTRUCTION

A Dissertation

Submitted to the Graduate Faculty of the
Louisiana State University and
Agricultural and Mechanical College
in partial fulfillment of the
requirements for the degree of
Doctor of Philosophy

in

The School of Music

by
Janet Claire Garton
B.M.E., University of Texas, 1970
M.M.E., University of Texas, 1974
December 1981
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Ms. Sue Crumpler - consultant
Mr. Jerry Ratcliff - equipment provision

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ABSTRACT

Harmonic dictation materials available in the Ear-Training Laboratory at Louisiana State University were programmed for computer presentation in order to observe the effects of the computer medium in comparison to the traditional laboratory approach. In accordance with the Solomon Four-Group Design, the sixty-two second-semester freshman music theory students were assigned randomly to computer and tape groups. Half of each group was assigned at random to take a pretest which was designed by the experimenter. After six withdrawals from the course, a total research population of fifty-six students remained.

Members of both the experimental and control groups were asked to practice a minimum of thirty minutes twice a week. Additional practice was encouraged. Approximately three hours (playing time) of reel-to-reel tapes were available for practice by the control group. The actual time spent on those tapes varied greatly from one individual to another. There were ten programs available for practice by the experimental group. Each program was designed to take approximately thirty minutes for the "average" student to complete.

The experiment was scheduled to begin January 19, 1981, but due to unavoidable delivery delays, the actual time period was from February 9, 1981, through March 13, 1981. The five-week experiment concluded with a posttest taken by the entire research population. In order to have points of reference for comparison for each student, scores for the final
examination of the previous semester (December 1980) were collected. To test any long-range effect, scores from the final examination (May 1981) were also collected.

Several analytical procedures from the Statistical Analysis System (SAS) were utilized to study the available data. Analysis of variance (ANOVA), t-test, paired t-test, chi square, regression, and Pearson correlation statistics were employed. Preference for computer practice was significant at the .001 level. Mean gain scores from the December final to the posttest were significant at .01, and those from the December final to the May final were significant at .0001. Differences in mean scores on the posttest were significant at .10. Reaction to the computer was positive.
CHAPTER I

INTRODUCTION

Historically, individualized instruction has been acknowledged as the ideal medium for all aspects of music instruction. However, undergraduate curriculum structure has tended to curtail individualized teaching of basic skills. In many instances, remedial tutoring of students on an individual basis has been the only method of helping them to develop necessary facility with basic skills, but this requires a large amount of instructor time.

A decade ago, the use of the computer as an instructional device was considered feasible by relatively few individuals. Nevertheless, computer-assisted instruction (CAI) has experienced very rapid development, due in part to declining hardware costs, but more importantly to its potential for fulfilling one of education's most pressing needs—individualized instruction. The computer not only allows a student to choose what materials he will study, but it also allows him to advance at his own pace. Furthermore, the computer is totally impartial and equally patient with all who use it.

One of the greatest advantages of CAI/CBI (computer-based instruction) is the immediate feedback it provides. Through interaction with the computer, a student's interest in a subject may be maintained at a high level. In addition, the instant correction of errors and reinforcement of correct responses not only lead to significant improvement, but also increase student confidence. As a result, an inherent enthusiasm for learning is encouraged.
Utilization of CAI also offers the advantage of saving time. Not only is learning time compressed for the student, but because more materials are being mastered outside of class, the instructor has more class time to present advanced concepts which could not be presented as clearly or efficiently by a computer.

The benefits of CAI are many.

Faculty and students in American universities have had considerable success in making application of computer technology to instruction and research. Forty percent of the nation's colleges and universities had computer facilities by 1969. Now, music educators should take advantage of those facilities and the benefits afforded by CAI.

**Statement of the Problem**

Traditional lecture, discussion, lockstep classes are potentially very depersonalizing. Each student is treated exactly the same; therefore, the slow are lost, the fast are bored, and the fortunate few "average" students learn the most.

Few, if any, instructors involved in the teaching of basic music theory would argue with the statement that more students fail the area of ear-training than fail the written portion of each class. Support for this statement may be found by studying the grade averages and percentage of failures (D's and F's) in the Music 1701-02 freshman theory courses offered at Louisiana State University. Based on information compiled from the 1977-80 school years, the following statistics result. In the 1977-78 classes, an average of 6 percent of the students enrolled failed the part-writing mid-term examination and 7.6 percent of those enrolled failed the part-writing final examination. These figures compare to 14.5 (mid-term) and 19.8 percent (final) average failures on the
### TABLE 1

**AVERAGE EXAM SCORES AND PERCENTAGE OF FAILURES IN 1701-1702 FRESHMAN MUSIC THEORY CLASSES IN 1979-80 AT LOUISIANA STATE UNIVERSITY**

<table>
<thead>
<tr>
<th></th>
<th>Part-Writing</th>
<th>Ear-Training</th>
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<tbody>
<tr>
<td><strong>FALL 1979</strong></td>
<td></td>
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<td></td>
<td><strong>Mid-Term</strong></td>
<td><strong>Final</strong></td>
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<td></td>
<td>Exam</td>
<td>Exam</td>
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<tr>
<td>Class A</td>
<td>88.4</td>
<td>86</td>
</tr>
<tr>
<td>B</td>
<td>84.6</td>
<td>80.8</td>
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<tr>
<td>C</td>
<td>80</td>
<td>89</td>
</tr>
<tr>
<td>D</td>
<td>86.2</td>
<td>89.5</td>
</tr>
<tr>
<td>Average</td>
<td>84.8</td>
<td>86.3</td>
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<tr>
<td><strong>SPRING 1980</strong></td>
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<tr>
<td></td>
<td><strong>Mid-Term</strong></td>
<td><strong>Final</strong></td>
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<td>Exam</td>
<td>Exam</td>
</tr>
<tr>
<td>Class A</td>
<td>78.7</td>
<td>85.2</td>
</tr>
<tr>
<td>B</td>
<td>71.6</td>
<td>87.6</td>
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<tr>
<td>C</td>
<td>65</td>
<td>78.3</td>
</tr>
<tr>
<td>D</td>
<td>74</td>
<td>81.2</td>
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<tr>
<td>Average</td>
<td>72.3</td>
<td>83.1</td>
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### FALL 1979

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<tr>
<td>Average</td>
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### SPRING 1980

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<td><strong>Mid-Term</strong></td>
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<td>Exam</td>
<td>Exam</td>
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<tr>
<td>Class A</td>
<td>90.7</td>
<td>86.3</td>
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<tr>
<td>B</td>
<td>77.3</td>
<td>60.8</td>
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<td>78.9</td>
<td>70.2</td>
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<tr>
<td>Average</td>
<td>83.1</td>
<td>74.9</td>
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ear-training examinations. In the 1978-79 school year, the average percentages were much higher, with 18 and 15.2 percent failing the mid-term and final part-writing examinations and 25.1 and 39.2 percent failing the ear-training mid-terms and finals. Specific information may be gained by analyzing individual class scores from 1979-80.

In table 1 it can be noted that during the fall semester an average of 37.3 percent—over one-third—of the students enrolled failed the ear-training mid-term examination; on this same examination one class had 53 percent failures. When the total number of failures in the aural and written portions of Music 1701 are compared, it can be seen that on the mid-term examinations 3.5 times as many students failed the ear-training examination as failed the complementary part-writing examination. On the final examinations, the number of failures in ear-training was four times higher than in part-writing. The average number of failures for the 1979-80 academic year on the mid-term and final part-writing examinations was 7.9 and 8.9 percent, respectively. The average failures for the companion mid-term and final ear-training examinations were 27.6 and 23.9 percent, respectively. The fact that a serious problem exists cannot be denied nor ignored.

**Significance of the Study**

We are at the onset of a major revolution in education, a revolution unparalleled since the invention of the printing press. The computer will be the instrument of this revolution. While we are at the very beginning—the computer as a learning device in current classes is, compared with all other learning modes—almost nonexistent—the pace will pick up rapidly over the next 15 years. By the year 2000 the major way of learning at all levels, and in almost all subject areas will be through the interactive use of computers.
Available literature reveals that a relatively small body of research has been accomplished concerning CAI as it related to learning music theory. For example, studies have focused on evaluation and development of materials, branching, and optimum drill time. Others have concentrated on the current and potential uses of CAI and even proposed hardware. However, studies which have concentrated on the basic elements involved in learning music theory are limited to the areas of rhythm, sightsinging, and construction of major scales and primary triads at the keyboard, and these studies used total research populations of six, twenty-one, and thirty subjects, respectively. Only one project attempted to apply CAI to ear-training, and this project has received criticism for lack of sufficient data and statistical support for several conclusions.

Researchers consistently agree that

Music educators can and should contribute to the development of computer-assisted instruction in music by encouraging further development of technical devices advantageous to music teaching, and by planning, programming, and field testing computer-assisted lessons in all phases of music.

"The subject is worthy, one which needs exploration. Additional studies in this area are greatly needed."

This research project included design, programming, and testing of CAI materials in ear-training. All programs were intended as drill and practice supplements to normal classroom instruction as presented in the second semester of freshman music theory.

Delimitations

This research project was available only to those students enrolled in Music 1702, second-semester freshman ear-training class, for a
five-week period from February 9, 1981, to March 13, 1981. Based upon a spring enrollment of sixty-two, students were randomly assigned to the experimental and control groups. Six withdrawals from the course resulted in groups of twenty-eight subjects each; an approximately equal number of students were from each of the four 1702 music theory classes which were offered that semester.

Structural presentation of computer programs was strictly coordinated with the harmonic aspects of the second edition of Elementary Harmony by Robert W. Ottman, which is currently utilized in the freshman music theory courses at Louisiana State University. With the exception of Chapter 16: The Melodic Line, practice programs were available for those chapters studied through the mid-term examination:

Ch. 14: The Secondary Triads, Principles of Chord Progression, The Diminished Triad, The Leading Tone Triad

Ch. 15: The Supertonic Triad

Ch. 17: The Submediant and Mediant Triads

Computer time was limited to availability of terminals and operating hours of the Ear-Training Laboratory. All students were requested to practice at least thirty minutes twice a week; additional practice was encouraged. All practice sessions for dictation, whether with tapes, programs, or other methods, took place outside of the regular classroom instruction.

The hardware employed by the experimental group included two Exidy "Sorcerer" model Z-80 microcomputers with 16 kilobytes (16K) memory and cassette bulk storage. In addition, Video 100, 12-inch cathode ray tube (CRT) video monitors and ASCII keyboards were utilized. Two D/A converters and Raymer model 790-6 amplifiers supplied the sound. The control
group utilized four Sony model TC-270 reel-to-reel tape decks. Both groups used headphone sets.

Definition of Terms

Listed below are terms which are common to the CAI vocabulary. Other terms will be defined as they appear in the body of the paper.

CHIP: an integrated circuit (IC). The first chip which consisted of the entire central processing unit (CPU) of a computer was produced in 1971.

MICROCOMPUTER: a computer based on a microprocessor (CPU); sometimes referred to as a "computer on a chip".

HARDWARE: the physical equipment which makes up the computer.

PERIPHERALS: equipment which may be added such as a printer, a disk (flexible material similar to a recording which replaces cassette information storage) system, clock, etc.

CRT: (Cathode Ray Tube) a video monitor similar to a television screen which can display output from or input to the computer.

SOFTWARE: computer programs.

PROGRAM: a series of logically-ordered steps which dictate the actions of the computer. Programs may be written in numerous languages from very simple---BASIC---to those which are very complex.

CAI: (Computer-Assisted Instruction) or

CBI: (Computer-Based Instruction) a form of instruction which relies on modification of the learner's responses through appropriate control of stimuli and reinforcements. In the tutorial, drill and practice, problem solving, and simulation modes, computer instruction may serve as a substitute or a supplement to other instructional methods.
BRANCHING: the electronic process by which individualization in a CAI program is accomplished. Students are "branched" or directed to one or more sets of materials, remedial or advanced, on the basis of a response or a series of responses made in previous materials.

Method of Research

The research method followed in this study was experimental, using the Solomon Four-Group Design. In accordance with the design, participants from each of the four 1702 music theory classes were randomly assigned to the experimental and control groups. Half of each of those groups were randomly assigned to take the pretest in order that any effect of preliminary testing could be statistically measured. The total research population took the posttest during the regularly-scheduled mid-term examination period. The pretest-posttest, patterned after previous mid-term ear-training examinations, was designed by the investigator and approved by each of the instructors teaching freshman music theory at Louisiana State University in the spring of 1981.

The following null hypotheses were tested at or beyond the .05 level of confidence. There will be no significant difference between

1. the mean scores of the control and experimental groups on the pretest (January 1981)
2. the mean scores of the control and experimental groups on the posttest (mid-term—March 1981)
3. the total number of practice sessions by the students of the control (tape) group and by the students of the experimental (computer) group between the pretest and the posttest
4. the number of students in the control group and the number of students in the experimental group who scored below seventy on the pretest

5. the number of students in the control group and the number of students in the experimental group who scored below seventy on the posttest (mid-term)

6. the mean scores of the control and experimental groups on the final examination (May 1981)

7. the total number of practice sessions by the students of the control (tape) group and by the students of the experimental (computer) group between the posttest and the final examination

8. the number of students in the control group and the number of students in the experimental group who scored below seventy on the final examination

9. the mean gain scores of the control group from the pretest to the posttest and the mean gain scores of the experimental group from the pretest to the posttest

10. the mean gain scores of the control group from the posttest (mid-term—March 1981) to the final examination (May 1981) and the mean gain scores of the experimental group from the posttest (mid-term—March 1981) to the final examination (May 1981)

11. the mean gain scores of the control group from the pretest to the final examination (May 1981) and the mean gain scores of the experimental group from the pretest to the final examination (May 1981)

12. the mean gain scores of the control group from the final
examination (December 1980) to the posttest and the mean gain scores of the experimental group from the final examination (December 1980) to the posttest

13. the mean gain scores of the control group from the final examination (December 1980) to the final examination (May 1981) and the mean gain scores of the experimental group from the final examination (December 1980) to the final examination (May 1981)

Scores by the individual design groups on the pretest and posttest were compared statistically by ANOVA (analysis of variance) and t-test procedures from the Statistical Analysis System (SAS) computer program. Comparisons of total practice sessions and scores below seventy in each design group were made by the use of a chi-square test. Gain scores were statistically analyzed with t-tests.

Development of Remainder of Report

An outline of the remainder of the research report follows:

Chapter II  Review of the Literature
Chapter III  Design of the Study
Chapter IV  Evaluation of the Data
Chapter V  Summary, Conclusions, and Recommendations
Notes


4 Falzetta, p. 8.

5 Kuhn, "Computer-Assisted Instruction in Music," p. 91


21 Deihl, "Basic Musicianship," p. 82.

22 An eight-week session was proposed, but delay in delivery of equipment and program revisions resulted in a shorter experimental period.

CHAPTER II

REVIEW OF THE LITERATURE

Introduction

In the 1960s, B. F. Skinner was actively engaged in the formulation of the principles of self-paced/individualized instruction. As a mode for delivery, he constructed a teaching machine based on a revision of the model by Sidney Pressey which had failed to attract the attention of educators in the 1920s. By combining the elements of Skinner's programmed instruction and his teaching machine presentation into the modernized computer medium, computer-assisted instruction was born.\(^1\)

Presented with a new instructional tool, educators first attempted to define the role of the computer in the educational setting. In 1972, the following objectives of computer education were published.

