

AN ABSTRACT OF THE THESIS OF

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Title: A STUDY OF THE CONTRAST BETWEEN COMPUTER-
ASSISTED INSTRUCTION AND THE TRADITIONAL TEACHER/
LEARNER METHOD OF INSTRUCTION IN BASIC
MUSICIANSHIP

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The purpose of this study was to contrast the effectiveness of computer-assisted ear-training instruction with the traditional style of ear-training instruction to determine if computer-assisted instruction increased the students' ability to identify auditory stimuli utilized in Basic Musicianship at a rate different from that of the traditional methodology.

Procedures

The setting of this experiment was at Oregon State University, Corvallis, Oregon, using classes in Basic Musicianship, during the fall and winter quarters, 1976-77. Eighty students were randomly selected and randomly assigned to either the computer-assisted method (experimental group) or the traditional method (control group). Both groups used the same textbook and received the same lectures.

The experimental group received the traditional classroom instruction including the theoretical underpinning necessary for understanding the concepts of ear-training, and used computer-assisted programs to reinforce the classroom learning. The control group received the same theoretical background as did the experimental group, but was free to reinforce this learning in any manner found satisfactory to each student.

The Solomon Four-Group design was used to investigate pretest effect on the posttest scores and on the treatment. The Aliferis Music Achievement Test was selected as the criterion measure and was used as both pretest and posttest. Those not required to take the pretest were given a placebo developed by the researcher. Eight hours of computer-assisted instruction was administered to members of the experimental group between pretesting and posttesting.

Selected Findings

Using the repeated measures analysis of variance to contrast the experimental and control groups on the basis of the criterion measure posttest, the following findings were noted:

1. The computed F for the total criterion test was 12.030 for the treatment variable, 142.300 for the test variable, and 32.292 for the interaction, a significant difference favoring the experimental group at the 0.05 level of confidence.

2. Contrasting the mean scores, based on test question categories of melodic, harmonic, and rhythmic, showed a significant difference again favoring the experimental group. In the melodic category the computed F was 6.527 for the treatment variable, 125.787 for the test variable, and 32.814 for the interaction. In the harmonic category the computed F was 4.597 for the treatment variable, 40.599 for the test variable, and 8.270 for the interaction. In the rhythmic category the computed F was 10.382 for the treatment variable, 47.134 for the test variable, and 9.640 for the interaction. All of the F-ratios were significant at the 0.05 level of confidence.

3. Selected t-tests revealed that both groups began the experiment at the same level of music achievement, and that the pretest had no learning effect upon the posttest scores.

4. Investigation of the sample using the Bartlett-Box F test for homogeneity of variance found that both groups were representative of the population.

5. In addition to the criterion measure, a study of student attitude toward computer-assisted instruction was made. The results of this questionnaire revealed that the students in the experimental group held a positive attitude regarding the use of the computer to study ear-training.

Conclusions

The following conclusions were made based on and supported by

the data in this study:

1. That significantly more academic growth in ear-training occurred when students utilized the computer for this study than when they did not.

2. That it made no difference if the type of computer-assisted instruction was melodic, harmonic, or rhythmic, achievement growth occurred in all areas.

3. That students using the computer were able to save a considerable amount of time in developing ear-training skills.

4. That because students could conceivably complete the ear-training portion of Basic Musicianship in less time, the expense of offering such courses might be reduced.

5. That the students showed a willingness to experiment with alternative methods of instruction.

6. That the concerns of music educators toward computer-assisted instruction need to be addressed before large-scale utilization is possible.

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A Study of the Contrast between Computer Assisted
Instruction and the Traditional Teacher/Learner
Method of Instruction in Basic Musicianship

by

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CHAPTER I

INTRODUCTION

Word has come down from the Dean
That, by use of the teaching machine
Young Oedipus Rex
Could have learnt about sex
Without ever bothering the Queen.

Nievergelt (82) published this limerick, which he found in the Alumni Review of Hamilton College in honor of alumnus B.F. Skinner, Class of 1926, to show the exaggeration of expectations related to computer-assisted instruction. Although this may be an exaggeration, if education is to remain dynamic, experimentation in new methodology is needed (16). In recent years the concern for adapting the curriculum to the ability and achievement level of each student has become a serious concern of educators (109). Education today has the good fortune to avail itself of a truly American innovation, one in which there exists no equal in the world, the computer (119). According to Suppes (110), the computer can provide control over the learning situation by responding to each student's behavior.

Need for the Study

The use of computers is well established in business and industry, and to some degree in education, especially in the areas of science education and language. However, research related to its use in the fields of music education and music theory is limited to a few scattered projects throughout the United States.

In a report by the President's Advisory Committee on Education (120), it was noted that:

. . . while computing has not yet become an important part of undergraduate work in such fields as English, history, music, and art, faculty members in some of these fields are making increasing use of computers in research, and computing is beginning to find its way into undergraduate instruction in the humanities (p.

Atkinson (13) notes that there are numerous articles written relating to the use of computers in the educational process. There is, however, relatively little scientific research as to the effectiveness of the computer in the learning process.

Abramson and Weiner (1) feel that proper evaluation processes have not played a sufficient part in the development of computer-assisted instruction programs; rather, that developers are more interested in having their programs adopted than in evaluating them. Secondly, they find that in computer-assisted instruction, programming is often more important than good educational strategies.

There is a need to evaluate the effectiveness of the computer in its role in educational technology because, as Margolin (75) points out, it has the potential for answering the current pressing need in education today.

Swanzy (114) relates, and is supported by Jones (53), that regardless of the apparent lack of interest on the part of music educators, the potential for computer-assisted instruction in music theory should be examined carefully for its effectiveness in contemporary education.

Purpose of the Study

The purpose of this investigation was to determine if computer-assisted instruction increased the students' ability in the area of auditory stimuli discrimination at a rate different from that of the traditional method presently used to reinforce these concepts. The traditional method follows the past practice of presenting, in large group lecture, the theoretical underpinning associated with melodic, harmonic, and rhythmic dictation, followed by repetitive drill by the students, either individually or in small groups. Computer programs were substituted for traditional method for the experimental group. More specifically, the purposes of this study were to:

1. Evaluate the effectiveness of computer-assisted instruction as

an instrument for teaching the ear-training portion of the Basic Musicianship Class.

2. Determine the adaptability of computer-assisted instruction for use in ear-training reinforcement drill.

Theoretical Basis for the Study

Educators today are realizing that developments in society make it increasingly more important to individualize the instructional process (35). Twenty years ago, use of the computer as an instructional device was an idea being considered by relatively few educators. Today the concept has become a reality. Computer-assisted instruction has undergone an amazingly rapid development (13).

Theoretical foundations for computer-assisted instruction have their roots in behaviorist psychology, and more specifically, in the theories of E. L. Thorndike (116). Most influential of his theories are "the law of effect" and "the revised law of exercise." Thorndike's "law of effect" states that when a modifiable connection between a situation and a response is made and is followed by a satisfying result, the strength of the relationship is increased. When this connection is followed by an unsatisfying result, the strength is decreased. Thorndike (117) later developed the "law of exercise," emphasizing the importance of the results in learning and not the mere repetition of stimulus-response connections. As he stated:

Our question is whether the mere repetition of a situation in and of itself causes learning, and in particular, whether the more frequent connections tend, just because they are frequent, to wax [sic] in strength at the expense of the less frequent. Our answer is no. . . ordinarily we reward certain of the connections leading from it and punish others by calling the responses to which they respectively lead right or wrong, or by otherwise favoring or thwarting them (p. 231).

Thus, Thorndike established the theoretical foundation which was later to be adopted in some general form or another by the advocates and developers of computer-assisted instruction. The influences of these general principles would not only support the concept of auto-instructional devices, but shape the design of the symbolic programming languages used for computer-assisted instruction as well.

Neal Miller (78) added motivation as an additional dimension to the stimulus-response-reward continuum. He reported that before the stimulus is presented, the student must want something, i.e., motivation. This motivation is then followed by the stimulus, response, and reward.

Recent developments in computer-assisted instruction have been most significantly affected by the writings of B.F. Skinner (103, 104). His theory of operant conditioning is defined as a type of learning whereby the student assumes an active and participative role in the learning situation. This conditioning is so arranged that the student will not receive any reinforcement or reward until the correct response is given. The reinforcement, therefore, depends upon the

prior occurrence of the correct response (103). When his theory is applied to pedagogical situations, the learning task is divided into minute stimulus-response bonds. A problem is presented to which the student is expected to respond with the appropriate answer. If the answer is correct, it is reinforced by some statement or sign of approval and the next question is presented (104). The rationale for computer-assisted instruction related to Skinner's theory is that it is advantageous to require the student to respond to questions by some overt act--writing, typing, pressing a key, etc. Likewise, the student is provided with an immediate feedback to determine if the response was correct. Coupled with the short-frame and small-step-size approach to programming computer materials, such a process of overt responding, feedback, and reinforcement, produces a thorough understanding of each question and answer set before moving on.

Atkinson (10, 11) distinguished between two concepts of optimality. One he referred to as short-term optimization and the other, long-term optimization. As he noted, short-term optimization takes advantage of current information and then modifies the instructional routine in respect to that short-term information. Long-term optimization, on the other hand, utilizes the entire history of a given individual when making decisions about the branching (12, 13).

Fishman (40) was interested in finding the optimum procedure for distributing instructional material in computer-assisted instruction. In his investigation he found that massed condition was superior to the distributed condition in short-term performance, but in the long-term, more learning occurred when repetitions of an item were well distributed. His model is a variation of the trial-dependent-forgetting theory presented in articles by Atkinson and Crothers (12), Calfee and Atkinson (22), and Groen and Atkinson (45).

In the past, the theoretical development in computer-assisted instruction has been the sole property of the behaviorists. As a result of this, there has been little serious attempt to relate developmental principles of cognitive growth to the pedagogical development of computer-assisted instruction (15). The behaviorists view all types of learning as variations upon a universal theme. However, general developmental theories, such as those proposed by Piaget (89) and Ausubel (15), have brought out important developmental variations in the area of perception, and in the nature of the thinking process itself. Many advocates of computer-assisted instruction have vociferously proclaimed the value of immediate feedback, the necessity of making a demonstrable response, and the direct tangible experience the learner has with the learning materials (108, 111). However, if we are to extrapolate from the developmental theories, it must be acknowledged that as age increases, the world is viewed in

more general and abstract terms, and less in tangible and time-bound contexts (89). According to Ausubel and Piaget, there is an increase in the ability to comprehend and manipulate abstract symbols and relationships without the benefit of direct and tangible experience. Therefore, these theorists feel that the utilization of computer-assisted instruction in its present behaviorist form, for all learners of all ages, is a regression to outmoded theories (15, 89). By following the cognitivist theory of the structure of thought, and applying developmental concepts, computer-assisted instruction can facilitate the identification of the individual learner's level of mastery and develop the subsequent curriculum accordingly. As a result, states Edwards (35), when the learning theories of the cognitive-developmental writers are applied to computer-assisted instruction, this pedagogical technique will become a more potent educational device.

Definition of Terms

Definitions of terms used throughout the study are provided so that they may be understood within the text.

Assembler--Generally translates input symbolic codes into machine instructions item for item, and produces as output the same number of instructions or constants which were defined in the input symbolic codes.

Author--A person who designs or writes a course for computer-assisted instruction.

Branching--The selection of a path in the flow of control, based on the results of previous operations.

Cathode ray tube (CRT)--An electronic vacuum tube, like that of a television set, containing a screen on which information may be displayed.

Central processing unit (CPU)--That portion of a computer exclusive of the input, output, and peripheral units. It contains the main storage, arithmetic unit and control units.

Computer--A device capable of accepting information, applying prescribed processes to the information, and supplying the results of these processes.

Computer-assisted instruction (CAI)--Instructional methods using a computer system for presentation of materials, evaluation of response, scoring and grading, and other functions.

Control group--Those students involved in the experiment who received only the traditional classroom instruction and not computer-assisted instruction.

Curriculum data base--Lesson materials stored on magnetic disc and available as required by the procedure program. Contains questions, answers, tutorial text, control information, and any other data needed during course presentation.

Data processing--Handling of data according to precise rules of procedure to accomplish such operations as classifying, sorting, calculating, summarizing, and recording; the production of records and reports.

Experimental group--Those students involved in the experiment who received computer-assisted instruction.

File--An organized collection of information directed toward some purpose and treated as a unit. In CAI, a curriculum file usually represents the information needed for a particular lesson.

Hardware--The physical equipment or devices forming a computer and its peripheral equipment.

Input--Information or data transferred from an external storage medium into the internal storage of the computer. Also, the routines which direct input, or the devices from which such information is available to the computer.

Input/output device--A general term for the equipment used to communicate with a computer, and the data involved in the communication.

Language--A system for communicating information between operators and machines or between machines and machines. Such a system consists of a carefully defined set of characters, rules for combining them into larger units such as words and expressions, and rules of word arrangement to achieve specific meaning.

Machine language--A language designed for interpretation and use by a machine without translation.

Magnetic disc--A storage device on which information is recorded on the magnetized surface of a rotating disc. A magnetic disc storage system is an array of such devices, with associated reading and writing heads mounted on movable arms.

Music box--A device used as an audio response unit connected to the terminal. The unit will, upon command, play back a message to the terminal operator. Up to 15 minutes of prerecorded audio messages may be available with an average access time of 0.5 second.

Off-line--Pertains to equipment or devices not in direct communication with the central processing unit of the computer; also used in CAI to refer to processing done during non-CAI hours, i. e., when students are not communicating with the system from terminals.

On-line--Pertains to equipment or devices directly connected to the central processing unit; also used in CAI to refer to CAI hours, when students and teachers can communicate with the system through terminals.

Output--The information transferred from the internal storage of a computer to an external device; used to refer to the routines which direct the output, and the device or set of devices necessary for output.

Peripheral equipment--The auxiliary machines which may be placed under the control of the central computer, e.g., card readers and punches, magnetic tape feeds, high-speed printers.

Permanent storage--A method or device used to retain intermediate or final results outside of the central computer.