1. The computer should help teachers motivate students into doing better work in all subject areas
2. The computer should allow students to work on creative and complex problems that would be impossible to solve by manual methods
3. The computer should better prepare college students with an understanding of the application of computer science to their special field of study
4. The mystery and bewilderment which students may have concerning
computers and automation should be removed

5. The computer should be used to help implement individualized learning

6. The computer will provide teachers with a powerful teaching tool that can help them do a better job of teaching many subjects to students of all interest levels

7. The computer will provide solid background for computer science majors

In addition, six ways to incorporate the computer as an instructional tool were listed: 1) tutor, 2) drill master, 3) experiment, 4) simulation, 5) student scheduler, 6) problem solver.

Numerous studies relating to the effectiveness of CAI were done in the late sixties and the early seventies. Of the thirty-three studies reported in the Association for Educational Data Systems Journal in the summer of 1974, sixty percent found that the use of CAI increased achievement as a supplement or a substitute for the traditional method of instruction—often with spectacular progress. As compared to the non-traditional methods such as tutors, language laboratories, and programmed instruction, a CAI approach was found to obtain equally effective results. In regards to the various modes of CAI (drill and practice, tutorial, problem solving, and simulation), it was stated that drill and practice was the most consistently effective. In fact, almost all studies cited showed drill and practice to be more effective when compared to traditional classroom instruction.

Several other conclusions were also reported. The CAI method seemed to be more effective for lower ability students rather than for
the middle or higher ability students. Through the use of CAI techniques, boys tended to achieve larger gains than girls. This finding, based upon sex, provided encouragement for educators at the early stages to narrow the learning differences between boys and girls.

The research results published by the *Association for Educational Data Systems Journal* also discussed attitudes toward computer-assisted instruction, its cost effectiveness, and the need for additional investigation. All of the studies cited showed approval of CAI by both students and teachers unless there were problems with hardware. In relation to cost, it was found that CAI and supplementary audio-visual aids were approximately equal in their results if equal amounts of money were spent on each; and that cost effectiveness depends on how much greater achievement is worth. Since only the drill and practice method as applied to mathematics had been adequately tested at the time, a great need for further research and documentation was reported.³

Related specifically to CAI in music rather than CAI in education in general, a survey of 434 institutions, 429 of which were National Association of Schools of Music (NASM) affiliates, was conducted by Jones in 1975. Twenty-three of the schools contacted reported that they employed some form of CAI, and fourteen of those respondents were selected as experts and interviewed concerning their current development, general acceptance, and recommendations for future development of CAI in higher education. Several factors were reported as inhibitors to the development and acceptance of CAI in the field of music.

1. Lack of commercial distributors of CAI materials
2. Lack of compatibility of computer systems
3. Lack of background concerning computer applications among faculty members
4. Lack of well-trained support personnel to work with faculty members
5. Lack of availability of genuinely useful programs for music
6. Lack of understanding of the teaching and learning processes
7. Lack of a working program as a large-scale demonstration of CAI in music
8. Lack of a hierarchy of required musical learnings, definable in behavioristic terms

Jones also reported the following list of recommendations compiled from the replies of the institutions surveyed.

1. That teams of specialists be the principal thrust behind program development
2. That there is no critical need for a unique or common program language for music
3. That interface devices capable of handling musical input and output be developed
4. That the feasibility of circumventing problems of incompatibility of languages by automatic teaching machine translation be explored
5. That the development of functional curricular materials and research be concurrent processes
6. That efforts be made to find a vehicle to facilitate the exchange of CAI efforts
7. That drill and practice be continued as a viable mode of
presentation of CAI materials, and that CAI move away from the
direction of programmed instruction

From the opinions expressed by the educational community, a reluctance to accept and develop CAI in the music field was reflected.

1. Few educators were involved in using the computer for teaching purposes
2. Few students were learning through computer assistance
3. Few music educators or graduate students were involved in CAI-related research
4. Few quality course materials were available
5. No formal means for sharing CAI efforts in music existed

Many excellent sources are available on computers in general, computers in education, and computers in music education. Readings in humanistic research and several articles by Harry Lincoln on the subject of music research are recommended for students and teachers in music education.

Although they contain no CAI materials, books written by Lefkoff and Kostka both provide information on computer applications in music. Lefkoff includes sections by well-known music authors such as Barry Brook and Allen Forte on the relationship between the computer and music bibliography, analysis, notation, and composition. Kostka supplies a 641-item bibliography of significant writings published prior to mid-1973. Helpful bibliographies which concentrate on CAI may be found by van der Aar, Barnes, Lekan, Kurshan, and Levien.
Feasibility of CAI in Music

Having seen the effectiveness of computer-assisted instruction in many other academic disciplines, musicians became excited in the late sixties about the possible advantages of a union between music education and computer technology. Leaders in higher musical education anxiously began to test the potential of CAI.

One of the earliest projects which tested the feasibility of computer-assisted music training was reported in 1967. Working at Stanford University, Kuhn and Allvin constructed an experimental model extraction device which was capable of extracting pitch information directly from each note of a subject's musical performance and convey that information to a computerized teaching device for immediate evaluation. The researchers felt the potential was great.

The use of such computer-assisted teaching equipment would provide better understanding of the teaching process as well as the learning process in the areas of sight-singing and ear-training where present methods rely altogether too heavily on individually formed subjective ways.

This initial research project was tentative and experimental. A series of sightsinging exercises, branching instructions, and tests were encoded in a computer language which was specially designed for music instruction sequences. Controlled by an IBM 1620 computer, the instructional program judged the pitch accuracy of melodic patterns which students sang into a microphone. After completion of evaluation, the computer instructed the student to progress or repeat similar material for additional practice.

The main objective of this investigation was to study the interaction between the student and the machine. Feasibility of this
experimental system was verified. Student/machine interaction was highly positive, and increased pitch awareness by test subjects was reported. In addition, many areas of investigation such as curriculum sequencing and learning patterns as they relate in particular to eye-ear relationships in musical performance were suggested. Immediate application of research findings to melodic, harmonic, rhythmic studies, sightsinging, and dictation were also proposed. In 1971, Allvin continued to investigate the potential of computer-assisted instruction and its ability to augment the resources of the music teacher. He pointed out the need for a new pedagogical direction which would employ a behavioral science approach to solving music instruction problems rather than continuing to use the prevalent, historically based, theoretical-deductive method.

Benefits and goals, as well as examples of computer-assisted music instruction were discussed. Potential computer contributions were listed as individualized instruction, advancement in aural-visual techniques, and positive guidance in instructional sequencing based on error analysis. Whereas programs conducted by major universities concentrated on perceptual patterns and sequential ordering, research on the doctoral level generally has involved feasibility studies or comparison of teaching methods in isolated aspects of music theory. The first significant study in this area was done by Robert Placek at the University of Illinois in 1972. A single CAI lesson in rhythm was designed and programmed, and then was tested on six students from a music fundamentals course for elementary classroom teachers. Two program objectives were
stated: 1) the student can demonstrate a knowledge of the function of basic rhythmic notation and 2) the student can demonstrate a knowledge of the relation of rhythmic notation to aural rhythmic patterns. Out of eighty-four possible points, the test subjects scored a combined total of thirty points on the pretest and seventy-five on the post-test. Although the results lack credibility due to the very small sampling and the limited number of lessons, Placek's work was considered highly valuable for its contribution in the adaptation of a random-access audio device.

Thompson applied CAI techniques to another facet of music theory. In 1973 at the University of Utah, he developed an experimental program to teach music students to sing pitch patterns at sight. The major feature was a technique which enabled the computer to generate the instructional materials. Individualization was achieved by allowing each student to choose the level of difficulty of the exercises being practiced.

To test the effectiveness of the newly-developed materials, a sightsinging test was designed and validated by Thostenson of the University of Iowa. Results of the pretest-posttest format showed improvement significant at the .01 level for the experimental group over the control group. A questionnaire developed to sample student reactions and attitudes indicated favorable student response to CAI.

**Application of CAI in Music**

The studies cited in the previous section were all experimental. They helped to establish both the feasibility of computer-assisted instruction in music and the design requirements for such programs. The
actual delivery of musical instruction aided by the computer was to follow very soon.

By the fall of 1973, Kuhn had implemented CAI in the music theory courses at Stanford in the form of drill and practice in ear-training. Recognizing that drill has a fundamental function in the learning process, he listed several related facts for consideration.

1. In present educational systems a large fraction of the total time and effort is devoted to drill.
2. It is inefficient to have 28 pupils sit idly by while the 29th reports what he just understood.
3. Neither teachers nor pupils enjoy the present kinds of drill enough to oppose its automation.
4. In drill, as in few other phases of teaching or learning, we can hope to obtain the masses of statistically homogeneous behavior required to reveal the diverse effects and interactions we must have in order to understand the educational process.

Kuhn also addressed the concerns of educators who feared that the computer could replace teachers, and pointed out that drill-and-practice systems were meant to supplement the regular curriculum taught by the teacher.

Inspiration is left to human teachers, facts per se are left to books and other media, and the role of the computer is that of assisting the student in the development of appropriate and sound concepts.

"The computer's role is simply to amplify the teacher's capabilities. Its sole unique characteristic is speed. It does nothing that the instructor could not do if he had the time to do it."

In explaining how Stanford created a new computer-assisted instructional system for teaching music dictation skills, Kuhn listed five basic requirements which were considered and incorporated into its design.
1. Need for Sound: The primary stimulus must be provided by sound rather than by a textbook, workbook, or terminal.

2. Need for Real-time Interaction: Immediate feedback through computer interaction provides instant reinforcement.

3. Need for Individualization: By exercising a variety of options, the student is able to tailor the curriculum for the maximum personal benefit.

4. Need for Student Records: Detailed and accurate student records provide the information necessary to make branching decisions and check on student progress.

5. Need for Research: Through investigation of student performance on CAI programs, the computer may be utilized as a tool to study learning-acquisition patterns and effective curriculum construction.\(^{22}\)

Programs designed for the CAI system included materials to teach aural recognition of intervals, triads, chord progressions, modulations, as well as rhythmic and melodic dictation. Additional materials under consideration for future programming included modal recognition and dictation, twelve-tone dictation, and identification of non-harmonic tones.\(^ {23}\)

At the University of Delaware in the 1974-75 academic year, a computer-based dictation system named GUIDO (Graded Units for Interactive Dictation Operations) was developed by Hofstetter. Named for Guido d'Arezzo, inventor of the staff and principles of solmization, the system was able to play dictation exercises, display music notation, ask questions, and record student responses.
In the 1974-75 experiment, a freshman ear-training class of thirty-three was instructed for the first semester with drills and practice in the tape laboratory. For the second semester, the class was divided at random into the GUIDO group (seventeen) and the control group (sixteen). Both groups practiced as in the previous semester, but the GUIDO group also practiced at the computer terminals. At the end of the first semester, the mean harmonic dictation score was seventy-seven percent for the GUIDO and seventy-six percent for the control group. After the experiment, the control group mean score decreased to seventy-five percent; and the GUIDO group mean score increased to eighty-six percent. When applied to both groups, a t-test showed the difference between them to be significant at the .05 level.24

As recently as 1977, computer-assisted instruction in music theory was implemented at another major university. In the fall of that year, North Texas State University applied the microprocessor-based Automatic Music System (AMUS), developed by Scott and Hamilton, to drill and practice in ear-training. In designing AMUS, the developers were careful to allow for each student's needs. Four basic areas were considered necessary to include in software production.

1. sound—the student needs to hear musical sound combinations
2. immediate feedback—he needs to know whether he has identified a sound correctly before he forgets that sound
3. patience—it normally takes many repetitions before a student can accurately and consistently identify sounds
4. individualization—each student's weak points need to receive extra attention25

After the initial semester of operation with a single AMUS terminal, the results were very encouraging. The first generation of the
system was used in an experiment with two sections of twelve freshman music theory classes at North Texas State. These two sections were chosen as a result of scoring the lowest on a standard placement examination. Although both sections were taught by the same instructor, students in one class used the computer drill-and-practice programs while members of the other class did not. On the mid-term examination, those students who utilized the CAI facility had a median score of twenty percentage points higher than the students who did not. At the end of the fall semester, a significantly larger proportion of the CAI group passed with consistently higher grades than the members of the traditional group.

Plans for the future of CAI in ear-training at North Texas included notation display, addition of question generation capabilities, increased AMUS terminals for both CAI and experimentation, and modifications to allow for increased timbre and articulation possibilities. Computer identification of pitches hummed by students was also listed for consideration. Longer-range ideas involved the development of score entry through a piano keyboard and the production of a stand-alone version of the entire system using microprocessors to eliminate the time-sharing host computer.26

A comparative study contrasting CAI and traditional instruction in basic musicianship was conducted in the fall and winter quarters of 1976-77. Eighty students were randomly selected to participate in the aural discrimination project and were randomly assigned to experimental and control groups. Both groups used the same text and received the same lectures. However, the experimental group used CAI programs to
reinforce class learning in melodic, harmonic, and rhythmic dictation. The control group was allowed to choose any method for reinforcement of in-class learning.

As a result of the experimental treatment, Vaughn reported greater achievement by the group exposed to CAI over the group receiving "traditional" reinforcement. Significant F-ratios in melodic, harmonic, and rhythmic dictation all exceeded the .05 level of confidence. Positive student reaction and the need for additional research projects in CAI as it applies to music were noted. 27

Research to Improve CAI in Music

Study of the Learning Process

In 1979, Doerr discussed the factors which accounted for the slow pace at which computers have entered the world of education. Cost was a major factor along with the negative effect of complex operational procedures. The lack of teacher training, supporting curriculum, and significant research results have also contributed to the slow rate of acceptance. 28

Having established CAI as a valid method of instruction for music, researchers initiated experimental projects to improve on the method. For example, through concentration on perception, memorization, learning patterns, and motivation, as well as other cognitive-related areas, music educators hoped to discover ways to increase the effectiveness of computer-assisted techniques and increase acceptance.

Early efforts by Hullfish studied two methods of branching in CAI programs. One method was based on the history of student responses
(response-sensitive) while the other was based on the last response (response-insensitive). The primary goal of the experiment was to discover if the achievement and attitude of students in the two different programs were significantly different. At the conclusion of the learning sequences, achievement of the two groups was compared to find differences at four levels of the cognitive domain: knowledge, comprehension, application, and analysis. Significant differences were found in achievement, but no significant difference was found between the attitudes of the two groups.  

Another computer approach to music study was published the following year in 1973 with the nurturing of musicality as its purpose. Concentration was aimed at development of a musical ear or the ability to perform musically. Researchers at the Artificial Intelligence Laboratory of the Massachusetts Institute of Technology designed a learning environment in which students could manipulate and transform ideas about music as they related to the creation of their own musical awareness. This self-paced approach rested on the premise that studies concerning cognitive growth and its relation to perception should also be relevant to teaching and learning music. Rockart and Morton, also of M.I.T., presented a more in-depth look at computers in relation to the learning process in higher education.