Plasma panel--An eight and one-half inch square display panel, readable in a brightly lighted room without eyestrain. The device permits storage of information on the display screen without flicker. No refreshing of the display panel by the computer is required. The thin, transparent structure of the plasma panel permits the device to be used as a screen for viewing of information in the form of slides or microfiche which can be projected on the rear of the panel. This local storage of static information reduces the memory required in the central computer and at the same time results in more efficient use of the communication link.

Plato--Programmed Logic for Automatic Teaching Operations.

Program--The complete plan for the solution of a problem, including data gathering, processing, and reporting; more specifically, the complete sequence of instructions and routines necessary to solve a problem. Also, to plan the procedures for solving a problem.

Random access--Pertaining to the process of obtaining information from or placing information into storage, where the time required for such access is independent of the location of the information most

recently obtained or placed in storage. Also pertaining to a device in which random access can be achieved without effective penalty in time.

Response time--The elapsed time between generation of an inquiry at a terminal and receipt of a response by the system.

Software--The totality of programs and routines used to extend the capabilities of computers, e.g., compilers, assemblers, executive routines, etc.

Storage--Pertaining to a device in which data can be stored and from which data can be obtained at a later time. Synonymous with memory.

Storage capacity--The number of elementary pieces of data, e.g., characters or bytes, that can be contained in a storage device.

Student history vector--A CAI record reflecting a student's daily progress in the course. The student history vector file is maintained and updated through both procedure program processing and off-line processing.

Terminal--A device in a communication network capable of sending and/or receiving information over a communications channel. A machine used by students to communicate with the system.

Time out--A condition which occurs when a student fails to complete a response in the time allotted by the course author.

Time sharing--The use of a device for two or more purposes during the same overall time interval, accomplished by interspersing component activities in time.

Touch panel--A device on the student terminal plasma panel display which allows communication with the central system independent of the terminal keyboard. The device communicates responses by the operator interrupting vertical and horizontal light beams. The corresponding interruption indicates to the system the location of a response.

CHAPTER II

REVIEW OF RELATED LITERATURE

The material in this chapter is divided into four sections. The first segment presents the current research in the field, with a short analysis of the findings in each piece of research. Part two describes the types of programming used in presenting learning material. The third section deals with the history related to individualized instruction and the development and use of the computer in education. The final segment presents some criticisms and cost analyses of computer-assisted instruction.

Studies and Current Research

Several studies have been undertaken to determine the effectiveness of computer-assisted instruction as a method of imparting knowledge.

Blombach's research into the development of the computer as an analytic system found that so far the computer has had limited achievement. In the study, the importance of the contrapuntal and harmonic elements of music was approached through an investigation of the relationship between "key," the tonal implications reflected in a succession of temporal simultaneities, and "scale," the tonal implications reflected in a succession of pitches. Although Blombach did not

address evaluation in a direct nature, she did conclude that evaluation of computer-assisted instruction was indispensable if the value of the computer as an educational tool is to be attained (18).

In a recent study concerned with linear and branching formats of programmed instruction in music fundamentals, Moore (80) found that there was little difference in achievement or retention as a result of the format employed. It appeared, however, that those students following a branching format required less time to complete the programmed materials than did their linear counterparts. The objective of this study was to compare types of programming formats, and related little pertaining to computer-assisted instruction as an effective method of presenting music fundamentals. In any event, studies such as this are important when investigating the types of programming suitable for specific elements of the music curriculum.

Saul (100), in the research and development of the computer as applied to the education of music teachers, showed the effectiveness of using the computer in "teaching simulations," and in test development. However, no comparison of his applications and that of the standard method of teacher education was made.

In another doctoral study, completed at the University of North Carolina, entitled "The Efficacy of Computer Assisted Instruction with Traditional Teacher-Taught and Self-Taught Methods of Teaching Beginning Music Theory" (25), the author found no significant

difference between those students exposed to computer-assisted instruction and those taught in other fashions.

Cattaneo (23) concluded in his writing that computer-assisted instruction was most beneficial to middle- and lower-achievement students. He stated that these groups can most benefit from the individualized tutorial-drill instruction provided by computer based lessons. Results of his evaluations based on comparisons with non-computer assisted courses, cost per student determination, and student attitudes indicated the techniques of computer-assisted instruction can efficiently augment the instructor's efforts and have a positive effect on achievement and attitudes.

Sister O'Connor (83) assessed junior high students' ability to discriminate single and multiple musical concepts aurally and evaluated the growth in discrimination achieved through a programmed tape listening approach as compared to non-programmed general music class instruction. She found that the students in the experimental group gained significantly in mean scores over the students in the control group. Although the study did not utilize the computer as the method of presentation, the results strongly confirmed that single and multiple musical concepts can be taught to large groups of students through the use of programmed tape teaching techniques.

In a study conducted at Stanford University, "Computer-Assisted Instruction: A Study of Student Performance in a CAI

Ear-Training Program" (47), relationships between the participants' performance in a computer-assisted ear-training program and musical background and attitude toward computer-assisted instruction were studied. Although the data related to this study were conclusive in the area of attitude and background, evaluation, as such, of the total effect of computer-assisted instruction on learning did not seem to be intended.

In another study, "An Analysis of a Computer-Assisted Laboratory Method of Instruction in Elementary Business Statistics" (122), conducted at Southern Oregon State College, it was shown that through the use of computer-assisted instruction it is possible for students to achieve as well as those receiving a teacher-taught method. Although the data found in this Ph.D. dissertation seemed to indicate that computer-assisted instruction is at least as effective as the other method of instruction, the type of computer program and the academic discipline make it difficult to generalize as to the possible effect of a multi-dimensional computer program, i. e. Plato IV, on learning.

In his study, Hullfish (50) compared two methods of programming music theory materials for presentation through the medium of computer-assisted instruction. The methods differed in the structures of their decision rules, the strategies used to determine the order of presentation to individual students. One method was

characterized by the computer's presentation of material determined by the response history of the student. The other, only by responses to certain key questions. Each method determined the branching pattern relayed from the computer. Hullfish found significant differences favoring the students who had worked with the response-sensitive program. No significant differences in attitude between the groups were found. Hullfish's study has several basic strengths. A valid comparison of two methods of presenting identical musical material to similar students through the same medium was made, and empirical evidence was gathered to show that significantly greater achievement results from the programming strategy which takes greater account of the student's prior knowledge and response patterns.

A study by Pickering (90), related more to programmed learning than to actual computer-assisted instruction, found the experimental group produced higher mean scores on two of three posttest sections of the criterion measure. In addition, students in the individualized instructional program were shown to have a more positive attitude toward this type of learning than toward the traditional type of learning situation. His program was designed to include principles of learning theory developed by Gagne and Ausubel, utilizing five interchangeable tracks. The material was recorded on cassette tapes for use by the experimental group in the music listening center. Although the study

material presented to the experimental group was not computerized, the study does relate further empirical evidence of the success of using programmed material for introductory music courses.

Jones (53), in an attitude study to determine the status of computer-assisted instruction in music education within higher education, revealed the following results. In a survey of 434 institutions he found that [1] few music educators were involved in teaching by computer systems, [2] few students were involved with computer-assisted instruction as learners, [3] few music educators and music graduate students were involved in research in computer-assisted instruction, [4] few quality course materials were available, and [5] no formal mechanism exists for sharing computer-assisted efforts in music.

The United States Office of Education (57) sponsored a study to determine the feasibility of individualized computer-assisted instruction in keyboard experience music education at the elementary school level. Following 13 months of research, conclusions emerged indicating the interactive computer-assisted instruction keyboard system was technologically feasible but that it was not economically feasible. The study, however, was not intended to evaluate the effectiveness of computer-assisted instruction but to determine the cost-effectiveness. The researcher did note that the children participating in the testing made remarkably fast progress through the lessons.

An experiment exploring the effect of group size on student learning when small groups of students worked together at a computer-assisted instruction terminal brought out some facts which may relate to the eventual cost-effectiveness of this method of instruction (84). The study divided 60 college students into three groups-- 19 students studying alone, 16 in pairs, and 15 studying in groups of three or four. No significant differences in achievement between the groups were found, but very significant differences in the time to complete the lessons or modules were observed. When total achievement scores for the groups were divided by the total time at the terminal, utilization efficiency of the computer-assisted instruction terminal was found to increase with group size. The study concluded, therefore, that learning effectiveness is not substantially altered by small group use of computer-assisted instructional terminals, but that relative efficiency is considerably improved. However, no determination of the comparative effectiveness of computer-assisted instruction and other methods of instruction was measured.

A report relating to the use of computer-assisted instruction at Kennedy-King Community College found that the use of Plato during a two-year period resulted in a high level of acceptability by both the students and the faculty (74). The study was not intended to measure the effectiveness of computer-assisted instruction, however, but to

assess the attitudes of students and faculty toward this method of instruction.

In an experiment conducted by Allvin (6), students were taught sight-singing with a computer-assisted system. He found that although some of the melodic sequences taught did not rely on tonal systems of organization, students learned the intervals in context without reference to tonal centers. One inference that may be drawn from this study is that the automated music learning approach may make it easier to give more attention to contemporary music than the traditional curriculum does. Through the early establishment of a perceptual framework that goes beyond tonal music, it may make contemporary music an integral part of the student's basic musical experience, not a deviation from some assumed standard form of music.

Placek (92) designed and programmed a computer-assisted lesson for teaching selected behaviors in the area of rhythm perception to students preparing to be elementary teachers and studied the lesson's effect upon the students. Students participating in the study reacted positively to the computer-assisted instruction experience. They valued the feedback given in a relatively confidential situation and the ability of the computer to define a task, demand input, and quickly judge the response. They also expressed great approval of the audio-visual potential of the system including the personalized

responses and the immediate accessibility of musical examples. Placek concluded in his study that computer-assisted instruction in music was feasible and that music educators should become involved in the preparation and use of materials for such instruction.

In a study of the feasibility of computer-assisted instruction for instrumental music education, Peters (88) concluded that presenting trumpet performance to the computer for judgment of pitch and rhythm accuracy is feasible, and that the interface is technically capable of accepting and judging rapid tones, two tones trilled, and lip slurred tones. Legato tongued tones, however, seemed to present a problem when they approach an interrupted long-tone scale of almost continuous sound. Peters further concluded that students participating in the study were motivated to achieve a correct response judgment from the computer.

A study similar to that of Peters' was "Evaluation of Computer-Assisted Instruction in Instrumental Musicianship." Deihl (31) measured the applicability of a combined computer-assisted instruction material and related off-line practice program and evaluated its effectiveness through the implementation of criterion-referenced pre and posttest measures. Group gains in both listening and performance were significant and dramatic. An additional high correlation was found between aural concepts in musicianship and instrumental performance. Although both these studies go far in

demonstrating the effectiveness of computer-assisted instruction, the scope was limited to that of the trained musician and to the field of performance studies.

A variety of methods has been used in basic musicianship programs to teach students auditory skills. Unfortunately, for some students, even a minimal level of competence is not an easily attained goal. Ear-training instructors have known from experience that students have greater difficulty in recognizing certain intervals than others. However, relative difficulty of intervals has been subjected to little formal scrutiny. What little research which has been conducted has been an indirect result of studies of pitch perception or tuning systems, and only occasionally has the perception of intervals been the objective of study by auditory theorists. Plomp (93) described a wide variety of experiments pertinent to the formation of musical pitch, but only indirectly related to interval perception. Pickler (91) furnished a rather comprehensive review of research into the influence of interval performance on tuning systems. Attneave (14) used transposition of musical interval patterns as a method of studying psychophysical pitch functions. Allen (2) found a difference between musical and non-musical subjects in the perception of the octave. Plomp with others (94) investigated students' correct identification of harmonic intervals constructed from a one-octave pitch source generating both simple and complex tones.

A study by Killam (58, 59) measured student accuracy in the identification of simple intervals using a sound source of complex tones. Killam's study focused more sharply on the implications for teaching methods and possible yardsticks for measuring progress. Intervals presented in the experiment consisted of four series of the intervals minor second to octave, inclusive. The sound duration of the intervals was either 0.1 or 0.2 seconds and each set used only one form of presentation--ascending, descending, or simultaneous. Thus, a total of 288 intervals was presented to each student in one session of approximately one hour. A variety of contrasts in correct recognition emerged from the study. The most accurately recognized interval was the perfect eighth at 88 percent and the least accurately recognized was the minor sixth at 55 percent. Additional data showed that duration was not found to be a significant source of variability in recognition. The mode of presentation appeared to have little effect on the general outcome of scores for the interval, running counter to the general lore that descending intervals are more difficult to recognize. Analysis by gender showed significant difference, with females scoring nine percentage points higher on mean scores than males. Further conclusions showed that past theories of the consonance-dissonance ordering of correct identification did not hold. In addition, the data did not support theories of recognition correlated with interval width--the octave, with the highest percentage

of correct identification was but a whole step from the minor seventh, the interval second from the lowest in rank order of correct identification. Correct responses did not appear to cluster symmetrically around the stimulus, but tended to cluster a semitone to one side or the other of the correct interval. The study did not attempt to correlate or to contrast the computer-assisted method of presenting intervals with that of the traditional method. However, the data presented did show the ability of the computer to evaluate the extremely complex area of interval recognition.

The paper which most closely relates to the present study is "Guido: An Interactive Computer-Based System for Improvement of Instruction and Research in Ear-Training." Hofstetter (48), in his study of the Guido lessons in harmonic dictation, found that computer-assisted instruction could make a significant impact on student achievement in this area. The study was conducted with the freshman ear-training class, which during the first semester received the same course in ear-training with all drill-and-practice done in the tape laboratory. The second semester the class was randomly divided into two groups, with one group being assigned to an experimental Guido group, and one assigned to a control tape laboratory group. All students spent an average of two hours per week practicing harmonic dictation. Three tests were administered; test one at the end of the first semester to measure the training in both groups prior to the

introduction of Guido in the experimental group; the second and third tests were given during the second semester as measures of student achievement in both groups after the introduction of the Guido harmonic dictation program. A t-test was used to compare scores of the two groups for each harmonic dictation test. The scores of the two groups did not differ significantly on the first and second test, but they did differ beyond the 0.05 level on the third test. Students in the Guido group scored higher than students in the tape laboratory group, indicating that those students using Guido's interactive computer program for drill and practice achieved greater harmonic dictation skills than those using the type laboratory.