In the 1975-76 academic year, the second phase of the GUIDO experiment at the University of Delaware was conducted by Hofstetter. Responses from seventeen freshmen music majors working through the 1969 Benward Workbook in Ear Training dictation exercises were preserved. The purpose of this study was to analyze the data base and to report
patterns of student learning which were discerned. The class met for two hours a week with the instructor, two hours a week in the laboratory on their own, and did additional practice on their own at the computer terminals. All students received the same sequence of harmonic dictation exercises, non-modulating only; and all students answered in the same order: 1) Roman numerals, 2) soprano, 3) bass. When working with GUIDO, students who answered incorrectly could continue working until they achieved the correct response; but only the first response was recorded for purposes of this study.

The results showed a grand mean on all of the exercises to be seventy percent; harmonies were considered to be mastered if the student's first response was correct at least seventy percent of the time. Mean scores for each unit ranged from fifty-nine (unit number two) to eighty-two (units number six and number fourteen). Cross-tabulations of answers and responses, percentage of times a particular chord was presented, a product-moment correlation between the study group and the population, and correlations were compiled.

From analysis of the data, seven confusion tendencies which effect the perception of harmonies were identified: 1) bass line confusions, 2) inversions, 3) chord function, 4) chord quality, 5) unperceived sevenths, 6) unperceived roots, and 7) favorite response confusions (when the student had no idea what the answer was, he invariably gave dominant as the answer). The level of student achievement on individual harmonies was found to be highly correlated with the percentage of times these harmonies were asked in the curriculum.

Between 1975 and 1978, several research projects involved interval
identification. In 1975, Killam, Lorton, and Schubert collaborated on a study which involved measurement of student accuracy in identifying simple melodic and harmonic intervals. Rather than "simple" sinusoidal waveforms, complex tones were used as a sound source for Stanford University's CAI ear-training system. Analysis of the recognition and confusion patterns showed a need for reevaluation of some common theories on perception of intervals. First, small variations in the playing speed had no effect on judgment, contrary to the commonly-held belief that slower performance time could increase the accuracy of identification. Secondly, it was found that the perfect octave was not an easy interval to identify; it was incorrectly identified twelve percent of the time. The study also showed an effect of the mode of presentation—harmonic, ascending, and descending. 

A 1978 project at Arizona State University also concentrated on interval identification. The purpose of the project was to find the optimum length of a drill session to gain maximum achievement and to determine the effectiveness of a drill program used for the treatment in the study. Two freshman music theory classes were assigned randomly to four groups which practiced 1) zero, 2) one, 3) two, 4) three times each week for a period of three weeks. Each treatment drill session lasted twenty-five minutes. Analysis of computer-generated pretest and post-test results indicated increased aural identification of intervals after practicing the drill program. A single twenty-five minute lesson was found to be the most effective. Further research on an increased number of weekly drills was recommended.

As a part of his continuing research efforts during 1977-78,
Hofstetter designed and evaluated a competency-based approach to interval recognition drills. In this delivery mode, students were required to master materials at one level of instruction before they were allowed to branch ahead to more advanced exercises. Through the mastery method, each student was provided with individualized instruction.

Evaluation of the competency-based project involved twenty-four music majors. Half of the group were required to meet a competency level of ninety percent while the other half were required to practice only a minimum number of intervals. Although the two groups devoted equal amounts of learning time, the CAI group improved significantly over the control group. Responses of the experimental group indicated negative attitudes toward the competency requirements. However, when given an option, the students unanimously recommended continuation of the model program.

A second competency-based program utilizing the University of Delaware's GUIDO system was initiated in the same academic year. Eighteen entering music majors worked through twenty-two chord-quality units as partial fulfillment of their course requirements in freshman music theory. Materials in the first semester consisted of quality identification in close position; the second semester was spent learning open position chord qualities.

Prior to instruction and at the close of both the fall and spring semesters, a two-part test was given to measure student achievement. Significant gains were registered for each semester, and the existence of a transfer mechanism was indicated. Analysis of responses after the spring test revealed the existence of five principles of chord-quality
1. Response clustering: chord confusion results from inversions rather than qualities

2. Augmented/diminished clustering: when they were missed, augmented and diminished chords were almost always mistaken for each other

3. Expectations affect the perception of the diminished chord in root position: only fifty-five percent of the responses to close position and twenty-one percent to open position were correct

4. The major chord in root position is difficult to hear: contrary to popular belief, the minor chord in root position was the easiest to recognize followed by the augmented chord and then the major chord in second inversion

5. The minor chord in first inversion and the diminished chord in root position are the most difficult to hear: expectation accounts for difficulty in hearing the diminished chord, and the majority of problems with identifying the minor chord in first inversion was due to confusions of inversions. At the .05 level, statistical results showed no significant relationship between the number of times chord qualities were asked and the scores on the test.\(^36\)

A third study involved confusion patterns in rhythmic dictation drills. Categories of rhythmic patterns included basic notes (quarter notes or regular divisions and subdivisions of quarter notes), dotted notes, duplets, and triplets in simple and compound meters. Confusion
patterns indicated that basic notes were never confused with dotted notes, duplets, or triplets—only other basic notes. However, dotted notes, duplets, and triplets were confused only with basic notes. Contrary to expectation, no differences were recorded between simple and compound meters. In both meters, basic notes were the easiest, duplets and triplets were of moderate difficulty, and dotted notes were the most difficult to identify correctly.37

Courseware Development

While isolating the various processes involved in acquisition of knowledge, educators were anxious to develop programs which would incorporate their findings and encourage the maximum benefit from CAI.

For most people who have been purchasing microcomputers, the main interest has been in getting them up and running. In the long run, however, attention will focus on the use of the system, with software becoming of crucial importance. The equipment is thus likely to be evaluated in terms of its performance for specific applications whether or not these make full use of the capabilities of the computer. Many people will probably be less interested in programming the computer themselves than in running previously developed programs.38

Working at Ohio State University, Arenson discussed guidelines for the development of CAI materials for use in music theory. In 1976, he reported on a model to be used in revising such materials and a prototype program to be used in testing the proposed model. The purpose of the study was to inform developers of CAI software of the potential problems they might encounter and to offer constructive methodology to correct those problems.39 Various other authors have made recommendations in this important area of lesson design for computer-based systems. However, they restrict themselves to application in the field of
education in general rather than to music education in particular. 40

Most music educators just do not understand basic computing concepts and techniques. According to Parrish, this situation exists due to a lack of information concerning: 1) evaluation of the computer as a research tool in music education, 2) application of computer research to the field of music education, and 3) available courses for music educators to study computer research. To help remedy these deficiencies, he developed and evaluated a course of study which would provide music instructors with the knowledge and skills necessary to evaluate the computer as a research tool and take advantage of its many benefits.

To evaluate Parrish's model, a final revision of two pilot programs was offered as a course at Florida State University. Lesson design consisted of four units comprised of individual modules based on behavioral objectives. Unit one was an introduction to computers and music through a specially prepared media presentation. Unit two consisted of readings relative to current use of computers in music, the arts, music education, and society in addition to information retrieval, instruction, and sound synthesis. Unit three involved teaching students to employ algorithms and flowcharting principles to organize and document computer tasks when faced with music programming problems. Unit four consisted of interaction with the computer through an introduction to basic computing operations and skills. Lectures discussed several common computer languages, packages for use in statistics, information storage and retrieval, and graphics.

Auto-tutorial texts which employed programmed, standard instructional formats were designed for the course. Techniques and materials
utilized seemed to promote efficient learning and positive attitudes.\textsuperscript{41}

A 1971 index of CAI testified to the enthusiasm being played in the area of software development. In 1967, it was reported that less than one-hundred programs, many of which were not proven, were available. In the second edition (1970), Lekan listed 910 programs as compared to 456 which listed in the 1968 edition. The third edition described 1,264 programs from seventy subject areas. At that time, the editor predicted equal or accelerated production of software.\textsuperscript{42}

Software production is indeed moving at an accelerated pace. One major reason is that developers have given considerable thought to ease and convenience in programming for the person who is unfamiliar with computers. The result is author languages.

Author languages are especially useful for teachers. In contrast to standard languages which operate in an input-process-output format, author languages are designed to guide the author in entering lessons and organizing a dialogue presentation typical of instructional interaction. Brief codes for presenting instructional events and verbal material avoid complicated and time-consuming encoding. Some of the languages prompt and guide the author in entering the sequence of activities, instructional statements, questions and expected answers, responses, and branches according to the format of the particular language being used. Some of the more common languages available include Coursewriter, PLANIT, PILOT, IDF, DECAL, PLATO, and TICCIT.\textsuperscript{43}
Hardware Development

Music instruction, inherently linked to sound and sight media, and musical skills, requiring repetitive drill, need the technology of science to couple with art. Perhaps music educators can "invent the future," as one sage expressed it, rather than predict it.  

In this new age of microcomputer technology, music educators are building on the past to "invent" the future. The first generation computer hardware consisted of electric tubes, unsophisticated software, and basic assemblers. With the invention of solid-state circuitry, the second computer generation began. Software had improved with input/output service routines and high-level compilers. The third generation incorporated integrated circuitry advances in software, time-sharing, and multiprogramming.  

The new era— that of the microcomputer—is one of the personal computer. Since the size is small, the computing power is limited to one computer programming task at a time. However, this has cut the cost of computers to an affordable level for home and school use. With this perspective, one of an industry that has worked from a large multiple-user environment to one of a small, personal user environment, the reader can assess the developments in computer hardware as they apply to music instruction. Several unique problems are presented to the developers of computer hardware when the concept of audio instruction is considered. Since music is an aural medium, computers had to be developed to generate sound, play back music, record music performance, and analyze music performances.  

Hardware is in a state of progressive development. For sound generation, various peripherals such as D-to-A sound synthesizers have been developed for microcomputers. These synthesizers, or "music boards" as they are called, have greatly increased the effectiveness of CAI in ear-training. Keyboards have been interfaced to computers to judge performance and promote the feasibility of individualized instruction. To judge the accuracy of vocalists or instrumentalists other than keyboard
performers, an analog to digital process is being applied. However, the process is not yet at an acceptable level of accuracy to be used in judging music performance.

The newest available technology to be used in connection with computers and instruction in a few years involves the video disk and the bubble memory which allows greatly increased computer storage. The video disk is used for storage and retrieval of video and audio information.
Summary

Only within the last three years has the microcomputer been a reality. In that period of time, several hundred thousand microcomputers have been sold, mainly to intrigued individuals and to schools that were convinced of the potential the smaller hardware held for computer-based education. "Certainly the microcomputer is rapidly becoming a part of contemporary society, affecting our homes, our businesses, and our schools."48

The future of CAI rests in the development of microcomputers. Decrease in hardware size and cost, and increased population of both hardware and software are greatly improving not only the potential applications, but the accessibility of microcomputers. In fact, the ideal that production companies are striving to attain is to have a computer in every American household. As of March 1978, Radio Shack was well on its way to accomplishing this goal by manufacturing approximately 350 computers per day.49

Microelectronic technology is having a dual impact on music education. First, it is lowering the cost of computer equipment so that music schools and even private individuals can afford it. Second, it is increasing the range of applications of computers to music education, by its inclusion of high-speed graphics for music notation, voice input for teaching singing, and orchestral simulation for teaching orchestration and conducting, in addition to applications which have already been developed. Through the widespread use of microelectronics, music training will become much more available to the public than it ever has been in the past. By properly harnessing this technology the field of music education can make great progress towards improved instructional strategies and delivery techniques. Music educators can collectively develop effective curricula and distribute them across the population resulting in the public's being more keenly aware of music, a condition that can only be of great benefit to our profession.50
Notes


11. Ibid.


19 Ibid., p. 91.


23 Ibid., pp. 96, 100.


29 Hullfish, 1972.


42. Lekan, p. ix.


47. Ibid., pp. 20-1.

49 Howe, pp. 81-2.

CHAPTER III

DESIGN OF THE STUDY

Introduction

The experimental method of research was employed to complete this study. Following the Solomon Four-Group Design as outlined by Campbell and Stanley,\(^1\) experimental and control groups were determined at random; and results of the pretest-posttest format were tested statistically by ANOVA (analysis of variance) procedures. Chi square and t-tests were also run to obtain additional information concerning related hypotheses. The main objective of the study was to measure musical achievement of second-semester freshman music theory students using pre-recorded tapes and computer programs. Statistics pertaining to amount of practice and scores below seventy also were to be obtained.

Preliminary Considerations

Prior to beginning the study, the investigator consulted with faculty members involved in teaching freshman music theory as to their willingness to participate in an experimental research project in ear-training. Departmental permission for the study was obtained from Professor John F. Edmunds, Coordinator of Freshman Theory, and Professor Paul L. Abel, Coordinator of Music Theory. Approval on the University level was granted by Dr. W. Sheldon Biven, Chairman, Committee on the Use of Humans and Animals as Research Subjects (see form, appendix B).
Individual permission was acquired from each student in Music 1702 (see form, appendix B).

To insure equality in the level of difficulty of dictation materials, the computer programs contained the same exercises which were available in the taped medium. These exercises were taken from the units of *Aural Harmony* by A. Eugene Ellsworth which corresponded to the chapters studied in class through mid-term. Both the tapes and the computer programs were available for practice in the Ear-Training Laboratory Monday through Thursday from 9:30 A.M. to 4:30 P.M. and Friday from 9:30 A.M. to 1:30 P.M.—a total of thirty-two hours a week.

**The Main Study**

**The Subjects**

The research population for this study consisted of the total number of students who were enrolled in Music 1702 in the spring of 1981. After six withdrawals from the course, fifty-six subjects remained. To insure randomization, students in each of the four sections signed a numbered sheet which was circulated around the classroom. The investigator had predetermined that odd numbers would comprise the control group and even numbers would comprise the experimental group. Only every other person in each group was assigned to take the pretest in order to test its effect. Since each section of the subject was taught by a different instructor, an attempt was made to equalize the number of students from each class in the control and experimental groups. However, differences in class enrollments were so great, that attempts at equalization were abandoned and the total population from all Music 1702 classes was included in the research project.
The Test

In order to facilitate scheduling, the posttest was administered during the regular mid-term examination period. Therefore, according to standard procedure, the ear-training examination was designed after input and feedback from each of the instructors teaching freshman music theory. Patterned after mid-term tests given in previous semesters, the pretest-posttest covered those materials studied through chapter seventeen of the required text, *Elementary Harmony* by Robert W. Ottman. Since the pretest-posttest was not a standardized examination, no established norms for reliability and validity can be reported.

The Design

The research design chosen for the ear-training experiment was the Solomon Four-Group Design (see table 2).

TABLE 2

SOLOMON FOUR-GROUP DESIGN

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(R = random assignment, O = observation (testing), X = experimental treatment, X's = experimental group members, C's = control group members)
Based upon signatures as previously explained, students in all four sections of Music 1702 were randomly assigned to experimental and control groups. The even-numbered students of each group were requested to participate in pretesting. Only half of the total research population took the initial examination in order that any effect of pretesting on the results of the posttest could be statistically measured. The first and third observations ($O_1$ and $O_3$ in groups one and two) represent the pretest for the experimental and the control groups (see table 2). Observations two, four, five, and six ($O_2$, $O_4$, $O_5$, and $O_6$) represent the posttest which was taken by all groups.

The experimental treatment (computer programs) was introduced to only two of the groups in order to measure its effect. Students from each of the four class sections were placed in each of the four design groups in order to remove any teacher effect.

Design Group 1: experimental (computer) pretested
Design Group 2: control (tape) pretested
Design Group 3: experimental (computer)
Design Group 4: control (tape)

The Materials

Practice materials consisted of two reel-to-reel tapes for the control group and ten computer programs for the experimental group. The Aural Harmony tapes had been available in the Ear-Training Laboratory since it opened in the fall of 1978. Students listened to the tapes and wrote the answers in the frames provided in their class copy of Aural Harmony. Answers were also provided with each frame.
Experimental practice materials consisted of the same exercises duplicated in the computer medium and CAI format. The content of both the tapes and the computer programs was composed of short harmonic dictation drills of four to twelve chords which concentrated on practice involving the leading tone, supertonic, submediant, and mediant triads. Each of the ten computer programs was designed to last approximately thirty minutes for the "average" student. Although three hours of taped materials were available, it is not known how the playing time compared to the practice time for the control group members.

The Procedure

The pretest was given by the investigator at 5:00 P.M. on January 22, 1981 (the fourth day of classes). This later date was chosen to assure stabilization of all sections of the course caused by late registration and section changes by students. The even-numbered members of both the experimental and control groups were in attendance.

Due to unavoidable delays in arrival of computer equipment, the programs were not available for practice in the Ear-Training Laboratory until February 9, 1981. After the instructors had introduced the project, the investigator visited each class to give general background and to explain the role of each student. Each student, regardless of his assigned research group, was asked to practice a minimum of thirty minutes twice a week. Additional practice time was encouraged whenever equipment was available.

When practicing in the Ear-Training Laboratory, all persons must sign in and out and list the equipment used on the Check-out List (see
form, appendix B). By utilizing this information, it was possible to compile records on the amount of practice for members of both research groups. In addition, the students in the experimental group kept account of their practice sessions on a Computer Dictation Record by listing the program number and title, the amount of time spent per visit, the number of exercises completed, and the overall average for those exercises (see form, appendix B).

Students in the control group were seated in front of a tape deck with headphones and their ear-training textbook. The number of hearings, amount of material heard, and length of time between hearings were all controlled by the listener. Answers were recorded in the spaces provided. The key and time signatures were printed, and written cues were often supplied. Students could check their answers with those provided in their book.

Students in the experimental group were seated in front of the CRT and keyboard with headphones which were connected to a small amplifier. Tones were produced by the D/A converter "music board" (chip). Their answers were recorded on paper and then typed into the computer. Before the dictation exercises began, instructions concerning operation of the computer were displayed on the screen. The student was told that he would hear a five-note introduction for key orientation and then the exercise would begin. Based upon his own decision, the student could hear each dictation example up to three times. The amount of time between hearings was controlled by the listener, but each hearing presented a complete exercise. After the third hearing, the computer requested the answers to be typed in. If the wrong number of answers was entered, the
computer informed the student as to how many extra/insufficient answers he had typed and again requested that the answers be entered. Next, the student immediately was shown his graded answers with the correct answers displayed directly beneath. He was then given an opportunity to hear the example one additional time while both his own and the correct answers were displayed. The score for the current exercise and the average for the total exercises completed were then displayed along with a progress statement or an "encouraging word" from the computer. This process was repeated until the end of the program (see sample runs, appendix A).

The computer presentation incorporated two additional features. In response to the score on each individual exercise, the tempo of the material being played was regulated. These adjustments were set to occur for scores of one-hundred, below sixty, and for each ten-point increment between. Therefore, slower students were not quite so pressured while the better students were encouraged to work up to their ability.

Experimental group members were requested to practice the computer programs in the order in which they corresponded to the chapters of the textbook. Until a score of seventy or better had been achieved, the students were instructed to continue practicing on the current program. To prevent the student's partial memorization of the materials, the exercises were always presented in a random order determined by the computer.

It must be mentioned that problems did occur. Since the computer equipment was new, it was unfamiliar to research participants and laboratory workers alike. Although the experimental group members were enthusiastic about the opportunity to work with the computer, all too often
their practice was delayed or they were unable to practice at all because of malfunctions of one kind or another. Neither the investigator nor other qualified personnel could be present constantly and several students were inconvenienced and possibly became discouraged and disillusioned. This situation was very unfortunate.

The posttest, which served as the mid-term examination for all four sections of Music 1702 freshman music theory, occurred March 13, 1981. It was administered to each section by its instructor.
Notes

1 Campbell and Stanley, pp. 24-5.

2 Ibid.
CHAPTER IV

EVALUATION OF THE DATA

Introduction

In analyzing and discussing the data, several areas of concentration will be reported: 1) mean scores for the pretest, posttest, and final examination (May 1981), 2) mean gain scores between test periods, 3) scores below seventy on the pretest, posttest, and final examination (May 1981), and 4) practice between tests. Besides the pretest and posttest scores of the Solomon design, scores from the previous semester's final examination (December 1980) and the experimental semester's final examination (May 1981) will be considered for a broader view of progress in comparison to points before and after the research project.

Several analytical methods from the Statistical Analysis System (SAS) were utilized to study the available data. Analysis of variance (ANOVA), t-test, paired t-test, chi square, regression, and correlation procedures were employed.

An analysis of variance is an analysis of data based on the sums of squares of deviations in relation to their means. ANOVA results from two normal populations are expressed as an F value. The t-test is a statistic which compares means when there are only two samples, and a paired t-test is a statistic which compares the means of two populations based on paired observations from small samples. A chi square tests
"independence" when there are only two classifications of a contingency table being compared.

A regression analysis is a more general procedure which investigates what effect independent variables have on dependent variables. Results are charted in respect to an X and a Y axis. Correlation measures how well a straight line explains the relationship between two variables.\(^1\)

Two additional terms which must be reported when discussing statistical procedures are degrees of freedom (DF) and levels of confidence/levels of significance. The term degrees of freedom, symbolized by \(n\), \(n-1\), or \(n-2\), refers to the quantity of information available for estimating population variance. The level of significance refers to the outcome of a specific statistical test of a hypothesis. The resulting level is the probability of drawing a test value contradictory to the null hypothesis. Expressed as a percentage, the significance, or confidence level, indicates the validity or invalidity of a hypothesis. The levels of confidence chosen for comparison with the observed test values range from .0008 to .10 depending on the discipline, with application of .01 and .05 being the customary practice. Physical science studies, which involve minute variations, impose higher significance levels; whereas psychological, sociological, or educational studies involving greater degrees of variance because they are observing people, accept lower levels of confidence.\(^2\)

**Analysis**

Hypothesis 1: At the .05 level of confidence, there will be no significant difference between the mean scores of the control
and experimental groups on the pretest (January 1981).

Research subjects from each of the four freshman music theory classes were assigned randomly to the experimental and control groups. Half of each of those groups then were assigned randomly to the pretest groups. The purpose of this procedure was to measure any possible effect of preliminary testing. Since comparison was being made between only two groups, a t-test was run to check for significance. None was found, and the null hypothesis was accepted.

Hypothesis 2: At the .05 level, there will be no significant difference between the mean scores of the control and experimental groups on the posttest (mid-term—March 1981).

Following a five-week period of classroom instruction and practice outside of class in the Ear-Training Laboratory, the entire research population was given the posttest in conjunction with the regular mid-term examination period. After completion of analysis of variance (ANOVA) procedures, a difference of approximately seven points between the two research groups was found to be non-significant; and the null hypothesis was accepted. However, the difference between groups was significant at the .10 level in favor of the experimental group.

Hypothesis 3: At the .05 level, there will be no significant difference between the total number of practice sessions by the students of the control (tape) group and by the students of the experimental (computer) group between the pretest and the posttest.

Students in each of the design groups were told to practice thirty minutes twice a week. This was the suggested minimum, and additional
practice was encouraged. By allowing students the freedom to choose whether or not to practice, it was hoped that a pattern suggesting preference for one medium or another would be found.

Eighty percent of the practicing prior to the posttest was performed by members of the experimental group. On the basis of a chi-square test, the null hypothesis was rejected. The difference in the total practice sessions for each group was so great, that it proved to be significant at the .001 level.

Hypothesis 4: At the .05 level, there will be no significant difference between the number of students in the control group and the number of students in the experimental group who score below seventy on the pretest.

Differences in the number of scores below seventy for each of the two groups were small. The null hypothesis, therefore, was accepted.

Hypothesis 5: At the .05 level, there will be no significant difference between the number of students in the control group and the number of students in the experimental group who score below seventy on the posttest (mid-term).

Although differences measured by a chi-square test showed no statistical significance, there was a large practical difference of eighteen percent in the number of scores below seventy between the control and the experimental groups. The null hypothesis, however, was accepted.

Hypothesis 6: At the .05 level, there will be no significant difference between the mean scores of the control and experimental groups on the final examination (May 1981).

To test a possible long-range effect, comparisons were made on the
final examination (May 1981). ANOVA indications showed no significance, and the null hypothesis was accepted. The level of confidence for the mean scores of the two groups on the final examination in May approached .10.

Hypothesis 7: At the .05 level, there will be no significant difference between the total number of practice sessions by the students of the control (tape) group and by the students in the experimental (computer) group between the posttest and the final examination.

A chi-square test of comparison showed the difference in the amount of practice done by each group between mid-term and finals to be highly significant. The null hypothesis was rejected. In this time period, practice was significant for the control group.

Hypothesis 8: At the .05 level, there will be no significant difference between the number of students in the control group and the number of students in the experimental group who score below seventy on the final examination.

Looking for long-range effects, a chi-square test was performed to discover what different effects may have resulted between the two research groups after the experiment was completed. Statistical findings were not significant, and the null hypothesis was accepted.

Large practical differences were found. Within the period from the posttest to the final examination, a decrease of 18.7 percent by the tape group was measured. The computer registered no change for the same time period.

Hypothesis 9: At the .05 level, there will be no significant difference
between the mean gain scores of the control group from the pretest to the posttest and the mean gain scores of the experimental group from the pretest to the posttest.

When compared through a t-test, the difference between the two research groups proved to be insignificant. Therefore, the null hypothesis was accepted.

Hypothesis 10: At the .05 level, there will be no significant difference between the mean gain scores of the control group from the posttest (mid-term—March 1981) to the final examination (May 1981) and the mean gain scores of the experimental group from the posttest (mid-term—March 1981) to the final examination (May 1981).

Again, small differences between the gains by the two groups from one testing period to the next proved not to be significant. The null hypothesis was accepted.

Hypothesis 11: At the .05 level, there will be no significant difference between the mean gain scores of the control group from the pretest to the final examination (May 1981) and the mean gain scores of the experimental group from the pretest to the final examination (May 1981).

The difference in the gain scores of the control group and the gain scores of the experimental group was 1.6 points. Based on a t-test, that difference proved to be non-significant, and the null hypothesis was accepted.

Hypothesis 12: At the .05 level, there will be no significant difference between the mean gain scores of the control group from
the final examination (December 1980) to the posttest
and the mean gain scores of the experimental group from
the final examination (December 1980) to the posttest.

Since the pretest was taken by only one-half of the total research
population, it was decided to record scores from the final examination
of the previous semester. This was done in order that a reference point
would be available for all of the research subjects. When comparing the
paired gain scores from December to May for both research groups, t-test
results showed significance at the .01 level. The null hypothesis was
rejected.

Hypothesis 13: At the .05 level, there will be no significant difference
between the mean gain scores of the control group from
the final examination (December 1980) to the final
examination (May 1981) and the mean gain scores of the
experimental group from the final examination (December
1980) to the final examination (May 1981).

A difference of 4.05 points was found between the average gain
scores of the computer and the tape groups. Results of a t-test using
paired data proved significance at the .0001 level. The null hypothesis
was rejected.

Discussion

The first category of hypotheses to be considered is related to
mean scores (see table 3). Table 4 shows the results of statistical
procedures involving the pretest, posttest, and May final. As expected,
the mean scores on the pretest were not significantly different. The
posttest scores showed significant difference at the .10 level, and
Scores on the May final approached significance at the .10 level.

### TABLE 3
**MEAN SCORES ON TESTS AND AVERAGES FOR DESIGN GROUPS**

<table>
<thead>
<tr>
<th></th>
<th>Pretested Average</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tape</td>
<td>Computer</td>
</tr>
<tr>
<td>December Final</td>
<td>77.9</td>
<td>82.7</td>
</tr>
<tr>
<td>Pretest</td>
<td>50.7</td>
<td>60.5</td>
</tr>
<tr>
<td>Posttest</td>
<td>74.4</td>
<td>83.9</td>
</tr>
<tr>
<td>May Final</td>
<td>74.8</td>
<td>86.2</td>
</tr>
</tbody>
</table>

### TABLE 4
**STATISTICAL RESULTS RELATING TO TESTS**

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>DF</th>
<th>t-value</th>
<th>Critical value at .05</th>
<th>Prob. t</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1 Pretest</td>
<td>24</td>
<td>-.9767</td>
<td>2.06</td>
<td>.83</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>DF</th>
<th>F-value</th>
<th>Critical value at .05</th>
<th>Prob. F</th>
</tr>
</thead>
<tbody>
<tr>
<td>#2 Posttest</td>
<td>1 and 62</td>
<td>2.74</td>
<td>4.00</td>
<td>.10</td>
</tr>
<tr>
<td>#6 May Final</td>
<td>1 and 44</td>
<td>2.48</td>
<td>4.06</td>
<td>.12</td>
</tr>
</tbody>
</table>
Higher levels of significance were expected on statistical results for the scores on the posttest and final examination (May 1981). However, a study of the ranges of the design groups offered some explanation.

On the posttest, the lower boundaries of the ranges were thirty for tape, forty-eight for computer, fifty-six for tape-pretested, and fifty-eight for computer-pretested. The upper boundary for tape-pretested was ninety-nine, and for the other three groups it was one-hundred. This wide range of scores indicates the wide variability within each group. This great amount of variation within the groups added to the problem of testing the variation between groups as a result of the treatments used. Similar variation existed in the ranges of the May final.

The second category of related hypotheses involves the mean gain scores between tests. In table 5, it may be seen that the greatest difference in the group means disregarding those using the December final is 1.6 for the period between the pretest and the May final examination. However, the differences in the two mean gains measured from the December final are much larger. From the December final to the posttest, average mean gains for the tape and computer groups showed a difference of 7.1 points. From that same starting point of reference to the May final, the difference in the average mean gains was 4.05 points.