Further research into the relationship between computer-assisted instruction and music, especially in the area of theory, appears to be needed if music educators are to justify further expenditures of time and funds in this field. Clearly, the relatively few studies show that computer-assisted instruction may have an impact upon learning, but, just as clearly, the scope of the research to date appears to be extremely limited.

Although there seems to be a lack of research related to music theory and computer-assisted instruction, the relative effectiveness of computer-assisted instruction in other fields appears to be a reasonably well-established fact. Vinsonhaler and Bass (123) suggest that there seems to be little doubt that computer-assisted

instruction plus traditional teacher/learner instruction is usually more effective than traditional instruction alone. Studies have shown that knowledge can be produced in a variety of different students, with a variety of materials, with a variety of procedures, and, in general the students learn. A consistent finding is that students learn at least equally well using machines compared with other methods of instruction (64).

In a review of some of the principles of teaching, Chapman and Carpenter in Coulson (27) noted that when a number of great teachers analyzed their methods and wrote down rules for successful teaching they all emphasized more or less the same points:

Information should be presented in a logical, step-by-step sequence.

Learning should proceed from the known to the unknown.

Instruction should proceed at a student's own pace.

Efforts should be made to insure the student's understanding of each point before he proceeds to the next.

Misunderstandings should be detected and corrected immediately.

New ideas should be made meaningful in terms of the student's own experience.

The student should actively practice what he is learning.

Instruction should be fitted to the comprehension of the learner.

Computer-assisted instruction provides a method of putting these teaching principles into practice.

As Coulson states, in modern systems of education there is an urgent need to increase the efficiency with which pure content is transmitted to the learner. There is, in addition, the need for the development of socialization and desirable attitudes, and further, a need to develop within the individual an ability to reason, to think, and to be creative in attacking life's problems. While it is neither the purpose nor the function of computer-assisted instruction to replace the classroom teacher, the system can absorb many of the teacher's present activities, particularly in transmitting content and information. The teacher is then free to concentrate on the socialization of the student or the transmission of attitudes, a role that true professionals welcome (27).

Under a 1963 Carnegie Corporation grant, Stanford University designed and developed a computer-assisted laboratory for teaching and learning under the direction of Patrick Suppes and Richard C. Atkinson. Atkinson's area of development was in reading, while Suppes worked in mathematics. Both researchers worked with primary grade students. Basic curriculum development was done in the respective areas and tested over a three-year period. Atkinson (13) stated that the treatment of data of first grade students who received computer-assisted instruction revealed reading scores significantly

higher on all posttests except one. These results were further confirmed as Fletcher and Atkinson (41) reported on expanded studies done on grades kindergarten through third. A clinical psychologist's report made on the study also showed that students, teachers, and parents were quite favorable to the program (13). According to Goodlad and others (43), the Stanford group felt that computer-assisted instruction could provide extensive accommodation to individual differences, teacher relief from routine tasks, and systematic ordering of curriculum sequences. According to Kuhn (62), individualized instruction has historically 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 develop necessary facility with basic skills, and this requires a large amount of instructor time. The curriculum areas of music have been designed to correspond with the traditional outlines of music theory ear-training, and the flexibility of the program has made it very useful as a supplement to the regular music fundamentals course at Stanford (62).

Computer-assisted instruction has emerged during the past several years as a specific, demonstrable and potentially powerful instructional tool (68). Educators at all levels have indicated growing

interest in the possibilities of computer-controlled presentation of instructional materials. However, virtually every source work on computer-assisted instruction has included a plea for the development of more software or program materials to be used in computer systems. According to Bacon, the Systems Manager in Education Systems of the IBM Corporation, the key to progress is in the maintenance of an attitude of evaluation. Computer-assisted instruction is still in a developmental phase in terms of both its educational value and its appropriate place in schools. The pacing element in the development of computer-assisted instruction will be the availability of good materials for instruction (81).

Types of Computer-Assisted Instruction Programming Used in Education

Computers, historically, have been an important and very visible technological advancement in our society. Such areas as the space program, banking operations, billing processes, election predictions, and many others have been introduced. The computer's role in education has run from administrative functions such as class registration, payroll, and curriculum scheduling, to the teaching of computer programming and mathematical services. However, utilization of the computer in the area of education should not only include management and informational processes, but learning

processes as well. As an educational tool of the twentieth century, the computer is unmatched in its potential to help educators achieve individualized teaching (29). Margolin and Misch (75) state that if the computer is properly understood and correctly applied it can satisfy one of the primary goals in education, that of meeting the needs of the individual student. As Lekan (68) points out, computer-assisted instruction is difficult to define because there remains a controversy over the exact role the computer should play in education. This may be evidenced by the list of names used to describe the topic, i. e., computer-assisted instruction, computer-aided instruction, computer-based instruction, computer-assisted learning, etc.

Computer-assisted instruction can be divided into five fundamental types or modes of presentation. Stolurow (106) identifies these modes as [1] problem-solving, [2] drill-and-practice, [3] inquiry, [4] simulation and gaming, and [5] tutorial.

In the problem-solving mode, the student has access to the computer through the use of an input-output device, usually with on-line, real-time capabilities. The student then is able to utilize the computational capabilities of the computer. A computer language is many times necessary in this mode to permit the student to enter data and receive instructions for problem solving. Stocker (105) states that the problem-solving mode is often used as a teaching tool in mathematics, science, and other problem-oriented subject areas.

Salisbury (99) relates that the problem-solving mode for quantitative applications is relatively easy to introduce into an educational setting since it need not involve additional instructional staff for programming. The use of this mode of presentation allows the instructor to either become involved or not, as he desires.

The drill-and-practice mode permits the instructor to program quantitative or qualitative problems to give the students practice sessions covering related materials found in the objectives of the class. This mode in many cases has the capabilities to accumulate information about each student's performance in the program so that the progress of his learning is available to the instructor (121). In addition, the ability of the computer to record a complete profile of the student's responses and the time required to solve each problem makes observation of the problem-solving behavior over a protracted period possible without disrupting the process being studied (54). As Licklider (70) pointed out in his research on computer-assisted drill instruction:

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--or did not.
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

homogenous behavior required to reveal the diverse effects and interactions we must have in order to understand the educational processes (p. 39).

The inquiry mode allows the student to question the computer about some topic. The program provides the student with answers it has stored in its files based on the extent that a set of algorithms provides access to the information. Because of the storage requirements and the need to have data presented in a uniform manner, additional staff, such as knowledgeable programmers, are necessary. Stocker (105) notes that the inquiry mode represents an area where more development is needed before broad adoption can take place.

The simulation and gaming mode requires that the instructor formulate a model of a real or idealized situation. The objective of this mode is to allow the student to learn about the complex relationships of a situation through the study of the variables representing that situation. Such areas as teaching strategy involving the critical conditions facing the teacher are examples of its use. Simulations allow the student to gain a considerable amount of experience in a relatively short time with little threat regarding the consequences of inappropriate responses. The model must be programmed to allow the student to interact in his natural language (99).

The tutorial mode is programmed based upon information about a particular student, with the program logic branching to an instructional strategy indicated by the instructor as best for a specific

response. Alternative methods of formalizing the logic are possible to lend flexibility to the program. As Jerman (52) points out, the branching process allows for a high degree of individualization of instruction.

One common element, that of interaction, is found in all the modes used in computer-assisted instruction. Feingold (37) defines this interaction as:

. . . the sequence of operations in which the computer presents some information, the student responds, and the computer, on the basis of his response, presents more information. The computer's ability to interact with a student is fundamental to the achievement of meaningful instruction whenever the instruction is such that it can vary according to the student's performance (p. 47).

Suppes (112) and Jerman (52) note that, regardless of the mode, computer-assisted instruction will remain just a supplement to the classroom instructor--an enrichment experience for the student, and in some cases for the instructor as well. As Suppes (113) states:

. . . I do not see the computer as an instructional device in competition with the teacher. The role of the computer is like the role of books: to amplify the skills and time of the teacher (p. 250).

Review of Related History

Although computer-assisted instruction may appear new and revolutionary, the emphasis of this system is, in reality, a

rediscovery of the Socratic method of instruction. According to lore, Socrates (469-399 BC), the Grecian sage and teacher, employed a simple technique of question and answer whereby his students were taught to think with reason and clarity. Computer-assisted instruction in many ways utilizes the same approach; it begins with simple questions progressing to more complex material in accordance with the individual student's progress (121).

Gomenius (1592-1670), in The Great Didactic, promised a system of education in which all students would be educated without blows or compulsion but as gently and pleasantly as possible (55). By the end of the seventeenth century, Locke (1632-1704) emphasized that, ". . .the plainest, easiest, and most efficacious way to instruct students was to set examples of those things one would have them do and invite them to observe" (p. 145). He noted that students understood reason as early as they did language and love, and that they should be "treated as rational creatures sooner than one imagined" (71).

Froebel (1782-1852), in The Education of Man, prescribed education that was adapted to the student's nature and needs throughout the different stages of human development. He emphasized that students not be looked upon as "pieces of wax or lumps of clay to be molded by man into what he pleased" (118, p. 161).

The Swiss educator, Pestalozzi (1746-1827), expressed his view that experience and comprehension were inseparably linked (15). According to Brubacher (20), the Pestalozzian method of object instruction had its major thrust in this country with the establishment of the Oswego Normal School in New York at the beginning of the Civil War. Objective instruction was embodied in the form of the field trip, visits to museums, shop work, and the manual-labor movement as a method of helping students form concepts based on observation.

The end of the Civil War marked the close of a pioneer era and the beginning of a new industrialized age. Rejection of the philosophy of traditional education brought problems for those who desired a new form of education (98). Parker (1837-1902), an admirer of both Pestalozzi and Froebel, instigated the self-activity movement in such areas as music, speech, and art (20). Dewey's children were students in Parker's school until Dewey (1859-1952) established his "Laboratory School" in Chicago in 1897 (28). To Dewey, the rise of what was then called "New Education" was of itself a product of discontent with traditional education. The traditional method had been one of imposition from above and from outside, imposing adult standards, subject matter, and methods upon those growing toward maturity (33).

Kilpatrick (1871-1965), who was one of the interpreters of Dewey's theories at Columbia Teachers College, taught that the important thing in education was insuring that the purposes and plans

in the school were those of the pupils and not of the teachers. He advocated letting students plan and think for themselves (107).

Historically, the first attempt to utilize a machine for teaching was made by Maria Montessori (1870-1952) in Rome in 1907. Her work with teaching devices anticipated later concepts of programmed instruction (79).

In the 1920's, Sidney Pressey (b. 1888), reacting to the boredom and listlessness during question and answer sessions, decided to use mechanical devices for administering and scoring test questions. In this method the students could be asked questions, respond, and then receive confirmation as to the correctness of their responses (72). At a meeting of the American Psychological Association in Washington in 1924, he exhibited an apparatus which anticipated the modern teaching machine. The device automatically gave and scored a test and in addition, taught informational and drill material (95). The machine was intended by Pressey to free the instructor for more real teaching, of the thought-stimulating and idea-developing type, than had been possible before, and to eliminate the labor and mistakes in scoring. Pressey wrote of the coming evolution in education, and in 1932 predicted that the use of machines for drilling students in arithmetic and spelling could overcome the considerations for efficiency and the need for labor-saving devices in education (72). With the introduction of machines for instruction, an

individualized program was no longer a remote possibility.

Machines were used to free teachers and students from the drudgery of memorization, drill, and scoring; more and more, education became involved in teaching the skills of inquiry and problem-solving (115).

Burrhus F. Skinner (b. 1904), the Harvard psychologist known for his experimentation with pigeons, noted that learning elaborate movements and even color discriminations could be accomplished when the complex learning situation was divided into small objectives and successful responses were immediately reinforced. In a paper given in 1954, Skinner (62) arrived at the conclusion that the teacher, as a source of reinforcement, is physically unable to provide each student with individual reinforcement every time it is appropriate and needed. He stated that:

Since much learning takes place covertly, it is impossible to know when a correct response has been made, an appropriate conclusion reached, or a correct idea produced. A tutor, on the other hand, interacts directly with one student, provides the guidance necessary to allow the students to arrive at a correct response, and then gives reinforcement. A tutor is always in the position of being able to provide necessary reinforcement and to adapt to the student's progress by further elaboration of ideas, repetition, and changes in pace (p. 97).

Skinner's experimentation led him to develop an audio-instructional technique whereby direct interaction between the student and a program was possible. He described a teaching device which

made it practical to present carefully designed material in which one problem depended on the answer to the preceding one, and thereby presented a more efficient progression to a complex repertoire (72). In 1958, Skinner and Holland (39), in a study of the use of teaching machines in college instruction, found that students reacted in a positive manner but suggested that the development of a special technique of composing items was needed to deal with unexplained types of responses. However, they did note that the response by the subjects indicated a similarity between the machine and a tutor:

. . .there is constant interchange between program and student; the machine induces sustained activity; like a good tutor, the machine insists that a given point be understood before the student moves on; the machine presents just that material for which the student is ready; it helps the student to come up with the right answer; and, like the private tutor, the machine reinforces the student for every correct response (p. 151).

Feldhusen (38) stated that just as programmed instruction of the late 1950's and early 1960's was the major new development in education, computer-assisted instruction was an outgrowth of this in the late 1960's and the 1970's. Although it has been well argued whether programmed instruction has validity as a learning process, such scholars as Lange (65), Corey (26), and Glasser (42) have presented convincing arguments and data which indicate that programmed instruction is a relevant method of instruction. Thus, it is seen that programmed instruction achieved its initial momentum because it

provided the answers to the individualization of learning materials. However, it fell short in its ultimate goal, that of allowing the student to learn at his own pace (106). Computer-assisted instruction, then, can be viewed as a new format for programmed instruction. The variety of media forms which computer-assisted instruction allows for widely expands programmed instruction capabilities and gives it added validity as a learning method (38).