The smaller differences in the average mean gains were not statistically significant. The gains measured through the posttest were significant at the .01 level of confidence. The gains through the entire semester proved to be significant at the point of .0001 (see table 6).
TABLE 5

MEAN GAIN SCORES BETWEEN TESTS FOR DESIGN GROUPS

<table>
<thead>
<tr>
<th></th>
<th>Pretested</th>
<th></th>
<th></th>
<th>Average</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tape</td>
<td>Computer</td>
<td>Tape</td>
<td>Computer</td>
<td>Tape</td>
</tr>
<tr>
<td>Pretest to</td>
<td>23.7</td>
<td>23.4</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Posttest</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Posttest to</td>
<td>.4</td>
<td>2.3</td>
<td>8.9</td>
<td>5.0</td>
<td>4.7</td>
</tr>
<tr>
<td>May</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pretest to</td>
<td>24.1</td>
<td>25.7</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>May</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>December to</td>
<td>-3.5</td>
<td>1.2</td>
<td>-7.1</td>
<td>1.7</td>
<td>-5.3</td>
</tr>
<tr>
<td>Posttest</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>December to</td>
<td>-3.1</td>
<td>3.5</td>
<td>1.8</td>
<td>3.3</td>
<td>-.65</td>
</tr>
<tr>
<td>to May</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hypothesis</td>
<td>DF</td>
<td>t-value</td>
<td>Critical value at .05</td>
<td>Prob. t</td>
<td></td>
</tr>
<tr>
<td>-----------------------------</td>
<td>-----</td>
<td>---------</td>
<td>-----------------------</td>
<td>---------</td>
<td></td>
</tr>
<tr>
<td>9: Pretest to Posttest</td>
<td>24</td>
<td>0.1487</td>
<td>2.06</td>
<td>0.56</td>
<td></td>
</tr>
<tr>
<td>10: Posttest to May</td>
<td>54</td>
<td>-0.3247</td>
<td>2.02</td>
<td>0.62</td>
<td></td>
</tr>
<tr>
<td>11: Pretest to May</td>
<td>24</td>
<td>0.4427</td>
<td>2.06</td>
<td>0.66</td>
<td></td>
</tr>
<tr>
<td>12: December to Posttest</td>
<td>27</td>
<td>-6.435</td>
<td>1.70</td>
<td>0.01</td>
<td></td>
</tr>
<tr>
<td>13: December to May</td>
<td>27</td>
<td>59.52</td>
<td>1.70</td>
<td>0.0001</td>
<td></td>
</tr>
</tbody>
</table>
The fact that only the comparisons involving the final examination scores from the previous semester were significant, is very interesting. Since the scores were so low on the pretest, measurement involving the pretest might not be a successful predictor of significance in relation to gain. When comparing mean gains from the December final, all of the groups were starting at an approximately equal level with means of 77.9 for tape-pretested, 78.0 for computer, 79.8 for tape, and 82.7 for computer-pretested (see table 3). On all of the other tests, the differences between the means of the research groups ranged up to ten and eleven points.

It also should be noted in table 5 that from the period between the December final and the posttest, both of the tape groups decreased their mean scores with a combined loss of 10.6 points. In the same period, the two computer groups had a combined increase of 2.9 points. In the period from the December final to the May final, the tape groups registered a combined loss of 1.3 points; and the computer groups enjoyed a combined increase of 6.8 points. In addition to accurate predictors of significance, statistical results relating to mean gains between tests, perhaps may also be pointing out information which involves length of learning time.

The third category of similar hypotheses is related to scores below seventy on each of the three tests given in the spring semester 1981. Table 7 shows the frequency of scores falling below seventy and the rather large differences between groups on the pretest and posttest. However, percentages for the two final examinations are all within 2.7 points of each other. In table 8, it may be seen that even test results
which reported the largest practical difference between the tape and computer groups are not significant although the .17 level of confidence is the highest of the three statistical results.

TABLE 7

PERCENTAGE OF SCORES BELOW SEVENTY WITHIN DESIGN GROUP

<p>| | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pretested</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tape</td>
<td>Computer</td>
<td>Tape</td>
<td>Computer</td>
<td></td>
</tr>
<tr>
<td>December</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Final</td>
<td>30.8</td>
<td>28.6</td>
<td>20.0</td>
<td>26.7</td>
<td>25.4</td>
</tr>
<tr>
<td>Pretest</td>
<td>78.8</td>
<td>64.3</td>
<td>---</td>
<td>---</td>
<td>78.8</td>
</tr>
<tr>
<td>Posttest</td>
<td>43.7</td>
<td>12.5</td>
<td>43.7</td>
<td>37.5</td>
<td>43.7</td>
</tr>
<tr>
<td>May Final</td>
<td>38.5</td>
<td>23.1</td>
<td>13.3</td>
<td>26.7</td>
<td>25.9</td>
</tr>
</tbody>
</table>

TABLE 8

STATISTICAL RESULTS RELATING TO SCORES BELOW SEVENTY

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>DF</th>
<th>chi value</th>
<th>Critical value at .05</th>
<th>Prob. chi</th>
</tr>
</thead>
<tbody>
<tr>
<td>4: Pretest</td>
<td>1</td>
<td>.2777</td>
<td>3.84</td>
<td>.60</td>
</tr>
<tr>
<td>5: Posttest</td>
<td>1</td>
<td>1.85</td>
<td>3.84</td>
<td>.17</td>
</tr>
<tr>
<td>8: Final</td>
<td>1</td>
<td>.1538</td>
<td>3.84</td>
<td>.70</td>
</tr>
</tbody>
</table>
Even though the computer groups began with a slightly greater average percentage of scores below seventy, they were able to maintain a consistent percentage. The tape groups, on the other hand, registered a wide fluctuation on the posttest with an increase of 18.3 percent in the lower scores (see table 9).

**TABLE 9**

GAINS IN PERCENTAGES OF SCORES BELOW SEVENTY
FOR DESIGN GROUPS

<table>
<thead>
<tr>
<th></th>
<th>Pretested Average</th>
<th></th>
<th>Average</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tape</td>
<td>Computer</td>
<td>Tape</td>
<td>Computer</td>
</tr>
<tr>
<td>December to Pretest</td>
<td>48.0</td>
<td>35.7</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td></td>
<td>53.4</td>
<td>36.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pretest to Posttest</td>
<td>-35.1</td>
<td>-51.8</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td></td>
<td>-35.1</td>
<td>-39.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>December to Posttest</td>
<td>12.9</td>
<td>-16.1</td>
<td>23.7</td>
<td>10.8</td>
</tr>
<tr>
<td></td>
<td>18.3</td>
<td>-2.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Posttest to May</td>
<td>-5.2</td>
<td>10.6</td>
<td>-30.4</td>
<td>-10.8</td>
</tr>
<tr>
<td></td>
<td>-17.8</td>
<td>-0.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>December to May</td>
<td>7.7</td>
<td>-5.5</td>
<td>-6.7</td>
<td>0.0</td>
</tr>
<tr>
<td></td>
<td>0.5</td>
<td>-2.7</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In table 9, the gains shown for the average tape groups indicate an irregular pattern of rising and falling failing scores, whereas, the average computer groups show consistently lower failing percentages. Changes in scores below seventy may have resulted from practice.
The final group of related hypotheses to be compared involves practice outside of class as recorded in the Ear-Training Laboratory. The willingness to practice is shown in table 10 for each research group. Note the almost inverted pattern of attendance between the two groups. Sixty-seven percent of the computer group members practiced from two to ten or more times, while seventy-seven percent of the tape group members practiced once or none at all. The willingness of the experimental group members to practice before the posttest is significant at the .001 level. Their reluctance to practice after the posttest without the computer medium is significant at the .0002 level (see table 11).

TABLE 10
PERCENTAGE OF ATTENDANCE AT REQUESTED PRACTICE BETWEEN THE PRETEST AND THE POSTTEST

<table>
<thead>
<tr>
<th>Sessions</th>
<th>Tape</th>
<th>Computer</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>52%</td>
<td>20%</td>
</tr>
<tr>
<td>1</td>
<td>25%</td>
<td>13%</td>
</tr>
<tr>
<td>2 - 4</td>
<td>14%</td>
<td>29%</td>
</tr>
<tr>
<td>5 - 10 (or more)</td>
<td>9%</td>
<td>38%</td>
</tr>
</tbody>
</table>
TABLE 11

STATISTICAL RESULTS RELATING TO PRACTICE
BEFORE AND AFTER THE POSTTEST

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>DF</th>
<th>chi value</th>
<th>Critical value at .05</th>
<th>Prob. chi</th>
</tr>
</thead>
<tbody>
<tr>
<td>3: Pretest to Posttest</td>
<td>1</td>
<td>55.09</td>
<td>3.84</td>
<td>.001</td>
</tr>
<tr>
<td>7: Posttest to May Final</td>
<td>1</td>
<td>16.77</td>
<td>3.84</td>
<td>.0002</td>
</tr>
</tbody>
</table>

In Table 12, it can be seen that the willingness to practice is related to the students' test scores. The students with lower averages are anxious to find a method to improve their grades, but students who are consistently able to make higher scores on ear-training examinations see no advantage to practice outside of class in lieu of utilizing that same amount of time where it would afford them a greater benefit. It is this group of talented students who do relatively little practice at all and are still able to make very high grades on aural examinations, who have complicated the statistical analysis of the effects of practice on test scores.

Table 12 also shows a relationship between test means in the middle or at the end of a semester. In all but one case, the mid-term means are lower than those of either of the final examinations. Comparison of final tests from the fall and the spring indicates a negative difference of -2.5 for attendance at one practice session, and minor positive and
TABLE 12
MEANS AND GAINS FROM FALL 1980 TO SPRING 1981
AS RELATED TO PRACTICE

<table>
<thead>
<tr>
<th>Practice Sessions Attended</th>
<th>Final Fall 1980</th>
<th>Mid-Term 1981</th>
<th>Final Spring 1981</th>
<th>Gains Fall to Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>82.1</td>
<td>79.8</td>
<td>82.3</td>
<td>+ 0.2</td>
</tr>
<tr>
<td>1</td>
<td>84.2</td>
<td>77.6</td>
<td>81.7</td>
<td>- 2.5</td>
</tr>
<tr>
<td>2 - 4</td>
<td>80.8</td>
<td>82.7</td>
<td>80.6</td>
<td>- 0.2</td>
</tr>
<tr>
<td>5 - 10 (or more)</td>
<td>77.7</td>
<td>73.2</td>
<td>80.0</td>
<td>+ 2.3</td>
</tr>
</tbody>
</table>

negative changes for zero and two to four practice sessions. The only group to register a noticeable positive gain was the group who practiced five or more times. The fact that the total gain for the groups who practiced less than five times is -2.5 and the gain for the group who practiced over five times is +2.3, seems to indicate a beneficial effect of practicing at least once a week.

Students who practiced more than one time were also able to decrease the percentage of failures on major ear-training examinations (see table 13). As with the mid-term means, the percentage of failures at mid-term was generally worse than at either of the finals. The gain between semesters showed no change for zero practice, a large increase for those who practiced only once, and a decrease of 5.8 percent for
practicing two to four times. For practice of more than five times, the percentage of failures decreased by an impressive 14.3 percent. In comparison, the total change for practicing less than 5 times, resulted in an increase of 10.8 percent failures.

### TABLE 13
PERCENTAGE OF FAILURES AS RELATED TO PRACTICE

<table>
<thead>
<tr>
<th>Practice Sessions Attended</th>
<th>Final Fall 1980</th>
<th>Mid-Term 1981</th>
<th>Final Spring 1981</th>
<th>Gains Fall to Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>21.1%</td>
<td>39.1%</td>
<td>21.1%</td>
<td>0.0%</td>
</tr>
<tr>
<td>1</td>
<td>16.7%</td>
<td>50.0%</td>
<td>33.3%</td>
<td>+ 16.6%</td>
</tr>
<tr>
<td>2 - 4</td>
<td>30.8%</td>
<td>23.1%</td>
<td>25.0%</td>
<td>- 5.8%</td>
</tr>
<tr>
<td>5 - 10 (or more)</td>
<td>35.7%</td>
<td>35.7%</td>
<td>21.4%</td>
<td>- 14.3%</td>
</tr>
</tbody>
</table>

In addition to presenting information related to the effect of a certain number of practice sessions, the information in table 13 seems to give strong indications that a student does not really assimilate newly-learned information until sometime after mid-term. The group who did not practice dropped eighteen points at mid-term, but returned to their original level by the May final. Those who practiced only once, more than tripled their percentage of failures at mid-term, and doubled them between December and May. Students in the group who practiced two to four times were the only participants to show a decrease in failures at
mid-term and an increase prior to the May final. Practice of over five sessions resulted in no change in failures and a loss of 4.5 points on the mean score at mid-term (see table 12). Whereas, between mid-term and the May final the failures decreased by 14.3 percent while the mean score on the final increased by 6.8 points. These results seem to indicate very strongly that comprehension is a long-term process. Tables 14 and 15 show statistics which support the idea of a long-range effect of practice.

Correlations in table 14 show that practice before mid-term had no significant effect on the posttest scores. Similarly, the total practice by both groups for the semester had no significant effect on the May final scores. Comparison between practice before the posttest by the computer groups with the gain scores from the posttest to the May final, however, shows significance at the .05 level. Practice by the tape group was not significant in this test.

<table>
<thead>
<tr>
<th>Variables</th>
<th>DF</th>
<th>r-value</th>
<th>Critical Value at .05</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computer Practice to Posttest</td>
<td>26</td>
<td>.497</td>
<td>.374</td>
</tr>
<tr>
<td>Total Practice to May Final</td>
<td>54</td>
<td>-.164</td>
<td>.273</td>
</tr>
<tr>
<td>Mid-Term Practice on Gain from Posttest to May Final</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Computer</td>
<td>26</td>
<td>-.012</td>
<td>.374</td>
</tr>
<tr>
<td>Tape</td>
<td></td>
<td>.376</td>
<td></td>
</tr>
</tbody>
</table>
### Table 15

**Statistical Results of Spring 1981 Practice**

*Minus Students Who Attended Zero Sessions*

<table>
<thead>
<tr>
<th></th>
<th>DF</th>
<th>F-value</th>
<th>Critical value at .05</th>
<th>Prob. F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mid-Term Practice on Posttest</td>
<td>1 and 44</td>
<td>2.34</td>
<td>4.06</td>
<td>.1338</td>
</tr>
<tr>
<td>Mid-Term Practice on May Final</td>
<td>1 and 44</td>
<td>.96</td>
<td>4.06</td>
<td>.3326</td>
</tr>
<tr>
<td>Final Practice on May Final</td>
<td>1 and 44</td>
<td>.44</td>
<td>4.06</td>
<td>.5091</td>
</tr>
</tbody>
</table>

To more accurately detect the effects of practice, ANOVA results presented in Table 15 were calculated without the data from those students who failed to attend any practice sessions in the Ear-Training Laboratory. Even so, no significant effect of practice before or after mid-term on the posttest or May final was found. The effect of practice before mid-term on the posttest did approach significance at the .10 level.

For the experimental semester, spring 1981, the total variables for which effects were measured included the December final, posttest, May final, tape practice, and computer practice. Results of a linear regression analysis using the May final examination as the dependent variable and the remaining scores and the amount of practice by the two research groups as the independent variables, were very interesting.
It was found that practice done by the tape group had a negligible effect on the final ear-training examination score, and computer practice and the posttest score accounted for approximately seven percent each on the May final. The great majority of the variance accounted for was attributed to the final examination from the previous semester. The probability that the four independent variables did account for the variance in the May final was significant at .001 (see table 16). The almost twenty percent variance which was unaccounted for by the variables measured can be explained by psychological, emotional, physical, and cultural influences which were not taken into consideration for purposes of this study.

TABLE 16
MULTIPLE LINEAR REGRESSION WITH MAY FINAL
SCORE AS THE DEPENDENT VARIABLE

<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>Variance Accounted For</th>
</tr>
</thead>
<tbody>
<tr>
<td>December Final</td>
<td>65.3%</td>
</tr>
<tr>
<td>Posttest</td>
<td>7.3%</td>
</tr>
<tr>
<td>Computer Practice</td>
<td>7.3%</td>
</tr>
<tr>
<td>Tape Practice</td>
<td>.5%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>80.4%</strong></td>
</tr>
</tbody>
</table>

R-SQ. .799 F-value 50.87 DF 4 and 51 Prob. F .001
The most significant item reported by the regression analysis is the fact that 65.3 percent of a student's final aural test grade is directly related to his score on the corresponding examination from the previous semester. This means that a student's test scores depend significantly on his previous knowledge and innate ability, and much less on what transpires in or out of the classroom. However, progress as a result of an individual's effort and desire to succeed must not be underestimated.

Related Findings

Statistical results were such that the investigator was encouraged to seek data from other semesters for comparison. Similar information relating to test scores and practice habits was collected and analyzed in order that similarities, differences, and possible recurring patterns could be investigated. Since the Ear-Training Laboratory had been open only three years, facts concerning mean scores, scores below seventy, and lab attendance were collected from 1978 to 1981. For additional comparison, the same information was collected for the year prior to the opening of the laboratory.

In table 17, mean scores for the mid-term and final ear-training examinations are given for seven semesters in addition to the experimental semester (spring 1981). Except for 1979-1980, each of the years showed increases in mean scores from the fall to the spring. From the mid-term examination to the final examination, only three semesters registered gains: 1) fall 1979 +10.8, 2) fall 1980 +2.1, and 3) spring 1981 +2.7. The experimental semester was the only spring semester to show an increase in the four years compared.
<table>
<thead>
<tr>
<th></th>
<th>Mid-Term</th>
<th>Final</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall 1977</td>
<td>81.7</td>
<td>73.8</td>
</tr>
<tr>
<td>Spring 1978</td>
<td>81.8</td>
<td>76.1</td>
</tr>
<tr>
<td></td>
<td>+ .1</td>
<td>+ 2.3</td>
</tr>
<tr>
<td>Fall 1978</td>
<td>77.8</td>
<td>73.8</td>
</tr>
<tr>
<td>Spring 1979</td>
<td>85.3</td>
<td>74.7</td>
</tr>
<tr>
<td></td>
<td>+ 7.5</td>
<td>+ .9</td>
</tr>
<tr>
<td>Fall 1979</td>
<td>72.3</td>
<td>83.1</td>
</tr>
<tr>
<td>Spring 1980</td>
<td>83.1</td>
<td>74.9</td>
</tr>
<tr>
<td></td>
<td>+ 10.8</td>
<td>- 8.2</td>
</tr>
<tr>
<td>Fall 1980</td>
<td>75.9</td>
<td>78.0</td>
</tr>
<tr>
<td>Spring 1981</td>
<td>76.1</td>
<td>78.8</td>
</tr>
<tr>
<td></td>
<td>+ .2</td>
<td>+ .8</td>
</tr>
<tr>
<td>Rank</td>
<td>Semester</td>
<td>Mid-Term</td>
</tr>
<tr>
<td>------</td>
<td>------------</td>
<td>----------</td>
</tr>
<tr>
<td>1</td>
<td>Spring 1979</td>
<td>85.3</td>
</tr>
<tr>
<td>2</td>
<td>Spring 1980</td>
<td>83.1</td>
</tr>
<tr>
<td>3</td>
<td>Spring 1978</td>
<td>81.8</td>
</tr>
<tr>
<td>4</td>
<td>Fall 1977</td>
<td>81.7</td>
</tr>
<tr>
<td>5</td>
<td>Fall 1978</td>
<td>77.8</td>
</tr>
<tr>
<td>6</td>
<td>Spring 1981</td>
<td>76.1</td>
</tr>
<tr>
<td>7</td>
<td>Fall 1980</td>
<td>75.9</td>
</tr>
<tr>
<td>8</td>
<td>Fall 1979</td>
<td>72.3</td>
</tr>
</tbody>
</table>
It is interesting to note that when ranked according to mean scores, the same three semesters which showed the only gains through the semester changed from the lowest three mean scores at mid-term to the highest three mean scores by the final examination (see table 18). Perhaps this is another commentary on the length of learning time.

In studying the percentage of scores below seventy for each semester and their rankings, a pattern similar to the one seen in relation to mean scores and gains may be seen. At mid-term, the fall 1979, fall 1980, and spring 1981 semesters recorded the highest three percentages. However, by the end of the semester the rankings of those three semesters had moved to eighth, fourth, and seventh (see table 19). Table 19 shows that again, the only decreases in percentage of scores below seventy were recorded in these three semesters: 1) fall 1979 -16.4%, 2) fall 1980 -13.1%, and 3) spring 1981 -13.3%. By comparing percentages for the fall semesters in chronological order, a pattern of increasing failures for mid-term may be seen. This could be an indication of weaker students entering the theory program.

In studying the laboratory attendance habits of freshman music theory students, data was collected from the fall of 1978, when the lab opened, through the spring of 1981. In table 20, it can be seen that the three semesters which registered the only gains in mean scores and the only decreases in scores below seventy from mid-term until the final examination, are the three semesters with the highest average weekly practice before mid-term. All of the semesters showed patterns of decreased practice after mid-term—approximately sixty percent before mid-term and forty percent after mid-term.
<table>
<thead>
<tr>
<th>Semester</th>
<th>Mid-Term</th>
<th>Rank</th>
<th>Final</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall 1977</td>
<td>24.6</td>
<td>5</td>
<td>35.9</td>
<td>2</td>
</tr>
<tr>
<td>Spring 1978</td>
<td>17.2</td>
<td>8</td>
<td>26.7</td>
<td>6</td>
</tr>
<tr>
<td>Fall 1978</td>
<td>27.5</td>
<td>4</td>
<td>41.7</td>
<td>1</td>
</tr>
<tr>
<td>Spring 1979</td>
<td>21.5</td>
<td>6</td>
<td>35.5</td>
<td>3</td>
</tr>
<tr>
<td>Fall 1979</td>
<td>37.3</td>
<td>3</td>
<td>20.9</td>
<td>8</td>
</tr>
<tr>
<td>Spring 1980</td>
<td>17.9</td>
<td>7</td>
<td>26.8</td>
<td>5</td>
</tr>
<tr>
<td>Fall 1980</td>
<td>40.7</td>
<td>1</td>
<td>27.6</td>
<td>4</td>
</tr>
<tr>
<td>Spring 1981</td>
<td>38.0</td>
<td>2</td>
<td>24.7</td>
<td>7</td>
</tr>
<tr>
<td>Semester</td>
<td>Rank</td>
<td>Mid-Term</td>
<td>Final Rank</td>
<td>Average</td>
</tr>
<tr>
<td>-----------</td>
<td>------</td>
<td>----------</td>
<td>------------</td>
<td>---------</td>
</tr>
<tr>
<td>Fall 1978</td>
<td>5</td>
<td>32</td>
<td>29</td>
<td>1</td>
</tr>
<tr>
<td>Spring 1979</td>
<td>6</td>
<td>16</td>
<td>12</td>
<td>6</td>
</tr>
<tr>
<td>Fall 1979</td>
<td>1</td>
<td>45</td>
<td>26</td>
<td>3</td>
</tr>
<tr>
<td>Spring 1980</td>
<td>2</td>
<td>39</td>
<td>27</td>
<td>2</td>
</tr>
<tr>
<td>Fall 1980</td>
<td>4</td>
<td>35</td>
<td>21</td>
<td>4</td>
</tr>
<tr>
<td>Spring 1981</td>
<td>3</td>
<td>38</td>
<td>20</td>
<td>5</td>
</tr>
</tbody>
</table>
It is interesting to observe how the ranked practice averages fall into annual pairs. The experimental semester is the only spring semester to have a higher practice attendance than its fall semester partner. In addition, the spring semester 1981 lists the highest attendance in a period of five consecutive weeks. This attendance was recorded during the experimental period, mostly by members of the computer group. Therefore, these observations seem to indicate a positive response to computer-assisted ear-training (see appendix C).

For the total freshman music theory population who practiced between 1978 and 1981, statistical results show no significance for practice before mid-term on mid-term or final scores, practice after mid-term on the final score, or mid-term and final practice together on final score (see table 21). When considering the population, minus the students who did not practice in the Ear-Training Laboratory, for the same three-year period, only mid-term practice is related to mid-term score, significant at the .10 level (see table 22). However, when considering the effect of practice before mid-term on the gain from the posttest to the May final, the correlation approaches significance at the .05 level of confidence (see table 23). Once again, support is presented for the hypothesis that comprehension of materials studied prior to mid-term is not fully realized until some point after the mid-term examination.
### TABLE 21

**STATISTICAL RESULTS RELATING TO PRACTICE**

**BY THE TOTAL POPULATION FOR 1978–81**

<table>
<thead>
<tr>
<th>Regression</th>
<th>DF</th>
<th>F-value</th>
<th>Prob. F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mid-Term Practice on Posttest</td>
<td>1</td>
<td>0.16</td>
<td>.69</td>
</tr>
<tr>
<td>Mid-Term Practice on May Final</td>
<td>1</td>
<td>1.33</td>
<td>.24</td>
</tr>
<tr>
<td>Final Practice on May Final</td>
<td>1</td>
<td>0.54</td>
<td>.46</td>
</tr>
<tr>
<td>Mid-Term Practice and Final Practice on May Final</td>
<td>1</td>
<td>1.33</td>
<td>.25</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>0.00</td>
<td>.95</td>
</tr>
</tbody>
</table>

### TABLE 22

**STATISTICAL RESULTS RELATING TO PRACTICE FOR 1978–81**

**MINUS STUDENTS WITH ZERO ATTENDANCE**

<table>
<thead>
<tr>
<th>Regression</th>
<th>DF</th>
<th>F-value</th>
<th>Prob. F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mid-Term Practice on Posttest</td>
<td>1</td>
<td>2.61</td>
<td>.10</td>
</tr>
<tr>
<td>Mid-Term Practice on May Final</td>
<td>1</td>
<td>.61</td>
<td>.44</td>
</tr>
<tr>
<td>Final Practice on May Final</td>
<td>1</td>
<td>.52</td>
<td>.47</td>
</tr>
<tr>
<td>Mid-Term Practice and Final Practice on May Final</td>
<td>1</td>
<td>.28</td>
<td>.59</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>.19</td>
<td>.66</td>
</tr>
</tbody>
</table>
TABLE 23
STATISTICAL RESULTS RELATING TO PRACTICE AND GAIN FOR 1978–81

<table>
<thead>
<tr>
<th>Correlation</th>
<th>DF</th>
<th>r-value</th>
<th>Critical value at .05</th>
<th>Prob. r</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mid-Term Practice to Gain from Posttest to May Final</td>
<td>4</td>
<td>.74</td>
<td>.81</td>
<td>appr .05</td>
</tr>
</tbody>
</table>

Summary
As a result of statistical and practical comparisons, several of the null hypotheses were rejected at the .05 level or better. Practice before and after the posttest was significantly different with the computer group accounting for eighty percent of the practice before midterm and only twenty-five percent after midterm. A preference for practicing with the computer seems to be clearly indicated.

Although gains related to pretest, posttest, and May final were not significant, those gains which were measured from the December final examination to the posttest and to the May final were both significant at the .01 and .0001 levels, respectively. These results seem related to long-range comprehension.

Percentages of scores below seventy were not significantly different for the two research groups at any of the examination periods, but whereas those scores on the pretest and May final were significant at .60 and .70, scores below seventy on the posttest were significant at .17.
Mean scores between the experimental and control groups were not significantly different on the pretest. The posttest scores were significant at the .10 level in favor of the computer group. On the May final, significance was approached at the .10 level.

It was also found that students' final examination scores were dependent on their final examination scores from the previous semester. The previous score accounted for sixty-five percent of the variance in the current semester. Posttest score and computer practice each added to the regression by approximately seven percent. Tape practice contributed only one-half percent to the May final score. Therefore, natural ability accounted for the majority of a student's score, while practice had very little effect.

Quite possibly, the statistical probabilities might have been higher for differences in means within research groups. Although technical problems added to the confusion, two main factors influenced the outcome of statistical results. First, contrary to instructions given to research participants, theory instructors and laboratory workers, members of the experimental group failed to follow the prescribed curriculum outline and instead practiced on aural programs in random order. Obviously, practicing contrary to a simple to complex, "building on previous knowledge" method will not be as effective as an orderly, educationally-sound approach.

Second, differences within groups were so great that they masked the potential for measuring differences between the groups. In the field of music, students who begin a college-level program of study enter with a very wide range in ability, attitudes, training, and personal experiences.
Taking these factors into consideration, the research sample probably did not fit a normal curve. Even normal distribution is difficult to detect unless very large sample sizes are used. For the current research project, a sample size of eighty in each group and a minimum significant difference of twelve points between groups on the posttest would have been needed to overcome the excess of variation which was present.
CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

Trends in attendance at workshops and conferences, frequency of requests for information about CAI, purchase of microcomputers for educational applications, all these indicate that we are on the verge of a tremendous surge in the use of CAI.

The computer has been utilized by the educational community since the 1960s. As an instructional tool, it has been employed as a tutor, drill master, student scheduler, problem solver, and for experimentation and simulation. The majority of studies have reported equal or better results with CAI over a traditional approach to learning.

Attitudes towards computers are definitely changing. In education, acceptance of advanced technology has been slow and very often accompanied by suspicion and hostility. Several factors have contributed to the reluctance of educators to accept CAI and become involved in its development. Compatibility, software, hardware, and insufficient knowledge of a general or technical nature, in addition to many other problems, have contributed to the lack of wide-spread acceptance of CAI in all fields of education. However, continuing reductions in cost of computer hardware are forcing the educational community to reevaluate its position on CAI.

In the field of music education, the earliest feasibility studies began at Stanford in the late 1960s and continued throughout the country
until CAI was established and applied in musical instruction. Early major centers of computer learning included Stanford, the University of Delaware (GUIDO), and the University of Illinois (PLATO). Currently, CAI is spreading very rapidly; and several universities such as North Texas State, Florida State, the University of North Carolina at Greensboro, and many others are committing themselves to providing complete CAI facilities and opportunities.

Acceptance of CAI was promoted through application of drill and practice techniques to aural study done in the Ear-Training Laboratory. A total of sixty-two students from four second-semester freshman music theory classes participated in an experimental comparison of computer and tape-recorded presentations of harmonic dictation drills. A total of thirteen hypotheses relating to mean exam scores, practice, scores below seventy, and mean gain scores were tested statistically through SAS procedures. The Solomon Four-Group Design was employed.

Conclusions

The computer has provided educators with an invaluable tool. Individualized instruction places no limit on what course content can be studied; it allows for maximum personal choice in regard to pace and presentation, and it is constantly available and impartial. With the continuing pattern of decreasing equipment costs and increasing hardware capabilities, the time is right for instituting CAI.

In the experimental semester, spring 1981, differences in mean scores, influenced by human variation within groups, approached significance except on the pretest. Mean gain scores between tests were very similar except when measured from the previous semester. Scores below
seventy on recorded tests showed large practical differences, but no statistical differences. In comparison to the tape group, the computer group exhibited a significant willingness (.001) to practice before mid-term, and a significant reluctance (.0002) to practice after mid-term when the computer medium was no longer available.

Additional findings showed that innate ability, as reflected by the previous semester's final score, accounted for 65.3 percent of the May final score. The posttest score and computer practice added to the regression by 7.3 percent each, while tape practice accounted for only .5 percent. Twenty percent of the variation was not explained by the variables which were measured.