In 1959, the University of Illinois installed the Plato program (Programmed Logic for Automatic Teaching Operation), one of the first efforts to build a computer-assisted instruction system. Plato II followed in 1962 with two terminals and Plato III in 1964 with 20, and a theoretical limit of 100 terminals. Two computer-assisted instruction projects, investigating the audio capabilities of Plato III, were initiated during the later part of the 1969-1970 academic year. One was designed to implement a random-access audio device in an elementary music fundamentals program by Placek (92), the other was designed to interface the Plato system to judge pitch and rhythm performance in instrumental music by Peters (88). From 1970 to 1972 a number of computer-assisted instruction programs were written in various areas of music instruction for demonstration purposes. Programming areas included music theory, music history, music education methods, plus the programs developed in elementary music fundamentals and performance judging areas of the initial

studies. Although the limited Plato III facilities would allow only 20 students or authors to work with the computer at any one time, all University of Illinois graduate students in music education in 1972 became familiar with the available programs in music and learned basic programming techniques on the Plato III computer system (87).

After some six years of research in computer-assisted instruction using the Plato III system, a decision was made to develop a much larger system which could better provide the facilities for evaluating computer-assisted instructional concepts. This new system, Plato IV, contained as many as 4,000 terminals which are remotely located throughout the United States. With the implementation of the Plato IV system, larger numbers of classes and students could be accommodated. By January 1973, 25 programs were available to students in music, including a lesson series developed in instrumental music by Peters (88). The effective lessons developed on the Plato III system were transferred to the new computer system. Several lessons developed by graduate students were tested in the elementary school for the first time in 1973 (73).

While the Plato III system utilized student terminals containing cathode ray tube displays (CRT), similar to the picture tubes in television receivers, the Plato IV system used a new display called the plasma panel. This device is a transparent flat sandwich of glass in which the computer can write information and on the rear of

which images from a slide projector can be displayed. Such a technique allows the super-position of computer-generated information on locally stored slides information. Additional new hardware recently developed for use with the Plato IV terminal include an audio device (music box) and a touch panel. This panel allows the interaction with the program unrelated to the level of typing skill possessed by the user. The music box, although restricted in having no timbral variation and only producing four-part audio examples, has been used successfully in dictation programs. Research work continues on a large, 16-voice tone generator for added flexibility in programming music. The new version of the music box will have the added capabilities of computer-controlled enveloping and timbre control. Work should be complete on the prototype of the 16-voice music generator within the calendar year (73).

An improved random-access audio device has been developed and is now capable of reproducing pre-recorded music examples of satisfactory fidelity. This commercially-available device is adaptable to any computer system and gives much needed flexibility in music programming. This playback device presents a record-playback feature, as well as the quick access selection of any pre-recorded materials. Future application is planned using the record-playback feature in music appreciation and music testing (87).

From 1975 to the present, a growing number of students and music faculty at the University of Illinois have used Plato in course offerings. An experimental lesson sequence in music theory was initiated during the spring of 1976, and has since been incorporated into the course as a weekly requirement (87).

In July 1974, the University of Delaware initiated an Automated Instruction and Research Laboratory for improving ear-training skills. The Graded Units for Interactive Dictation Operations System (GUIDO), developed by Fred Hofstetter (49), is named in honor of Guido d'Arezzo, the eleventh century musician and music educator who conceived the music staff and established the theory of solmization. These programs were made available by the University of Delaware through the Plato system at the University of Illinois. The basic design of this system (GUIDO) includes two modes of operation. In the drill-and-practice mode, students hear dictation exercises and then are required to respond to questions about what they hear. In the touch-sensitive mode, students hear either intervals, melodies, harmonies, rhythms, or chord-quality exercises by touching the items displayed on a touch-sensitive panel. In this mode, students can actually play musical examples for themselves (48, 49).

Criticisms and Cost Factors Related to Computer-
Assisted Instruction in Education

One of the major criticisms of computer-assisted instruction is its cost. As Allvin (5) states, because of skyrocketing costs, music schools have responded with larger classes, more lectures, less student-teacher interaction, and lowering of skill objectives. Daniel Alpert (7) noted that college and university students at all levels are questioning the style, structure, and relevance of our educational programs. Efforts to counteract the trend toward mass education, Allvin (5) reports, have had some good results--notably the use of programmed instruction materials. But increased pressure for individualization has conflicted with demands for cost reduction (5). Early studies by Kuhn and Allvin (63), Allvin (3), and Diehl and Radocy (30) were able to show a promise of significant reduction in learning time, but made no attempt to relate this to cost-effectiveness. Latta and Gilbert (66) attempted to answer the criticism of high cost by pointing out the decreasing cost of input-output devices. Kopstein and Seidel (60), in an optimistic study, predicted that costs involved in computer-assisted instruction will be half that of traditional instruction by the late 1970's. However, Anderson (8) cautions that the economic feasibility of computer-assisted instruction has yet to be shown and that this type of instruction is not "a plaything, and despite its glamor, it isn't yet ready for many subject areas" (p. 50).

Hartley (46) tends to agree when he stated:

Attempts to produce a suitable economic analysis at this stage are speculative and thus one of the most important areas for research lies in developing methods of analyzing the costs and benefits of CAI in relationship to present and future educational systems. CAI invites investigation from the 'systems' point of view because it is too expensive to be used as a mere aid to be taken out of the cupboard as needed (p. 89).

Although empirical data are not present in Nievergelt's (82) report on computer-assisted instruction, he finds that computer-assisted instruction is still significantly more expensive than conventional instruction. Brightman (19) recommends that considerably more research is needed to compare the relative costs of computer-assisted instruction and increased effectiveness, suggesting that alternative instructional systems may be more cost-effective. Dick and others (34) at Florida State University, on the other hand, reported that the cost of conducting classes by computer-assisted instruction was one-half to one-third that of conventional graduate instruction. In a later article by Allvin (4), he states that the conclusions reached in many of the cost-effect studies are contradictory because the researchers are attempting to measure several different computer-assisted possibilities. He developed a cost factor matrix showing the relative expense of the varied subject matter in music education, the least expensive being a stimulus/response type program and the most costly a heuristic principle system. The cost

differences are mainly those of central processing time and storage. A large heuristic (tutorial) program must have an enormous volume of possible replies to student inputs, a set of complex procedures for sampling and discriminating among the possible inputs, multiple branching plans at every input-output point, specialized input-output equipment, and a large space for recording student history and progress data. A drill-and-practice routine, on the other hand, may use only a single instructional system into which the next routine is placed and few anticipated answers are stored.

MATRIX

STIMULUS-RESPONSE

HEURISTIC

Ear-training
Dictation

Sight Singing

Traditional
Harmony

Basic Theory &
Terminology

Form & Analysis

Keyboard Harmony

Composition

Basic Contemporary Theory

\$2.00

\$4.00

\$8.00

\$16.00

\$32.00

\$64.00

COST PER HOUR

Allvin (4) points out that these costs do not reflect the expense of computer hardware. He cautions, however, that until such time as a small degree of standardization in either hardware or language

comes about, each new strategy may require completely new hardware-software configurations and therefore more expense.

Weinstock (124), along with others, finds that in addition to the criticism of extreme cost there are five other major criticisms. Important among these is that some educators believe that "CAI is too impersonal and may interfere with the normal social and psychological growth of the student" (p. 430). This criticism is also common to the concept of programmed instruction and to the computer as well. Perhaps Burke (21) answers this criticism best when he suggests a "humanized model" for computer-assisted instruction. This model allows for the student to be in control of the machine, rather than the other way around. It is felt that if the student maps the educational paths and works closely with a teacher/counselor, continuous feedback as to the progress will result. The other criticisms noted in the Weinstock (124) report include:

1. Education is already too standardized.
2. The "wrong people" may gain control of the computer material presented.
3. Only easy educational tasks will be used.
4. Man runs the risk of becoming a slave to the machine.

The second statement made above, that the "wrong people" may gain control of the computer material presented, does pose a fear related in much of the current literature. This apparent threat may

be felt because of the rapidly expanded use of the computer and the problems posed to faculty members, many of whom were educated prior to the current computer revolution. As Sharry (102) noted, the administration and faculty have difficulty understanding the use of computers in the schools. As indicated in his paper, administrators need to know more about computers and should help faculty overcome misapprehensions about the device.

Rockart and Morton (97) report that the suspicions held by many faculty members may be a major factor in minimizing the amount of new technology introduced into the learning process in higher education. Schein (101) feels that innovation on the college and university campus suffers because of what he refers to as "inherent faculty conservatism." He goes on to say, "professors are professional hairsplitters" (p. 45), and tend not to take action until they understand the consequences. Because of this inaction, the introduction of new technology may suffer. Levien (69) and Korn (61) both report that teachers at the university level, like any other men and women, are apt to spend their efforts in areas that will be directly rewarded. Because of the attitude "publish or perish," efforts toward improving teaching, especially using new technology, become secondary. Mayhew (77) relates that analysis of the full effects of unionization on educational change suggests that negotiated contracts are protective of faculty economic privileges, and do not favor innovation. Graves (44)

takes the viewpoint that the practice of individual autonomy in teaching methods does not encourage innovation because it allows each professor to freely discard technology if it does not "fit" with his concept of how to teach a course. In a survey by Wilcox (125), he suggests that faculty members are not optimistic in regard to the introduction of new learning and teaching technology into the curriculum. He finds that the negative factors, with respect to innovation in the field of educational technology, far outweigh those that tend to encourage faster adoption of learning technology. Without the help and understanding of the faculty, George Pake (86) expresses little hope that innovation will be forthcoming in the near future. Trustees, administrators, and students can scarcely wield any authority without the support of the faculty. Therefore, according to Pake, the future of new innovative technology lies with the faculty.

Laws (67) notes that there is grave concern that computers will severely jeopardize the humanities in higher education. He feels that leaders in education must require that a balance be met between the humanities and the sciences to offset those who may have a "blind belief in technology as a savior" (p. 89). To assure those that feel the machine will "take over" the role of the instructor, Sharry (102) concluded his paper with:

There is nothing in the world which will take the place of an excellent scholar in all of his or her three dimensions, responding to the questions of students with the emotion, the

drama, the conviction that only a live human being can bring. Further, the faculty should, of course, know that only a human being can possibly contain enough information so that he or she is prepared to answer the inconceivable questions which students are able to ask. Only human beings can then launch into a thought or an idea from that question, a discussion which will be fruitful to all those who hear (p. 3).

For those interested in more detail than this chapter presents, the treatments by Levien (69), Orlicky (85), and Martinson and Miller (76) are fully recommended.

CHAPTER III

PROCEDURES

Setting of the Experiment

The study was conducted at Oregon State University, Corvallis, Oregon. Oregon State University is the state's land-grant institution, thereby obligated not only to offer instruction in the liberal arts, but to develop professional and vocational excellence in other fields as well. It is one of seven colleges and universities that make up the State System of Higher Education in Oregon. The university is accredited by the Northwest Association of Secondary and Higher Schools.

Population of the Experiment

The population of the experiment at Oregon State University consisted of all students enrolled in Basic Musicianship, Music 101, during the fall and winter quarters of the 1976-77 academic year. The total enrollment was 156 students encompassing 28 academic areas (Appendix B).

Selection of the Sample

A complete list of all students enrolled in Basic Musicianship

was compiled following registration, and a table of random numbers was used in the selection of the student sample for the experiment. The 80 participants were also assigned to either the control or experimental groups, and selected to take the pretest or a placebo, in the same random manner. To avoid as much Hawthorne effect as possible, the total enrollment, including those outside the sample, was treated as if all students were included in the study.

Demographics of the Sample

A questionnaire, contained in the Aliferis Music Achievement Test and the placebo, was administered to the students participating in the study. The purpose of the questionnaire was to determine the nature of the musical background of these students.

The age range of the sample was 18 to 26 years, with 87.5 percent falling into the customary undergraduate bracket of 18 to 21 years of age (Appendix B).

As to gender, 48.7 percent of the students were female and 51.3 percent were male. This corresponds closely to the usual population found on campus (Appendix B).

When their academic interests were taken into consideration, this diversified sample showed a large number of students with some musical experience (Appendix B).

Two students had taken a class in basic musicianship, while one had completed a music theory class. This experience, however, was at the high school level (Appendix B).

In the area of music appreciation and music history, seven students had taken music appreciation and an additional seven indicated prior classes in music history (Appendix B).

The largest number of responses to questions related to previous experience fell into the applied and performance fields. Ten students had taken band, 16 had sung in chorus or other large vocal ensembles, and two had participated in orchestra. Six students related participation in some form of small group ensemble (Appendix B).

Twenty-five students responded that they had taken private study. However, the majority of this experience was in high school and junior high school. Many of the students who indicated that they had participated in a performance group also took private lessons. It was not apparent if this private study was in conjunction with the performance (Appendix B).

The Treatment Variable

Related to the independent or treatment variable, the following instructional practices were followed during the period of the experiment for both the control and experimental groups.

1. All lectures and lecture material used in the experiment were prepared and presented by the music instructors at Oregon State University. The researcher reviewed the material prior to delivery.
2. Normal use was made of all audio-visual aids, music charts, chalkboards, and musical instruments by the classroom instructor.
3. Attendance was required at all lectures.
4. All students received the same lectures and writing assignments.
5. Following the presentation of the theoretical basis associated with ear-training, students in the control group were free to reinforce the practical aspects of audio discrimination on an individual basis or in small groups. Students in the experimental group utilized the computer programs especially designed for this reinforcement.
6. Supervision of the experimental group during the computer-assisted instruction was by the researcher. However, the supervision entailed only time and lesson monitoring and assistance with the log on-log off process. No classroom type instruction was given.
7. All students received the same number of clock-hours of instruction, and were instructed in as nearly the same procedure as possible.

8. Evaluation and classroom testing procedures were the same for all students.

Computer Programs Used in the
Treatment Variable

The Plato programs utilized in the treatment variable consisted of three and one-half hours of material. Although every student did not need or use all the programs, they were available. Although these programs included no auditory elements, they were useful as either remedial or review material.

1. Elementary Music (1.5 hours)
 - a. Complete the Measure
 - b. Keyboard Drill
 - c. Notes and Rests
 - d. Rhythm Exercises
 - e. Time Signatures
2. Kodaly Handsignals and Solmization (1 hour)
3. Scale Structures (1 hour)

For complete sub-programs and student on-line time in each program, see Appendix E.

The Guido programs used in the treatment variable consisted of 56 hours of material. Not all the students used the entire program, but it was made available.

1. Interval Play, Quiz and Game
2. Interval Dictation Drill
3. Melodic Dictation Drill
4. Harmonic Dictation Drill

5. Rhythmic Dictation Drill
6. Test Routines

For complete sub-programs and student on-line time in each program, see Appendix E.

The students using computer-assisted instruction programs did so for a total of 16,949.00 minutes (approximately 282 hours), with a student on-line mean time of 423.725 minutes (approximately seven hours) and a range of 557 minutes (approximately nine hours) maximum and 223 minutes (approximately four hours). Since approximately eight hours of computer time was allocated for each student in the program, the mean utilization time appeared more than adequate considering the time-down experienced because of transmission by common telephone line (Appendix D).

The Instrument Variable

An objective criterion examination was used as both a pretest and a posttest measure encompassing the instructional content during the treatment period. The criterion test selected for the study was one specifically designed for measuring college level music achievement, the Aliferis Music Achievement Test, #194a, published by the University of Minnesota Press, Minneapolis (Appendix C). Using musical examples prerecorded on a tape, the test provided for a

measure of the student's ability to match these audio examples to printed musical notation.

The test satisfied the demands of both musical content and objective test controls by dividing each of the organizing forces of music, i.e., melody, harmony, and rhythm, into two parts--elements and idioms. The element was established as the smallest musical unit that can be recognized out of context. All secondary factors were eliminated so that judgment was given on only one musical problem. The idiom, on the other hand, presented each of the elements in a single context created by grouping two or three elements so as to enlarge the configuration of the one problem contained in the elements. In this manner, the idiom presented a test item which came closer to the art form than the element and thereby brought the test into proximity with everyday musical experience without changing the test controls which were established in the element (Appendix C).

Test Controls. A pre-recorded tape recording made by the piano was utilized in administering the test as this provided a stimulus that remained constant through a great number of administrations. The piano was used in making the pre-recorded tape because of its general use by musicians, and further, because of its general acceptance as representative of the complete tonal realm. Multiple-choice answers were used to eliminate the use of nomenclature and

terminology which might be a serious stumbling block for the untutored and inexperienced music student (Appendix C).

Validity. The content validity of the criterion test appeared to be well established. An unbiased appraisal was made by 13 leading musicians from across the country including both academia and the professional performance field. Without exception these experts strongly supported both the content and the discriminatory functions of the test (Appendix C).

Reliability. The reliability for the total test score was reasonably high for a test of a musical nature which could not hope to reach the level of reliability of tests of mere sensory acuity (Appendix C).

Intercorrelations. The high correlation of part scores with the total score denoted that each section was contributing toward the measurement of a common musical ability (Appendix C).

Item Discrimination and Difficulty. Item analysis indicated that the ability of the test to discriminate between the good and poor student and correct and incorrect answers was substantial, and that the major portion of the test was in the middle range of difficulty (Appendix C).

Robert Keller (56) concluded his review of the Aliferis Music Achievement Test with the following statement of support:

This is a well documented and thoroughly prepared and developed test of a good scientific standard. It may be used used with confidence for the purpose and at the level intended

by the author. . .the music student's power of auditory-visual discrimination of melodic, harmonic, and rhythmic elements and idioms (p. 249).

Placebo. The researcher developed a test to be administered to those not randomly selected for the study and for those of the control and experimental groups not to be pretested. Because the effect upon the treatment by a pretest was not known, a measurement of the effect, if any, needed to be made. A placebo was administered so that sampling bias, such as the Hawthorne Effect, might not distort the test results. The placebo included all elements of music found in the achievement test, but without the inclusion of audio transmissions, and, as will be shown later, had no effect upon the posttest or the treatment (Appendix G).

Limitations of the Study

The following were limitations related to this study:

1. The subjects were limited to the classes in basic music theory or Music 101, Basic Musicianship, at Oregon State University during the fall and winter quarters of the 1976-77 academic year.
2. Only those students in attendance on the day of testing were included in the study.
3. The researcher did not teach the regular classroom material.

4. Although scheduled, access to time-sharing terminals was on a first come-first use basis within the university community.
5. Only computer programs contained in the PLATO IV System transmitted to the Oregon State University Computer Center were used.
6. Alternate randomly selected individuals were used in three instances to keep cell size equal.
7. The generation of a synthesized pitch was utilized in the PLATO IV programs. This pitch varied considerably from that produced by the pianoforte, the instrument commonly used for classroom instruction. Although this discrepancy may have resulted in learning interference, it was not possible in this study to measure the effect (see questionnaire, Appendix F).

Hypothesis to be Tested

One hypothesis was tested for the study, and the results determined either retention or rejection of the null hypothesis:

H_0 : There is no significant difference between achievement posttest scores of the control and the experimental groups.

The Experimental Procedures

Because the effects of the pretest upon the level of achievement as measured by the posttest were not known, the Solomon Four-group

Design was used as the most effective means by which pretest relationship could be measured. Winer (126) pointed out that this design enabled the researcher to examine the existence of any pretest effect upon the experimental treatment, allowing any change found in the experimental groups, over and above that of the control groups, to be attributed to the experimental treatment.

The procedure utilized in the study was to:

1. Pretest a randomly selected 50 percent of the experimental and control group members using an objective achievement test, i.e., the Aliferis Music Achievement Test (Appendix C).
2. Administer a placebo, constructed by the researcher, to those not being pretested and to those not selected for the study.
3. Administer the treatment variable to the experimental groups for an eight week period, or approximately eight hours (see Appendix D for student on-line time).
4. Posttest all members of both the control and experimental groups using the same objective achievement examination as was used for the pretest, i.e., the Aliferis Music Achievement Test.

The Solomon Four-group Design matrix as used in this study is presented on the following page.

Matrix

Solomon Four-group Design

<u>Students</u>		<u>Achievement Measures</u>		
<u>Section</u>	<u>Group</u>	<u>Pretest</u>	<u>Treatment</u>	<u>Posttest</u>
One	Experimental	n=20	n=20	n=20
Two	Control	n=20	none	n=20
Three	Experimental	none	n=20	n=20
Four	Control	none	none	n=20
Total	All	n=40	n=40	n=80

Method of Analysis

Ray (96) and Winer (126) both reported the analysis of variance as the most effective tool to test the several variances and the interaction between them because of the holding of all elements of the experimental situation constant, except the experimental treatment.

Therefore, for the purpose of this study, a two-factor analysis of variance was used to determine if the posttest scores of the control and experimental groups were equal and to measure the effect of the pretest upon the posttest and upon the treatment variable, i. e., whether any of the between-groups variances were significantly greater than the within-groups variances.

Additional two-factor analysis of variance tests were performed for each section of the criterion test, i. e., melody, harmony,

rhythm, to investigate for statistical significance within each test sub-section.

A confidence interval was also computed to examine for any pretest contamination upon the treatment.

Several t-tests were performed to question if each group achieved at the same level prior to the beginning of treatment, and to further probe into any effects of the pretest upon the posttest.

The Bartlett-Box F, a test for homogeneity of variance, was made to determine if the sample was a true image of the population.

Individual data cards were prepared for each student and the Statistical Package for the Social Sciences (SPSS) computer package was used to analyze the data.

CHAPTER IV

ANALYSIS OF DATA

The data gathered for this study are analyzed in four segments. The first part presents the results of the analysis of variance between the control and the experimental groups' total score on the criterion measure, with subsequent data denoting confidence predictions and treatment/time factors. Section two deals with the analysis of the sub-scores related to the criterion test, i. e., melody, harmony, and rhythm. This material is further examined in regard to confidence factors and treatment/time relationships. The third section presents the findings related to student time "on line" and achievement scores. The final portion represents the results of the student attitude questionnaire (Appendix F).

Analysis of Criterion Measurement Scores

As Atkinson (13) pointed out, there is little empirical data related to the effectiveness of computer-assisted instruction. Margolin (75) further emphasized the need to scientifically evaluate the computer in its role in educational technology.

The initial goal of this study was to examine the relative achievement of students enrolled in Basic Musicianship, and to

question the effects of computer-assisted instruction upon these achievements.

A two-factor analysis of variance with repeated measures was used to test the null hypothesis that the posttest scores of the control and the experimental groups were not significantly different. This test further investigated the relationship between the treatment and the criterion test (Table 1). Through comparisons of computed value with table value, decisions may be made about the acceptance or retention of the hypothesis. Since the tabular value was less than the computed values, a significant difference was found in the treatment, in the criterion test, and in the interaction between the test and the treatment. Therefore, the null hypothesis was rejected in each case.

A 95 percent confidence interval was computed for the posttest means of the two control groups. The interval for those who were pretested was found to lie between 27.57 and 34.23, and 25.95 to 31.85 for those not pretested. It was also shown that with 95 percent confidence, the interval of the posttest means of the experimental group that was pretested was 40.72 and 48.48, and 42.41 and 48.99 for those not pretested (Figure 1). These confidence intervals indicated that the pretest did not significantly effect the posttest results.

As graphically shown, the criterion test gain over time indicated that both groups were not significantly different in achievement prior to the treatment (t value = -0.26 , Appendix H), that learning did

Table 1. Repeated measures two-factor analysis of variance of pretest and posttest scores.

Source	DF	SS	MS	F
Treatment (A)	1	1022.4405	1022.4405	12.030*
Subjects within Treatment (error A)	38	3229.7619	84.99256	
Test (order) (B)	1	3781.7619	3781.7619	142.300*
Test (order) by Treatment (A x B)	1	858.19048	858.19048	32.292*
Test by Subjects within Treatment (error B)	38	1009.6905	26.576265	
Totals	79	9910.8452		

*Significant at the $\alpha = 0.05$ level.

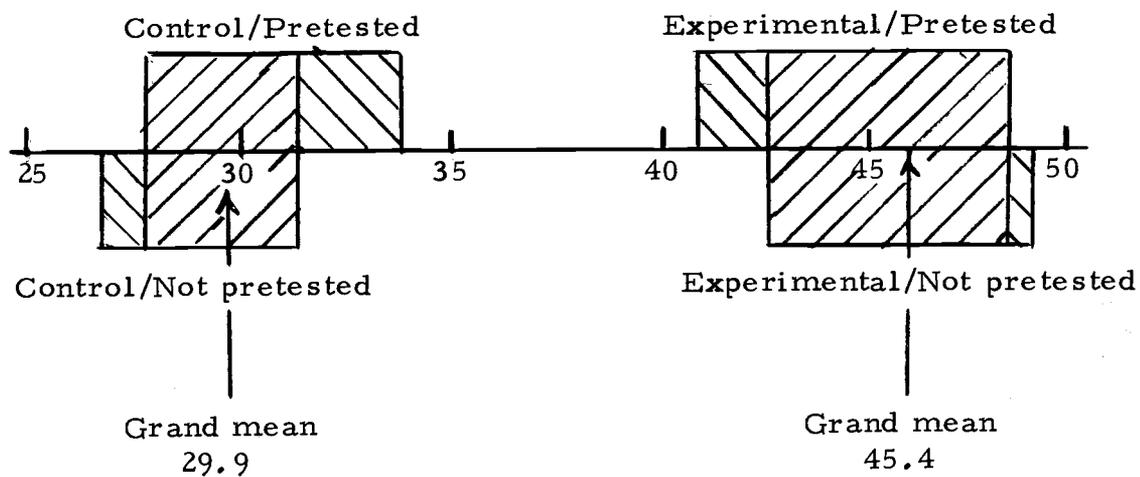


Figure 1. 95 Percent confidence interval of posttest scores.

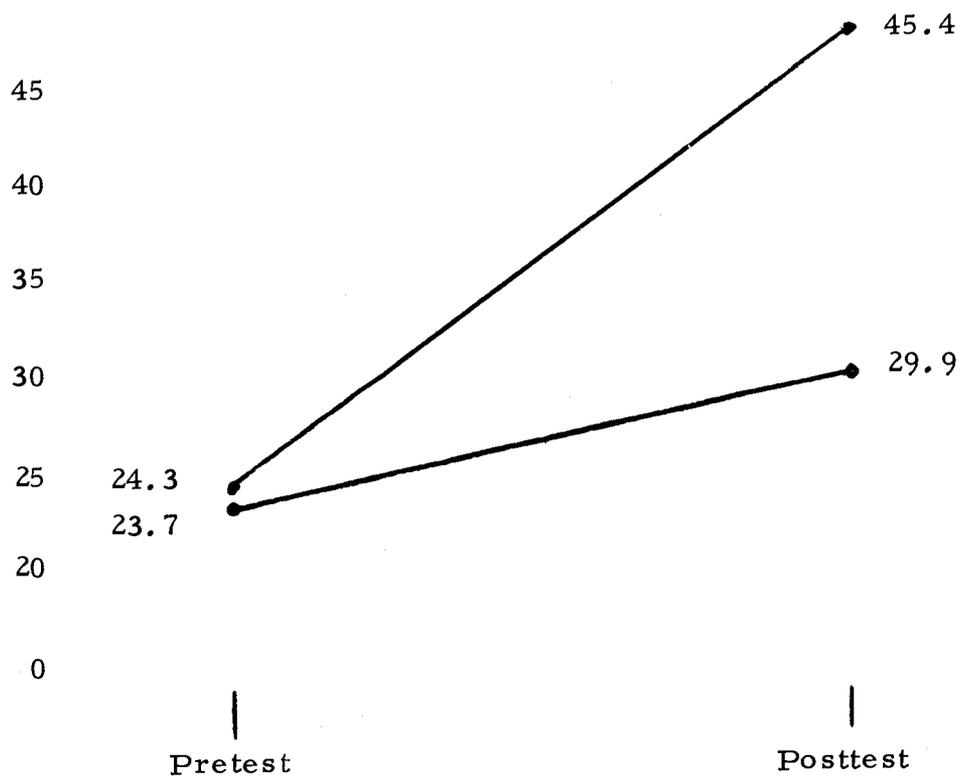


Figure 2. Means of pretest and posttest achievement scores by experimental and control subjects.

take place in both groups, and that the experimental group scored significantly higher on the posttest (Figure 2).

A test for homogeneity of variance was made using the Bartlett-Box F test, and the sample was found to be homogeneous ($F = 0.815$, $p < 0.01$).