Recommendations

In general, the first step toward implementation of a CAI program is to involve the faculty. They must familiarize themselves with the potential and the procedures available for achieving that potential through computer assistance. Administrations must encourage instructors to explore the available literature, to attend seminars, and to gain "hands-on" experience. In this way, faculty members will be better equipped to guide students in the acquisition of similar knowledge and experiences.

Once faculty members have become familiar with computer techniques, they should be strongly encouraged to develop their own courseware. Software development through specially-designed author languages is greatly simplified for the non-programmer. One of the advantages of teacher-originated materials is that they will correspond more directly to in-class procedures. In addition, question pools may be generated to
be shared within departments, and the computer may be employed to generate practice or test materials, provide progress reports on student users, and save instructor time by automatically grading the examinations, also. Computerized grading would provide a much-needed move toward standardized grading.

Additional research projects are needed on the application of CAI to music education. In response to the experimental study in the spring of 1981, it becomes evident that a CAI laboratory should be initiated at Louisiana State University. However, until additional equipment can be supplied, and greater control exercised, an indoctrination period should be provided for all involved personnel to insure a more efficient learning environment.

Based on information related to the wide range of talent within the student population, assignment to theory classes on the basis of innate ability, background, and experiences might be considered. In this way, the individual needs of each student might be served better.

Additional studies relating to the learning process are needed. In particular, to increase the efficiency of the local laboratory, studies on the effectiveness of materials and the effects of practice should be undertaken.

Computer applications to education will provide new avenues for fulfilling expectations.

With fundamental learning effectively taken care of, mainly through CAI and its many modifications and ramifications, perhaps we can finally correct our perspective. We can then value education for its own sake and ask what kinds of human beings we seek to become.
Notes


SELECTED BIBLIOGRAPHY

Books


**Periodicals**


Edwards, Judith; Norton, Shirley; Taylor, Sandra; Van Dusseldorp, Ralph; and Weiss, Martha. "Is Computer-Assisted Instruction Effective?" Association for Educational Data Systems 7 (Summer 1974):122-26.


Dissertations and Papers


APPENDIX A

COMPUTER SAMPLE RUNS
Sample Run

HARMONIC DICTATION

Chapter 14: Leading Tone Triad—Part A

Type in your full name and then return. JOHN DOE

Hello JOHN DOE — glad you’re here.

Hit return to continue.

You will hear a short progression of 4 to 10 chords with a 5-note introduction for key orientation.

Write your answers on scratch paper, and then type them into the computer when you are ready.

Type i vii6 i6 iv i etc., for minor and diminished chords and the same letters plus shift for major chords.

For example: I vii6 I6 IV I6/4 V I (*Note / on I6/4.)

If you hear unisons rather than chords, type in the scale-degree numbers and not the Roman numerals.

For example: 1 5 3 IV vii6 I

Non-harmonic tones need not be notated.

To correct an error, hit the rub key and then re-type.

******************** Prepare for dictation ********************

GOOD LUCK!!!

Hit return to continue.
EXERCISE NO. 1

This exercise has 5 chords.

You can have the computer play this exercise up to 3 times.

Hearing number 1 out of 3.
Play again? Type y or n then hit return.? y

Hearing number 2 out of 3.
Play again? Type y or n and then hit return.? y

Hearing number 3 out of 3.
There were 5 chords played.

Please enter the chords that were played on a single line with each answer separated from the previous answer with a space.
Enter your answers now after the ? and then hit return.

? I vii6 I V I

<table>
<thead>
<tr>
<th>Chord number</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correct answer</td>
<td>I</td>
<td>vii6</td>
<td>I</td>
<td>IV</td>
<td>I</td>
</tr>
<tr>
<td>Your answer</td>
<td>I</td>
<td>vii6</td>
<td>I</td>
<td>V</td>
<td>I</td>
</tr>
</tbody>
</table>

Scoring

For this exercise:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of chords</td>
<td>5</td>
</tr>
<tr>
<td>Number correct</td>
<td>3</td>
</tr>
<tr>
<td>Number missed</td>
<td>2</td>
</tr>
<tr>
<td>Percent correct</td>
<td>60%</td>
</tr>
</tbody>
</table>

Overall:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of chords</td>
<td>5</td>
</tr>
<tr>
<td>Number correct</td>
<td>3</td>
</tr>
<tr>
<td>Number missed</td>
<td>2</td>
</tr>
<tr>
<td>Percent correct</td>
<td>60%</td>
</tr>
</tbody>
</table>

Play again? Type y or n and then hit return.? y
This exercise has 5 chords.

You can have the computer play this exercise up to 3 times.

Hearing number 1 out of 3.

Play again? Type y or n and then hit return.? y

Hearing number 2 out of 3.

Play again? Type y or n and then hit return.? n

There were 5 chords played.

Please enter the chords that were played on a single line with each answer separated from the previous answer with a space.

Enter your answers now after the ? and then hit return.

? i i6 iv vii6

You only entered 4 chords.

There were 5 chords played.

Please enter the chords that were played on a single line with each answer separated from the previous answer with a space.

Enter your answers now after the ? and then hit return.

? i i6 iv vii6 i

<table>
<thead>
<tr>
<th>Chord number</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correct answer</td>
<td>I</td>
<td>i6</td>
<td>IV</td>
<td>vii6</td>
<td>I</td>
</tr>
<tr>
<td>Your answer</td>
<td>i</td>
<td>i6</td>
<td>iv</td>
<td>vii6</td>
<td>i</td>
</tr>
<tr>
<td>Scoring</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

For this exercise:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of chords</td>
<td>5</td>
</tr>
<tr>
<td>Number correct</td>
<td>1</td>
</tr>
<tr>
<td>Number missed</td>
<td>4</td>
</tr>
<tr>
<td>Percent correct</td>
<td>20%</td>
</tr>
</tbody>
</table>
Overall:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of chords</td>
<td>10</td>
</tr>
<tr>
<td>Number correct</td>
<td>4</td>
</tr>
<tr>
<td>Number missed</td>
<td>6</td>
</tr>
<tr>
<td>Percent correct</td>
<td>40%</td>
</tr>
</tbody>
</table>

Play again? Type y or n and then hit return.? y

EXERCISE NO. 3

This exercise has 7 chords.

You can have the computer play this exercise up to 3 times.

Hearing number 1 out of 3.

Play again? Type y or n then hit return.? y

Hearing number 2 out of 3.

Play again? Type y or n and then hit return.? y

Hearing number 3 out of 3.

There were 7 chords played.

Please enter the chords that were played on a single line with each answer separated from the previous answer with a space.

Enter your answers now after the ? and then hit return.

? I vii6 I6 IV V V I

Chord number  

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correct answer</td>
<td>I6</td>
<td>vii6 I</td>
<td>IV</td>
<td>V</td>
<td>V</td>
<td>I</td>
<td></td>
</tr>
<tr>
<td>Your answer</td>
<td>I</td>
<td>vii6 I6</td>
<td>IV</td>
<td>V</td>
<td>V</td>
<td>I</td>
<td></td>
</tr>
<tr>
<td>Scoring</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

For this exercise:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of chords</td>
<td>7</td>
</tr>
<tr>
<td>Number correct</td>
<td>5</td>
</tr>
<tr>
<td>Number missed</td>
<td>2</td>
</tr>
<tr>
<td>Percent correct</td>
<td>71%</td>
</tr>
</tbody>
</table>
Overall:
    Number of chords 17
    Number correct 9
    Number missed 8
    Percent correct 53%

Play again? Type y or n and then hit return.? y

EXERCISE NO. 4

This exercise has 10 chords.

You can have the computer play this exercise up to 3 times.

Hearing number 1 out of 3.

Play again? Type y or n then hit return.? y

Hearing number 2 out of 3.

Play again? Type y or n and then hit return.? y

Hearing number 3 out of 3.

There were 10 chords played.

Please enter the chords that were played on a single line with each answer separated from the previous answer with a space.

Enter your answers now after the ? and then hit return.

? 5 3 1 4 I6 vii I I V V I

You entered 1 chord too many.

There were 10 chords played.

Please enter the chords that were played on a single line with each answer separated from the previous answer with a space.

Enter your answers now after the ? and then hit return.

? 5 3 1 4 I6 vii I V V I
Chord number | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10
---|---|---|---|---|---|---|---|---|---|---
Correct answer | 5 | 3 | 1 | 6 | I6 | vii6 | I | I6/4 | V | I
Your answer | 5 | 3 | 1 | 4 | I6 | vii | I | V | V | I
Scoring | X | X | X

For this exercise:
- Number of chords: 10
- Number correct: 7
- Number missed: 3
- Percent correct: 70%

Overall:
- Number of chords: 27
- Number correct: 16
- Number missed: 11
- Percent correct: 59%

Play again? Type y or n and then hit return.? y

EXERCISE NO. 5

This exercise has 8 chords.

You can have the computer play this exercise up to 3 times.

Hearing number 1 out of 3.

Play again? Type y or n then hit return.? y

Hearing number 2 out of 3.

Play again? Type y or n and then hit return.? n

There were 8 chords played.

Please enter the chords that were played on a single line with each answer separated from the previous answer with a space.

Enter your answers now after the ? and then hit return.

? I I6 I IV I vii6 I6 V
Chord number 1 2 3 4 5 6 7 8
Correct answer  I  I  I6 IV I6 vii6 I  V
Your answer  I  I6 I  IV I  vii6 I6  V
Scoring  X  X  X  X

For this exercise:
Number of chords 8
Number correct 4
Number missed 4
Percent correct 50%

Overall:
Number of chords 35
Number correct 20
Number missed 15
Percent correct 57%

EXERCISE NO. 6

This exercise has 4 chords.

You can have the computer play this exercise up to 3 times.

Hearing number 1 out of 3.

Play again? Type y or n and then hit return.? y

Hearing number 2 out of 3.

Play again? Type y or n and then hit return.? y

Hearing number 3 out of 3.

Play again? Type y or n and then hit return.? n

There were 4 chords played.

Please enter the chords that were played on a single line with each answer separated from the previous answer with a space.

Enter your answers now after the ? and then hit return.

? I I6 vii6 I
Chord number | 1 | 2 | 3 | 4
---|---|---|---|---
Correct answer | I | IV | vii6 | I
Your answer | I | I6 | vii6 | I
Scoring | X

For this exercise:

<table>
<thead>
<tr>
<th>Number of chords</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number correct</td>
<td>3</td>
</tr>
<tr>
<td>Number missed</td>
<td>1</td>
</tr>
<tr>
<td>Percent correct</td>
<td>75%</td>
</tr>
</tbody>
</table>

Overall:

<table>
<thead>
<tr>
<th>Number of chords</th>
<th>39</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number correct</td>
<td>23</td>
</tr>
<tr>
<td>Number missed</td>
<td>16</td>
</tr>
<tr>
<td>Percent correct</td>
<td>59%</td>
</tr>
</tbody>
</table>

Play again? Type y or n and then hit return.? y

EXERCISE NO. 7

This exercise has 6 chords.

You can have the computer play this exercise up to 3 times.

Hearing number 1 out of 3.

Play again? Type y or n then hit return.? y

Hearing number 2 out of 3.

Play again? Type y or n and then hit return.? n

There were 6 chords played.

Please enter the chords that were played on a single line with each answer separated from the previous answer with a space.

Enter your answers now after the ? and then hit return.

? I vii6 I6 I IV6 V
<table>
<thead>
<tr>
<th>Chord number</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correct answer</td>
<td>i</td>
<td>vii6</td>
<td>i</td>
<td>iv6</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Your answer</td>
<td>i</td>
<td>vii6</td>
<td>I</td>
<td>IV6</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Scoring</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

For this exercise:
- Number of chords: 6
- Number correct: 2
- Number missed: 4
- Percent correct: 33%

Overall:
- Number of chords: 45
- Number correct: 25
- Number missed: 20
- Percent correct: 56%

Play again? Type y or n and then hit return.?

***END OF EXERCISE***

Your overall score is as follows:

- Number of chords: 45
- Number correct: 25
- Number missed: 20
- Percent correct: 56%

You need more practice. Come back later and try again.

When you have recorded your score on your Computer Dictation Record, hit return to reset computer.
Sample Run

HARMONIC DICTATION

Chapter 17: Submediant and Mediant Triads—Part F

Type in your full name and then return. JOHN DOE

Hello JOHN DOE -- glad you're here.

Hit return to continue?

You will hear a short progression of 4 to 10 chords with a 5-note introduction for key orientation.

Write your answers on scratch paper, and then type them into the computer when you are ready.

Type III VI ii6 V etc., for minor and diminished chords and the same letters plus shift for major chords.

For example:  I vi iii IV I6/4 V I (*Note / on I6/4.)

***Type III+ for BOTH root and 1st inv.***

If you hear unisons rather than chords, type in the scale-degree numbers and not the Roman numerals.

For example:  1 3 5 vi ii6 V

Non-harmonic tones need not be notated.

To correct an error, hit the rub key and then re-type.

********************** Prepare for dictation **********************

GOOD LUCK!!

Hit return to continue.
EXERCISE NO. 1

This exercise has 10 chords.

You can have the computer play this exercise up to 3 times.

Hearing number 1 out of 3.

Play again? Type y or n and then hit return.? y

Hearing number 2 out of 3.

Play again? Type y or n and then hit return.? y

Hearing number 3 out of 3.

There were 10 chords played.

Please enter the chords that were played on a single line with each answer separated from the previous answer with a space.

Enter your answers now after the ? and then hit return.

? i i i6 i V i VI III iv i

<table>
<thead>
<tr>
<th>Chord number</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correct answer</td>
<td>i</td>
<td>i</td>
<td>i</td>
<td>i</td>
<td>V6</td>
<td>i</td>
<td>VI</td>
<td>III</td>
<td>iv</td>
<td>i</td>
</tr>
<tr>
<td>Your answer</td>
<td>i</td>
<td>i</td>
<td>i6</td>
<td>i</td>
<td>V</td>
<td>i</td>
<td>VI</td>
<td>III</td>
<td>iv</td>
<td>i</td>
</tr>
</tbody>
</table>

Scoring

X

For this exercise:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of chords</td>
<td>10</td>
</tr>
<tr>
<td>Number correct</td>
<td>8</td>
</tr>
<tr>
<td>Number missed</td>
<td>2</td>
</tr>
<tr>
<td>Percent correct</td>
<td>80%</td>
</tr>
</tbody>
</table>

Overall:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of chords</td>
<td>10</td>
</tr>
<tr>
<td>Number correct</td>
<td>8</td>
</tr>
<tr>
<td>Number missed</td>
<td>2</td>
</tr>
<tr>
<td>Percent correct</td>
<td>80%</td>
</tr>
</tbody>
</table>

Play again? Type y or n and then hit return.? y
EXERCISE NO. 2

This exercise has 8 chords.

You can have the computer play this exercise up to 3 times.

Hearing number 1 out of 3.

Play again? Type y or n and then hit return.? y

Hearing number 2 out of 3.

Play again? Type y or n and then hit return.? n

There were 8 chords played.

Please enter the chords that were played on a single line with each answer separated from the previous answer with a space.

Enter your answers now after the ? and then hit return.

? I IV ii V iii V I

You only entered 7 chords.

There were 8 chords played.