Sub-Score Analysis of the Criterion Measurement

Because it was felt that investigation of the sub-scores would strengthen the applicability of the research, a two-factor analysis of variance with repeated measures was conducted for each sub-section, i. e., melody, harmony, and rhythm, to question the relationship between the treatment and the criterion test (Table 2a-c). The computed F for each set of sub-scores was found to be significant. The Bartlett-Box F test for homogeneity of variance again indicated that the samples were from the same population ($F = 1.920$, $p < 0.01$; $F = 0.685$, $p < 0.01$; $F = 0.805$, $p < 0.01$ for the melodic, harmonic, and rhythmic test, respectively).

A 95 percent confidence interval was computed for the melodic sub-scores, and showed that the control group posttest means for those who were pretested would lie between 10.87 and 14.63, and between 10.99 and 13.61 for those not pretested. The experimental group posttest means for those who were pretested and those who were not pretested were 16.97 to 20.63, and 18.01 to 20.39, respectively

Table 2. Repeated measures two-factor analysis of variance.

Source		SS	MS	F
<u>a. Melodic sub-scores</u>				
Treatment (A)	1	125.02381	125.02381	6.527*
Subjects within treatment (error A)	38	727.94048	19.15439	
Test (order) (B)	1	966.19048	966.19048	125.787*
Test (order) by treatment (A x B)	1	252.04762	252.04762	32.814*
Test by subjects within treatment (error B)	38	291.97024	7.6811756	
Total	79	2363.1725		
<u>b. Harmonic sub-scores</u>				
Treatment (A)	1	52.824405	52.834405	4.597*
Subjects within treatment (error A)	38	436.59524	11.491257	
Test (order) (B)	1	159.61012	159.61012	40.599*
Test (order) by treatment (A x B)	1	32.511905	32.511905	8.270*
Test by subjects within treatment (error B)	38	149.36012	3.9314081	
Total	79	830.90178		
<u>c. Rhythmic sub-scores</u>				
Treatment (A)	1	177.04762	177.04762	10.382*
Subjects within treatment (error A)	38	647.94048	17.052827	
Test (order) (B)	1	308.09524	308.09524	47.134*
Test (order) by treatment (A x B)	1	63.011905	63.011905	9.640*
Test by subjects within treatment (error B)	38	248.42262	6.5366443	
Total	79	1444.5178		

*Significant at the $\alpha = 0.05$ level.

(Figure 3). Therefore, the pretest did not significantly affect the melodic posttest sub-scores.

A 95 percent confidence interval was computed for the harmonic sub-scores, and showed that the control group posttest means for those who were pretested would lie between 5.47 and 8.13, and between 5.26 and 7.64 for those not pretested. The experimental group posttest means for those who were pretested and those who were not pretested were 8.27 to 11.13, and 9.66 to 12.94, respectively (Figure 4). This indicated that there was no pretest contamination of the posttest scores.

A 95 percent confidence interval was computed for the rhythmic sub-scores, and showed that the control posttest means for those who were pretested would lie between 9.71 and 12.99, and between 8.58 and 11.72 for those not pretested. The experimental group posttest means for those who pretested and those who were not pretested were 14.56 and 17.64, and 14.53 and 16.87, respectively (Figure 5). The confidence intervals indicated that the pretest did not significantly affect the posttest results.

An examination of the criterion test over time showed that, for the sub-scores, both the control and the experimental groups were not significantly different in achievement prior to the beginning of the treatment in the melodic (t value = 0.99), harmonic (t value = 0.43), or rhythmic (t value = -1.10) portions of the test (Appendix H). It was

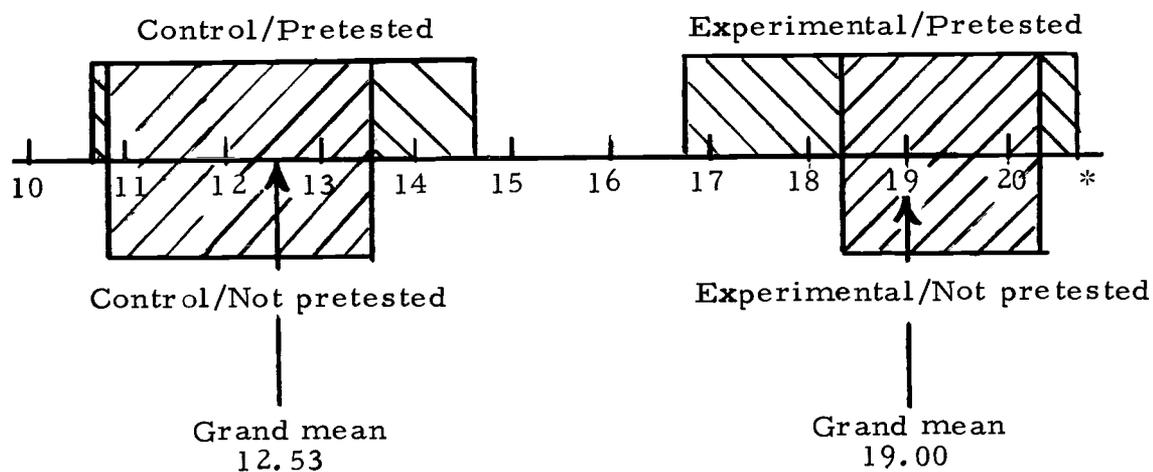


Figure 3. 95 Percent confidence interval of melodic sub-scores.

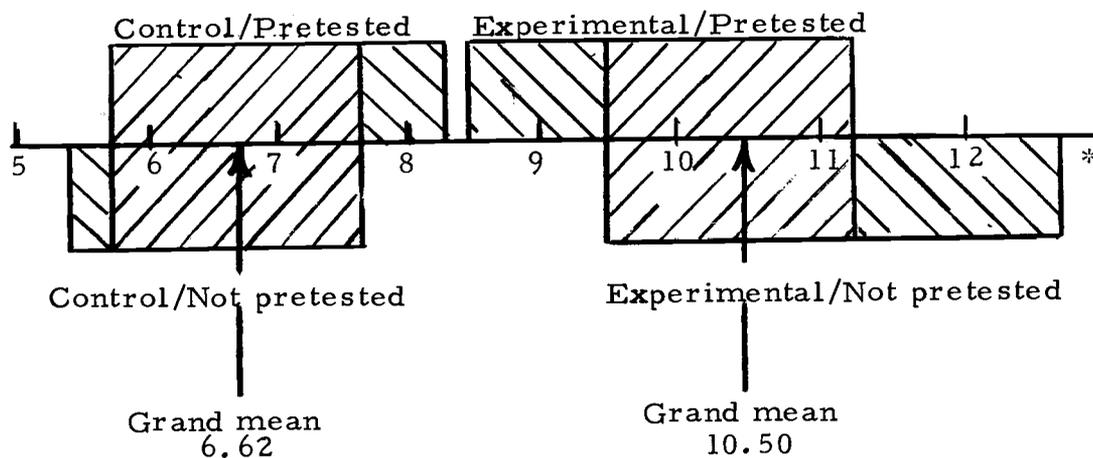


Figure 4. 95 Percent confidence interval of harmonic sub-scores.

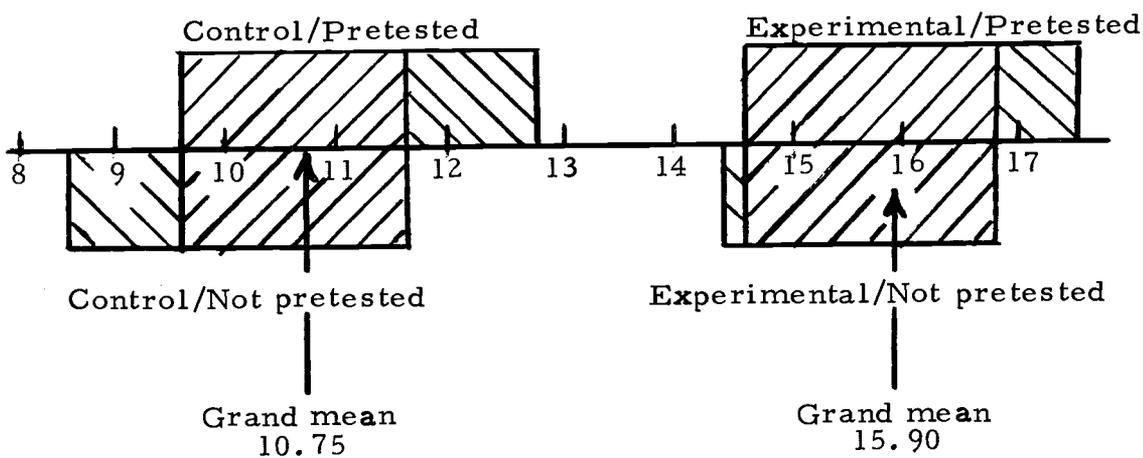


Figure 5. 95 Percent confidence interval of rhythmic sub-scores.

also revealed that learning had taken place in both groups, but that the experimental group scored higher on the posttest than did the control group (Figures 6-8).

Computer Time and Achievement Score Relationships

According to Suppes (110), the computer can provide control over the learning situation, enabling students to study at their own pace. As Deihl (31) brought out in his study, the time spent at the terminal by an individual student did not correlate with the achievement of that student. He went on to report that computer-assisted instruction allowed students to learn at different rates. Many of his students completed the program in less time than did others, yet achieved at an equal level. Kent (57) reported similar findings.

An investigation of the variables, posttest scores and time spent at the computer terminal by each student in the experimental group, indicated that the amount of time spent by the students did not correlate with the final achievement obtained (Figure 9). A Pearson product-moment correlation (r) of -0.02261 showed that students spending the most time "on line" did not necessarily score the highest on the posttest, and that those with less time at the terminal did not significantly score low on the posttest (t value = 0.1394 , $df = 39$, $p > 0.01$).

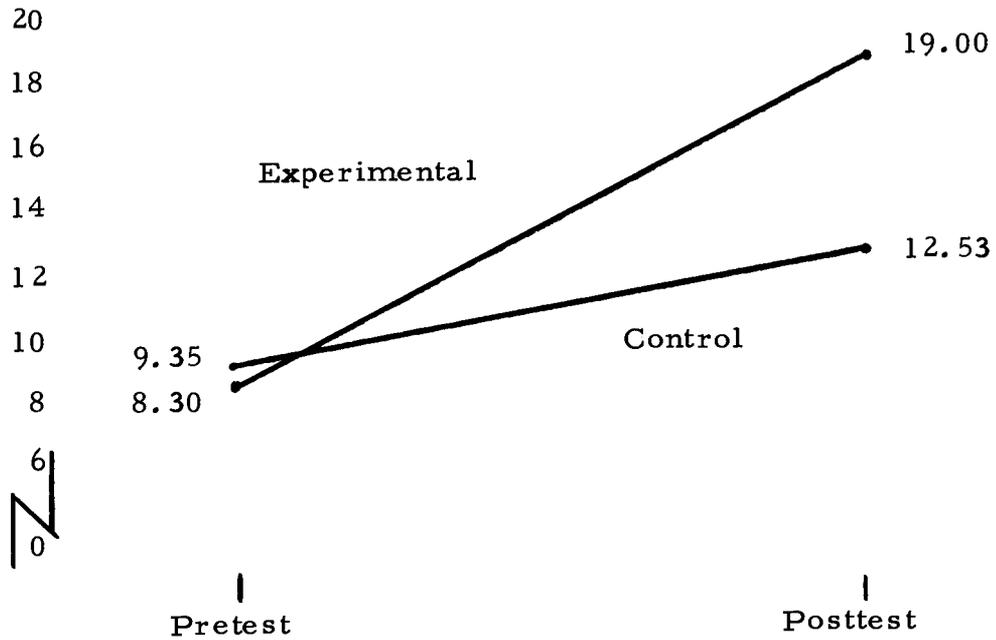


Figure 6. Means of pretest and posttest melodic sub-scores by experimental and control subjects over time factor.

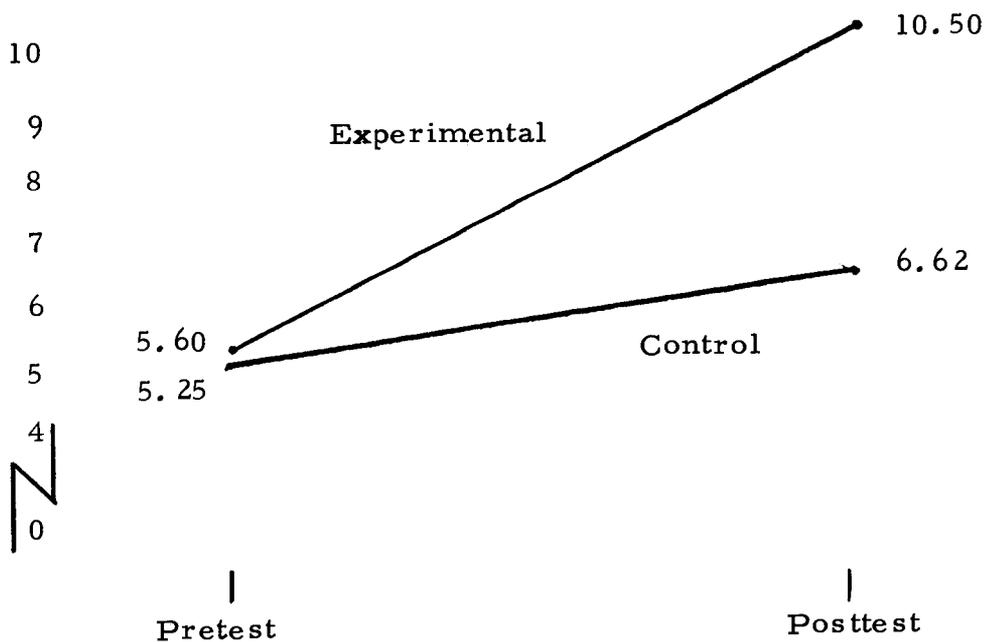


Figure 7. Means of pretest and posttest harmonic sub-scores by experimental and control subjects over time factor.

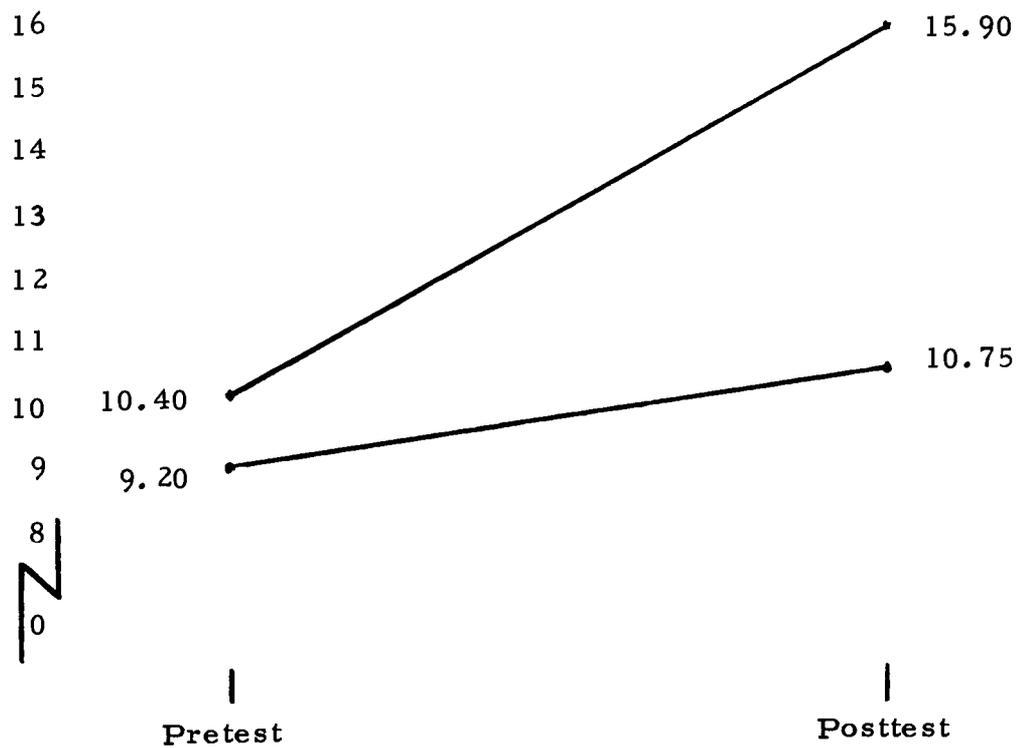


Figure 8. Means of pretest and posttest rhythmic sub-scores by experimental and control subjects over time factor.

FILE NONAML (CREATION DATE = 77/04/22.)
SCATTERGRAM OF (DOWN) POSTSUM

(ACROSS) TIMELINE

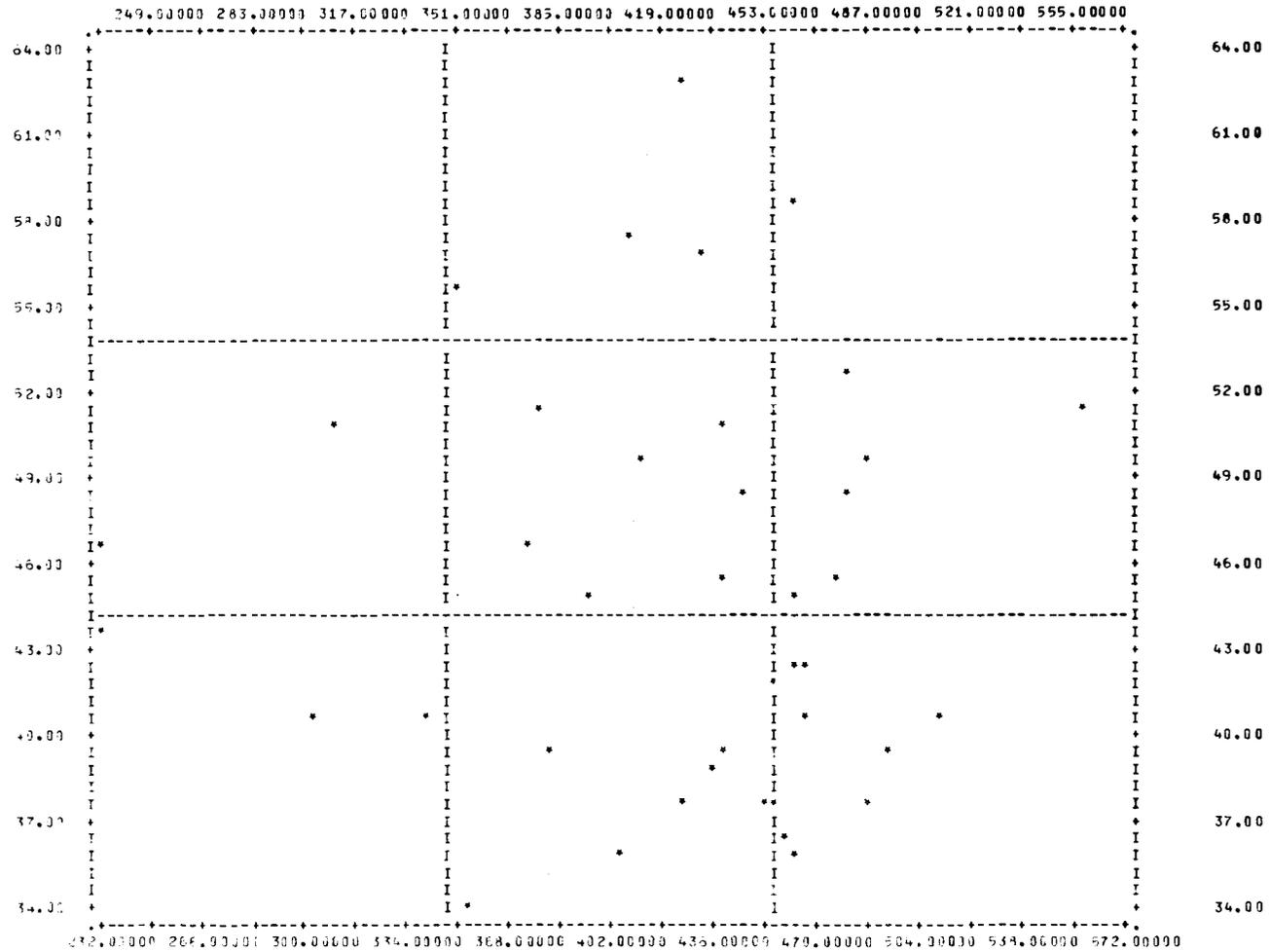


Figure 9. Scattergram of time "on line" and posttest scores for the experimental group.

Student Attitude Assessment

The final section in this chapter deals with the results of an attitude questionnaire given to the students in the experimental group following completion of the treatment (Appendix F).

In Chapter II, it was reported that studies by Cattaneo (83), Herrold (47), Magidson (74), and Placek (92) acknowledged student attitude as an important factor when assessing the worth of computer-assisted instruction. In response to the importance these authors placed on student attitude, this variable was studied.

The questionnaire used in this study was one developed by the staff at the Computer Center at Oregon State University and modified by the researcher to meet the specific requirements of the music students in the study. The students were asked to respond to 13 questions about the computer assisted program and were requested to use a Likert scale of numbers ranging from 1 to 5 to indicate their answers. The scale ranged from 1, "Strongly Agree," to 5, "Strongly Disagree," with a 3 meaning "Neutral." The specific questions and responses can be found in detail in Appendix F, but, in summary, the students felt that:

1. The use of synthesized sound did not hinder ability to correctly identify the audio examples used in the program.

2. The student work load was not appreciably increased, nor was it difficult to adjust work habits.
3. The program did not detract from the study of music, and preference was shown for use of computer materials in future classes.
4. The materials were a valuable addition to the basic musicianship class, and did not depersonalize instruction.
5. The computer made efficient use of time, and in some cases, was superior to the regular classroom experience.

CHAPTER V

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary

The purpose of this study was to determine if computer-assisted instruction was an effective method of presenting the auditory skills utilized in basic musicianship. To accomplish this, an experiment was designed involving 80 students randomly selected from the general population enrolled in Basic Musicianship at Oregon State University. The subjects were further randomly assigned to a control or an experimental group, of which one-half of each group was pretested. The Aliferis Music Achievement Test was selected as the tool for measuring the proficiency of the students. A placebo, developed by the researcher, was administered to those not pretested. Following the determination of the groups and the testing, a treatment consisting of eight hours of computer-assisted instruction was administered to the experimental group. The computer materials exposed during the treatment paralleled that given, in the traditional manner, to the control group. Following the application of the treatment, approximately eight weeks in length, the same test used for pretesting was administered to all members in the experiment.

A two-factor analysis of variance test was used to examine the hypothesis:

H_0 : There is no significant difference between the achievement posttest scores of the control and the experimental groups.

Results of the analysis showed that there was a significant gain in music achievement by those in the experimental group, over and above those in the control group. As a consequence, the hypothesis was rejected.

A two-factor analysis of variance test was also performed for each of the sub-sections of the test, i.e., melodic, harmonic, and rhythmic. Again, analysis revealed that the students in the experimental group achieved higher than those in the control group in these areas.

A test for homogeneity of variance showed that the sample was representative of the population, and selected t-tests found that both groups began the experiment at the same level of music achievement.

It was found that there was no correlation between the time each student spent at the computer terminal and the achievement measured by the posttest.

An attitude questionnaire given to the members of the experimental group acknowledged that, for the most part, the students held a positive attitude toward computer-assisted instruction.

As Allvin (1) noted, the key to progress in refining computer-assisted instruction is the maintenance of evaluation and the availability of good instructional materials. This study has been an attempt to add to the body of knowledge on the evaluation of the computer as an instrument for presenting educational materials, and to assess the applicability of instructional materials now in use in computer-assisted instruction.

Conclusions

A review of current literature, and an 18-year professional career as a music educator and music administrator at all levels, has led to the judgment that an alternative method of presenting ear-training materials is needed. Past associations with music educators have indicated that adequate ear-training methods are perhaps the most neglected area in music education today. Hence, this study was undertaken to explore the possibility that the computer could meet this important need.

Within the limitations of this study, the research has led to the following conclusions.

1. Computer-assisted instruction was a better medium than the traditional classroom for the teaching of the ear-training skills found in basic musicianship. Analysis showed that significantly

- more growth occurred when students utilized the computer for their ear-training study than when they did not.
2. A significant growth in achievement was found in all areas of computer instruction, melodic, harmonic, and rhythmic.
 3. By using the computer, the student was able to save a considerable amount of time in ear-training skills. In addition to the time-saving factor, the availability of the computer terminal made it possible for the students to study at a time most convenient to themselves.
 4. Since many students could conceivably complete the ear-training portion of Basic Musicianship in less time, the expense of conducting the class might be significantly reduced.
 5. The attitude of students, in regard to using the computer for the study of music fundamentals, revealed a willingness to experiment with alternative methods of instruction.
 6. A more positive attitude on the part of music educators and administrators was needed before any large-scale utilization of computer-assisted instruction could be possible.

Recommendations

As related in Chapter II, the field of computer-assisted instruction is far from thoroughly explored. Much additional information is required, and the investigation of other variables needed,

before our knowledge concerning the use of the computer as an aid to education can be complete.

As Bauernfeind (¹⁷Z) reported, there is a tendency in education to rely too heavily upon an individual piece of research without further attempts to confirm or refute the results. He stated that replication is "the cornerstone of scientific inquiry." With consideration of this caution, and in keeping with the conclusions found in this study, several recommendations are suggested.

1. That future study be conducted to identify the full potential of computer-assisted instruction at Oregon State University. Although this study investigated the effectiveness of computer-assisted instruction for use in Basic Musicianship, it is recognized that other music courses may also benefit from using computer-assisted instruction.
2. That computer-assisted instruction be adapted and used to instruct the ear-training drill in Basic Musicianship for the ensuing academic year.
3. That this study be replicated utilizing two distinct groups rather than the experimental and control groups being inter-graded as was the case in this study.
4. That research be undertaken to determine the cost-effectiveness of computer-assisted instruction in relationship to the music curriculum at Oregon State University. According to

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Brightman (3), cost-effectiveness of computer-assisted instruction has not been scrutinized as intensely as called for. Future inquiry into the comparative expense of computer-assisted instruction and that of traditional classroom instruction would be a vital addition to the body of existing literature.

5. That the possibility of utilizing a music faculty member to coordinate the future use of computer-assisted instruction within the music department at Oregon State University be explored.
6. That, through workshops and other informational programs, the music faculty at Oregon State University be made aware of the potential of computer-assisted instruction.
7. That a library be developed for the Music Department of Oregon State University, encompassing the publications necessary for the development and authorship of computer-assisted instructional programs.
8. That the music faculty at Oregon State University be encouraged to develop individual computer programs for use in their respective classes.
9. That financial assistance be requested, in the form of grants and departmental budget request, etc., to aid in the purchasing of required peripheral equipment necessary for the full development of computer-assisted instruction at Oregon State University.

10. That investigation be undertaken to determine the role that the Oregon State University Music Department might take in making computer-assisted instruction materials available to other educational institutions throughout the state, especially the 13 state community colleges.

Computer-assisted instruction, as it now exists on the Oregon State University campus, will not have a decided effect on music on this campus or in the state. However, the potential for leadership in the development and utilization of computer-assisted instruction in the state of Oregon does exist. The future role of the Oregon State University Music Department should be one of leadership in a new technology.

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APPENDICES

APPENDIX A

PROTECTION OF HUMAN SUBJECTS FORM

FACSIMILE

Oregon State University
Committee for Protection of Human Subjects

Summary of Review

Title: An Analysis of Computer Assisted Instruction vs. the
Traditional Method of Instruction in Basic Musicianship

Program Director: Tom Grigsby (Arthur Vaughn)

Recommendation:

- Approval
- Provisional Approval
- Disapproval
- No Action

Remarks:

Date October 4, 1976

Signature: Redacted for Privacy
J. Ralph Shay
Assistant Dean of Research

APPENDIX B

DEMOGRAPHIC MATERIAL RELATED TO THE
STUDENT SAMPLE

Table 3 . Academic areas of interest.