Please enter the chords that were played on a single line with each answer separated from the previous answer with a space.

Enter your answers now after the ? and then hit return.

? I IV ii V iii vi V I

<table>
<thead>
<tr>
<th>Chord number</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correct answer</td>
<td>I</td>
<td>IV</td>
<td>ii</td>
<td>V</td>
<td>iii</td>
<td>vi</td>
<td>IV</td>
<td>I</td>
</tr>
<tr>
<td>Your answer</td>
<td>I</td>
<td>IV</td>
<td>ii</td>
<td>V</td>
<td>iii</td>
<td>vi</td>
<td>V</td>
<td>I</td>
</tr>
</tbody>
</table>

Scoring X

For this exercise:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of chords</td>
<td>8</td>
</tr>
<tr>
<td>Number correct</td>
<td>7</td>
</tr>
<tr>
<td>Number missed</td>
<td>1</td>
</tr>
<tr>
<td>Percent correct</td>
<td>80%</td>
</tr>
</tbody>
</table>
Overall:

<table>
<thead>
<tr>
<th>Number of chords</th>
<th>18</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number correct</td>
<td>15</td>
</tr>
<tr>
<td>Number missed</td>
<td>3</td>
</tr>
<tr>
<td>Percent correct</td>
<td>83%</td>
</tr>
</tbody>
</table>

Play again? Type y or n and then hit return.? y

EXERCISE NO. 3

This exercise has 9 chords.
You can have the computer play this exercise up to 3 times.

Hearing number 1 out of 3.
Play again? Type y or n and then hit return.? y

Hearing number 2 out of 3.
Play again? Type y or n and then hit return.? y

Hearing number 3 out of 3.
There were 9 chords played.
Please enter the chords that were played on a single line with each answer separated from the previous answer with a space.

Enter your answers now after the ? and then hit return.

? V6 I I6 vi iii IV I6/4 V I

<table>
<thead>
<tr>
<th>Chord number</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correct answer</td>
<td>V6</td>
<td>I</td>
<td>iii</td>
<td>vi</td>
<td>I6</td>
<td>ii6</td>
<td>I6/4</td>
<td>V</td>
<td>I</td>
</tr>
<tr>
<td>Your answer</td>
<td>V6</td>
<td>I</td>
<td>I6</td>
<td>vi</td>
<td>iii</td>
<td>IV</td>
<td>I6/4</td>
<td>V</td>
<td>I</td>
</tr>
<tr>
<td>Scoring</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

For this exercise:

<table>
<thead>
<tr>
<th>Number of chords</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number correct</td>
<td>6</td>
</tr>
<tr>
<td>Number missed</td>
<td>3</td>
</tr>
<tr>
<td>Percent correct</td>
<td>67%</td>
</tr>
</tbody>
</table>
Overall:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of chords</td>
<td>27</td>
</tr>
<tr>
<td>Number correct</td>
<td>21</td>
</tr>
<tr>
<td>Number missed</td>
<td>6</td>
</tr>
<tr>
<td>Percent correct</td>
<td>78%</td>
</tr>
</tbody>
</table>

Play again? Type y or n and then hit return. y

EXERCISE NO. 4

This exercise has 8 chords.

You can have the computer play this exercise up to 3 times.

Hearing number 1 out of 3.

Play again? Type y or n and then hit return. y

Hearing number 2 out of 3.

Play again? Type y or n and then hit return. y

Hearing number 3 out of 3.

There were 8 chords played.

Please enter the chords that were played on a single line with each answer separated from the previous answer with a space.

Enter your answers now after the ? and then hit return.

? i i6 V6 i6 III IV V i

You entered 1 chord too many.

There were 8 chords played.

Please enter the chords that were played on a single line with each answer separated from the previous answer with a space.

Enter your answers now after the ? and then hit return.

? i i6 V6 i6 III IV V i
Chord number | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8  
---|---|---|---|---|---|---|---|---
Correct answer | i | 16 | vii6 | VI6 | III | iv | V | i
Your answer     | i | 16 | V6  | 16 | III | IV | V | i
Scoring         | X | X  | X  |    |    |    |    |    

For this exercise:
   Number of chords | 8
   Number correct   | 5
   Number missed    | 3
   Percent correct  | 63%

Overall:
   Number of chords | 35
   Number correct   | 26
   Number missed    | 9
   Percent correct  | 74%

Play again? Type y or n and then hit return. y

EXERCISE NO. 5

This exercise has 8 chords.

You can have the computer play this exercise up to 3 times.

Hearing number 1 out of 3.

Play again? Type y or n and then hit return. n

Hearing number 2 out of 3.

Play again? Type y or n and then hit return. n

There were 8 chords played.

Please enter the chords that were played on a single line with each answer separated from the previous answer with a space.

Enter your answers now after the ? and then hit return.

? V6 I V vi I6 ii6 ii V
<table>
<thead>
<tr>
<th>Chord number</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correct answer</td>
<td>V</td>
<td>I</td>
<td>V</td>
<td>vi</td>
<td>iii</td>
<td>IV</td>
<td>ii</td>
<td>V</td>
</tr>
<tr>
<td>Your answer</td>
<td>V6</td>
<td>I</td>
<td>V</td>
<td>vi</td>
<td>I6</td>
<td>ii6</td>
<td>ii</td>
<td>V</td>
</tr>
<tr>
<td>Scoring</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

For this exercise:
- Number of chords: 8
- Number correct: 5
- Number missed: 3
- Percent correct: 63%

Overall:
- Number of chords: 43
- Number correct: 31
- Number missed: 12
- Percent correct: 72%

Play again? Type y or n and then hit return.? y

***END OF EXERCISE***

Your overall score is as follows:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Number of chords</td>
<td>43</td>
</tr>
<tr>
<td>Number correct</td>
<td>31</td>
</tr>
<tr>
<td>Number missed</td>
<td>12</td>
</tr>
<tr>
<td>Percent correct</td>
<td>72%</td>
</tr>
</tbody>
</table>

Good. Keep working to improve your score even more.

When you have recorded your score on your Computer Dictation Record, hit return to reset computer.
APPENDIX B

MISCELLANEOUS FORMS
To: L.S.U. Committee on the Use of Humans and Animals as Research Subjects,
Dr. W. Sheldon Biven,
School of Veterinary Medicine
Chairman

From: Jane C. Garton, Ph.D. candidate,
School of Music

Title of Research Project: THE EFFICACY OF COMPUTER-BASED AND TAPE-RECORDED ASSISTANCE IN SECOND-SEMESTER FRESHMAN EAR-TRAINING INSTRUCTION

This experimental design will employ a control group of approximately thirty students, and an experimental group of approximately twenty students for a total of approximately fifty subjects. These students will be enrolled in second-semester ear-training, Music 1702, during the Spring semester, 1981.

A pretest of no more than forty minutes in length will be administered to one-half of each of the groups. Test and practice materials will include harmonic dictation in conjunction with subject matter covered in class during the Spring semester, 1981.

A posttest, identical to the pretest, will be administered to all research subjects upon completion of the dictation practice materials.

This experimental design proposal of the Doctoral Dissertation for partial fulfillment of the requirements of the Doctor of Philosophy Degree has been approved by the following committee members.

Robert Schambough
Chairman

Paul Louis Abel

Halsey McKenzie

Jane Edmunds

John W. Bank
NAME: Jane C. Garton       DATE: February 6, 1981

DEPT: Music

SUBJECT: Request for research approval

TITLE OF RESEARCH PROJECT: The Efficacy of Computer-Based and Tape-
Recorded Assistance in Second-Semester Freshman Ear-Training Instruction

The investigator gives assurances to the Committee on the Use of Humans and Animals as Research Subjects for each of the following:

1. The human subjects are volunteers.  X  

2. Subjects have the freedom to withdraw at any time.  X  

3. That the data collected will not be used for any purpose not approved by the subjects.  X  

4. The subjects are guaranteed anonymity.  X  

5. The subjects will be informed beforehand as to the nature of their activity.  X  

6. The nature of the activity will not cause any physical or psychological harm to the subjects.  X  

7. Individual performances will not be disclosed to persons other than those involved in the research, those authorized by the subject.  X  

8. If minors are to participate in this experiment, valid consent has been obtained from the parents or guardian.  X  

9. That all questions have been answered to the subject's satisfaction.  X  

10. All volunteers will consent by signature.  X  

Any exceptions or qualifications to the above assurances are explained below:

________________________________________________________________________

________________________________________________________________________

Investigator's Name
From: Committee on Humans and Animals as Research Subjects.

To: Vice Chancellor for Advanced Studies and Research
   David Boyd Hall

Re: Proposal of JANE C. GARTON - Music
   Principal Investigator

Entitled THE EFFICACY OF COMPUTER-BASED AND TAPE-RECORDED
   ASSISTANCE IN SECOND-SEMESTER FRESHMAN EAR-
   TRAINING INSTRUCTION

This is to certify that a quorum of the Committee on Humans and Animals as
Research Subjects reviewed the above proposal. The Committee evaluated the pro-
cedures of the proposal with appropriate guidelines established for activities
supported by federal funds involving as subjects humans and/or animals.

Recommendation of Committee APPROVED

Comments:

A review of this proposal by the Committee will be accomplished at least on
an annual basis and at more frequent intervals depending on the element of risk.

Date JUNE 8, 1981

Chairman, Committee on Use of
Humans and Animals as Research
Subjects
*TO BE RETAINED BY THE INVESTIGATOR:

EXPERIMENT SIGN-UP FORM

My signature, on this sheet, by which I volunteer to participate in the experiment on The Efficacy of Computer-Based and Tape-Recorded Assistance in Second-Semester Freshman Ear-Training Instruction conducted by Jane C. Garton Experimenter indicates that I understand that all subjects in the project are volunteers, that I can withdraw at any time from the experiment, that I have been or will be informed as to the nature of the experiment, that the data I provide will be anonymous and my identity will not be revealed without my permission, and that my performance in this experiment may be used for additional approved projects. Finally, I shall be given an opportunity to ask questions prior to the start of the experiment and after my participation is complete.

Subject's signature
EAR-TRAINING LAB CHECK OUT LIST

DATE:

<table>
<thead>
<tr>
<th>NAME</th>
<th>ITEM</th>
<th>TIME IN</th>
<th>TIME OUT</th>
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<tr>
<td>DATE</td>
<td>TAPE NUMBER AND TITLE</td>
<td>EXERCISES COMPLETED</td>
<td>TIME SPENT</td>
</tr>
<tr>
<td>------</td>
<td>-----------------------</td>
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<td>------------</td>
</tr>
<tr>
<td>Ex: 2/5/81</td>
<td>14A, vii 6</td>
<td>7</td>
<td>25 min.</td>
</tr>
</tbody>
</table>

1. 
2. 
3. 
4. 
5. 
6. 
7. 
8. 
9. 
10. 
11. 
12. 
13. 
14. 
15. 
16. 
17. 
18. 
19. 
20. 
21.
QUESTIONNAIRE REGARDING PRACTICE TIME AND METHOD EMPLOYED

Please carefully fill in the following information based on your personal records for this semester. Indicate the number of practice sessions and the amount of time spent per week. If more than one method was used, fill in the appropriate blanks.

<table>
<thead>
<tr>
<th>Method</th>
<th>Sessions Per Week</th>
<th>Average Time Per Session</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Tape-recorded materials in lab</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Computer materials in lab</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Small study groups</td>
<td></td>
<td></td>
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<tr>
<td>4. Private or group tutoring</td>
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<tr>
<td>5. Other (please explain briefly)</td>
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</tr>
</tbody>
</table>

Would you have practiced more if additional computer time had been available? Please comment on this or any other area of available ear-training materials. Construction suggestions will be appreciated.

Signed ________________________________
Would you have practiced more if additional computer time had been available? Please comment on this or any other area of the available ear-training materials. Constructive suggestions will be appreciated.

"Yes. I think the computer would have helped me, once I got used to using it. I think they could have left the lab open longer to accommodate people with full schedules."

"Yes. Twice I felt pressured into leaving because someone else came and waited for me to finish."

"Yes. The Ear-Training Laboratory should open at 7:30 A.M. and close at 6:00 P.M."

"Yes. If the lab were open as long as the music building itself is, or at least until 7:00 P.M. or so, I would have had more opportunity to make use of computer materials."

"Possibly yes. I have really enjoyed working with the computer—I hope it will be continued. I don't find the tapes helpful or enjoyable."

"I would have done more if I were on the computer because I heard it was fun and looked interesting. By the way, I hate tapes."

"The computer was fun so people wanted to practice. Computer ear-training is a definite asset."

"It would be less tiring to use the computer if the tone of the notes were a little richer (I think). Perhaps a synthesizer setting with more overtones could be used."

"The computer has not worked at least on the last 4 times I have tried to use it. Once I waited one whole hour for it to be set up, and still it didn't work. I like to use it, but never can."

"Maybe. Opening the lab on Saturday would be helpful."

"I was in the tape group and did not practice on the computer, but I'm looking forward to the opportunity to operate the computer."

"No. On the short progressions of 4 to 5, the chords were usually very simple and progressions were common. However, on the longer problems instead of grouping common short progressions, many less common progressions occurred. This seems just backwards to the way it should be."

"Computer was not always set up or working properly. When it was I found it to be enjoyable and helpful in ear-training exercises."
"If I were in the computer group I would have gone to the lab more."

"Yes. I would have rather had the computer than the tape. I like to try new things."

"The computer would be a much more enjoyable way of practicing than the tapes."

"I hated the reel-to-reel tapes last semester so I quit going to the lab. The computer was easy and fun. I enjoyed using it."

"Yes. I wish it were open later and/or on Saturdays."

"Yes. I wish the computer would play the progressions more than three times."

"I do not like these exercises--they do not help."

"I would have practiced more if the lab had been open longer hours during the day. Why not close at 8:00 P.M. or 10:00 P.M. instead of 4:30 P.M.?"

"The hours in which the lab was opened were not convenient to my schedule. Sorry."

"I would have practiced more if they had been available at the times I was available."

"A valuable aid. I would have benefitted more if the program had started at the beginning of the semester and if I had more available time."

"Yes. The computer is very helpful, especially the grading system (can see progress)."
VITA

Janet Claire Garton was born in Norfolk, Virginia August 23, 1948 to Nettie and Walter Garton. She received her secondary schooling and Junior College training in Victoria, Texas and graduated from The University of Texas in 1970 with a degree in secondary instrumental music education (trumpet).

In 1970-71, she was employed by the San Benito Consolidated School District as Assistant Band Director at San Benito High School before returning to The University of Texas to complete a Master of Music Education (music theory) in 1974. From 1972-74, Ms. Garton was employed as Assistant Band Director at Brownsville High School in Brownsville, Texas prior to becoming an instructor at Southmost Junior College in Brownsville from 1973 to 1978 when she returned to graduate school. At Louisiana State University, she served as a graduate assistant in undergraduate music theory until 1981.
EXAMINATION AND THESIS REPORT

Candidate: Janet Claire Garton

Major Field: Music Education

Title of Thesis: The Efficacy of Computer-Based and Tape-Recorded Assistance in Second-Semester Freshman Ear-Training Instruction

Approved:

[Signatures]

Major Professor and Chairman

Dean of the Graduate School

EXAMINING COMMITTEE:

[Signatures]

Date of Examination:

1 December 1987