Area	No. of Students	Area	No. of Students
Agricultural Engineering	1	Home Economics	3
Animal Science	3	History-Social Science	3
Architecture	4	Journalism	1
Art	1	Languages	2
Business	7	Liberal arts	8
Chemistry	2	Mechanical Engineering	1
Communication	4	Music Education	2
Computer Science	3	Physical Education	4
Design	1	Pre-dental	1
Education	1	Pre-medical	1
Electrical Engineering	3	Science	6
English	1	Statistics	3
Fisheries	1	Undecided	3
Forestry Engineering	6	Zoology	3
Geography	1		

Table 4 . Level of university experience.

Class	Frequency	Percentage
Freshman	33	41.3
Sophomore	23	28.8
Junior	14	17.5
Senior	8	10.0
Graduate	2	2.5
Total	80	100.0 (100.1)

Table 5. Gender.

Gender	Frequency	Percentage
Female	39	48.7
Male	41	51.3
Total	80	100.0

Table 6. Age.

Age	Frequency	Percentage
18	12	15.0
19	33	41.3
20	12	15.0
21	13	16.2
22	5	6.3
23	3	3.7
24	1	1.2
26	1	1.2
Total	80	100.0 (99.9)

Table 7. Previous choral experience.

Years of experience	Frequency	Percentage
0	64	80.0
1	6	7.5
2	1	1.2
3	2	2.5
4	1	1.2
5	2	2.5
6	1	1.2
8	3	3.7
Total	80	100.0 (99.8)

Table 8. Previous orchestral experience.

Years of experience	Frequency	Percentage
0	78	97.5
1	1	1.2
4	1	1.2
Total	80	100.0 (99.9)

Table 9. Previous band experience.

Years of experience	Frequency	Percentage
0	70	87.5
1	2	2.5
3	1	1.2
4	3	3.7
5	2	2.5
6	2	2.5
Total	80	100.0 (99.9)

Table 10. Previous ensemble experience.

Years of experience	Frequency	Percentage
0	74	92.5
1	1	1.2
2	1	1.2
4	2	2.5
5	1	1.2
8	1	1.2
Total	80	100.0 (99.8)

Table 11. Previous private study.

Years of study	Frequency	Percentage
0	55	68.8
1	6	7.5
2	6	7.5
3	2	2.5
4	2	2.5
5	2	2.5
6	2	2.5
7	2	2.5
8	3	3.7
Total	80	100.0

APPENDIX C

THE ALIFERIS MUSIC ACHIEVEMENT TEST

An objective criterion examination was used as both a pretest and a posttest measure encompassing the instructional content during the treatment period. The criterion test selected for the study was one specifically designed for measuring college level music achievement, the Aliferis Music Achievement Test, #194a, published by the University of Minnesota Press, Minneapolis. This test provided for a measure of the student's ability to select from musical notation items played on a pre-recorded tape.

The test satisfied the demands of both musical content and objective test controls by dividing each of the organizing forces of music, i.e., melody, harmony, and rhythm, into two parts--elements and idioms. The element was established as the smallest musical unit that can be recognized out of context. All secondary factors were eliminated so that judgment was given on only one musical problem. The idiom, on the other hand, presented each of the elements in a single context created by grouping two or three elements so as to enlarge the configuration of the one problem contained in the elements. In this manner, the idiom presented a test item which came closer to the art form than the element and thereby brought the test into

proximity with everyday musical experience without changing the test controls which were established in the element.

Melodic Section--This section presented all the intervals from a minor second through the octave as melodic elements, and further presented groups of four tones as melodic idioms. In the test, the student was not confronted with harmony or rhythm; however, duration of the stimulus and the time interval between items were controlled.

Harmonic Section--The elements portion of the test presented major and minor chords in all positions of the soprano and bass, and the diminished triad in first inversion. The idiom part of the test presented progressions of three chords including such well-known idioms as the $II_6 V I$ -- the Neopolitan cadence, and the deceptive cadence. The harmonic test required no judgment as to melody or rhythm; however, duration and spacing of items were controlled.

Rhythmic Section--The elements portion of the test presented one-beat rhythmic figures repeated three times in a C Major scale-wise melody. The figures are repeated inasmuch as a one-beat rhythmic figure could not be recognized when presented singly. Melody was added so as to avoid the "unmusical" tapping of rhythms. The student, however, made the selection from the notation of the rhythmic figure on a single line with no reference to pitch.

Test Controls--A pre-recorded tape recording made by the piano was utilized in administering the test as this provided a stimulus that remained constant through a great number of administrations. The piano was used in making the pre-recorded tape because of its general use by musicians, and further, because of its general acceptance as representative of the complete tonal realm. Multiple-choice answers were used to eliminate the use of nomenclature and terminology which might be a serious stumbling block for the untutored and inexperienced music student. The use of all single accidentals--natural, sharp, and flat--but no double accidentals, and the use of treble and bass staves but not the soprano, alto, and tenor staves was displayed for the same reason.

Validity--The content validity of the criterion test appeared to be well established. An unbiased appraisal was made by 13 leading musicians from across the country including both academia and the professional performance field. Without exception these experts strongly supported both the content and the discriminatory functions of the test. Empirically determined validity, in the form of concurrent validity, the extent of relationship between the Aliferis Test and another test measuring the same ability, was not determined because no other test existed with which to correlate. However, predictive validity was measured by correlational studies of music grades, academic grades, and total grades. A close agreement of test scores

with music grades was found (0.61 and 0.53), suggesting that the criterion test was measuring a form of musical activity. An even higher relationship was found between total scores and four-year grades (0.66), providing additional empirical evidence of predictive validity. The correlations between the Aliferis scores and grades in academic subjects, however, were conspicuously low (0.25, 0.28 and 0.32). This disparity clearly showed that the criterion test did not measure general intellectual achievement, but a musical skill. In his review of the test, Robert Keller (2) of the University of Minnesota's Bureau of Institutional Research, found the validity to be even higher than did Aliferis (0.88), and suggested that his validity coefficient was one of the highest recorded for a music test.

Reliability--The reliability for the total test score was reasonably high (0.88) for a test of a musical nature which could not hope to reach the level of reliability of test of mere sensory acuity. Hoyt's method of reliability coefficients further indicated that the melodic portion was quite high in correlation (0.84). Coefficients for the harmonic and rhythmic sections, however, were somewhat lower but considered acceptable for these types of test items (0.72 and 0.67). Some reliability, it appeared, was sacrificed when test sections were shortened to produce a 50-minute test.

Intercorrelations--Substantial intercorrelations were found between the melodic and harmonic sections (0.61), and between each

test section and the total score (0.90, 0.81 and 0.68). Less relationship appeared between the melodic and rhythmic (0.41), and the harmonic and rhythmic portions (0.32). However, the high correlation of part scores with the total score seemed to denote that each section was contributing toward the measurement of a common musical ability.

Item Discrimination--Item analysis results, based on the 100 high and 100 low papers in a random sample from 1963 answer sheets, indicated that the ability of the test to discriminate between the good and poor student and correct and incorrect answers was sustained in 57 of the 64 test items.

Item Difficulty--Item analysis results, based on the same data as the item discrimination analysis, denoted that five items were extremely difficult and that ten items appeared to be quite simple. The major portion of the test, 49 questions, was in the middle range of difficulty.

FACSIMILE OF THE ALIFERIS MUSIC
ACHIEVEMENT TEST

STUDENT DATA SHEET

Name _____ Date _____
 last first middle month day year

College _____ Age _____
 to nearest birthday

Year in College

- Freshman
- Sophomore
- Junior
- Senior
- Graduate
- Other _____ specify

	Raw Score	"T" Score	Percentile
Total score	_____	_____	_____
Melodic score	_____	_____	_____
Harmonic score	_____	_____	_____
Rhythmic score	_____	_____	_____

- Major sequence 1) Music Education Major 3) Liberal Arts, Music Major 5) Undeclared
 2) Music Education Minor 4) Liberal Arts, Music Minor 6) Other _____ specify

APPLIED STUDY

major instrument or voice	years of private study	amount of class instruction	minor instrument or voice	years of private study	amount of class instruction
_____	_____	_____	_____	_____	_____

THEORETICAL STUDY

	years	semesters	quarters	List other studies:	years	semesters	quarters
Elements of music	_____	_____	_____	_____	_____	_____	_____
Theory (ear training, sight singing, dictation)	_____	_____	_____	_____	_____	_____	_____
Harmony	_____	_____	_____	_____	_____	_____	_____
Music appreciation	_____	_____	_____	_____	_____	_____	_____
Music history	_____	_____	_____	_____	_____	_____	_____

PERFORMING EXPERIENCE

Band: marching	_____	_____	Choir, a cappella	_____	_____
concert	_____	_____	Glee club	_____	_____
Chorus	_____	_____	Ensemble: vocal	_____	_____
Orchestra	_____	_____	instrumental	_____	_____

COMMENTS

MELODIC ELEMENTS

EXAMPLE:

A B C D

A B C D

8va

A B C D

MELODIC IDIOMS

EXAMPLE:

A B C D

A B C D

14 *b* *a* *a* *b* *e* *b* *e* *#*

15 *a* *b* *b* *a* *a*

16 *#* *a* *a* *#* *a* *#* *a* *a*

17 *#* *a* *a* *a* *a* *#* *a* *#*

18 *a* *a* *a* *a* *#* *a* *b* *b*

19 *a* *b* *a* *b* *a* *a* *b* *a*

20 *a* *#* *a* *#* *a* *#* *a* *a*

A B C D

21 *a* *#* *a* *#* *a* *a* *#* *a*

22 *#* *a* *#* *a* *#* *a* *#* *a*

23 *a* *a* *b* *a* *a* *b* *a* *a*

24 *b* *a* *a* *b* *a* *a* *a* *a*

25 *a* *#* *a* *a* *#* *a* *a* *#* *a*

26 *a* *a* *a* *#* *a* *a* *a* *b* *a*

TOTAL MELODIC ITEMS 26
 MINUS NUMBER WRONG
 TOTAL MELODIC SCORE

HARMONIC ELEMENTS

EXAMPLE:

A	B	C	D

	A	B	C	D
1				
2				
3				
4				
5				

	A	B	C	D
6				
7				
8				
9				
10				

EXAMPLE:

A **B** **C**



HARMONIC IDIOMS

11

A **B** **C**



12



13



14



15



16

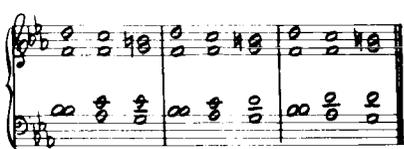
A **B** **C**



17



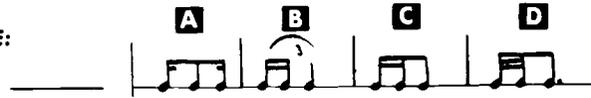
18



TOTAL HARMONIC ITEMS 18
MINUS NUMBER WRONG
TOTAL HARMONIC SCORE

RHYTHMIC ELEMENTS

EXAMPLE:



	A	B	C	D
1				
2				
3				
4				
5				
6				

	A	B	C	D
7				
8				
9				
10				
11				
12				

RHYTHMIC IDIOMS

	A	B	C
13			
14			
15			
16			
17			

	A	B	C
18			
19			
20			

TOTAL RHYTHMIC ITEMS 20
 MINUS NUMBER WRONG
 TOTAL RHYTHMIC SCORE

APPENDIX D

STUDENT COMPUTER TERMINAL TIME

Table 12. Plato programs.

Variable	Mean	In Minutes		Total
		Maximum	Minimum	
Plato (total)	182.775	336.000	78.000	7311.000
Complete the measure	45.700	95.000	8.000	1828.000
Keyboard drill	46.200	90.000	9.000	1848.000
Notes and rests	46.200	84.000	0	1848.000
Time signatures	44.675	121.000	0	1787.000

Table 13. Guido programs.

Variable	Mean	In Minutes		Total
		Maximum	Minimum	
Guido (total)	240.950	361.000	105.000	9638.000
Interval	94.225	135.000	60.000	3769.000
Melodic	55.150	87.000	13.000	2206.000
Rhythmic	68.000	100.000	21.000	2720.000
Chord-quality	23.575	66.000	0	943.000

APPENDIX E

COMPUTER PROGRAMS

Plato

MUSIC ROUTE:

A. MUSIC THEORY AND FUNDAMENTALS

1. Keyboard Drill
2. Music Fundamentals Lesson I
 - a. Notes and Rests
 - b. Time Signatures
 - c. Complete the Measure
3. Rhythmic Patterns
4. Music Fundamentals Lesson II
 - a. Note Names (G, Alto, Tenor, Base Clef)
5. Key Signatures (Major and Minor)
6. Keyspinner Drill (Key Signatures)
7. Music Part Writing Drill

B. EAR-TRAINING LESSONS

1. Major/Minor Triads Root Position
2. Major/Minor Triads First Inversion
3. Major/Minor Triads Second Inversion
4. Augmented/Diminished Triads
5. Major/Minor/Augmented/Diminished Triads Root Position
6. Major/Minor Triads Root, First, Second Position
7. Solfa-Melodic Dictation

C. MUSIC EDUCATION LESSONS

1. Conducting Terms Lesson
 - a. Basic Tempo Terms
 - b. More Tempo Terms
 - c. Dynamics Terms
 - d. Style and Articulation Terms
 - e. Qualifying and General Terms
 - f. Test
2. Transposition and Score Reading
3. Instrumental Methods Lessons
4. Kodaly Handsignals (Solmization)
 - a. C Major
 - b. D Major
 - c. F Major
5. Vocal Dictation Exercises
 - a. To Study "Voiced" and "Unvoiced" Consonants
 - b. To Study the Classification of Consonants
 - c. To Drill "Voiced" and "Unvoiced" Consonants
 - d. To Drill the Classification of Consonants
6. Behavior Modification

Guido

INTERVAL PLAY, QUIZ, and GAME

1. Basic Intervals--P1, m2, M2, m3, M3, P4, Tt, P5, m6, M6, m7, M7
2. Enharmonics--d2, A1, d3, A2, d4, A3, Tt, d6, A5, d7, A6, d8, A7

INTERVAL DICTATION DRILL

1. P8, P4, M7, M2
2. P8, P4, M7, M2
3. m2, M3, Tt, M6

4. m2, M3, Tt, M6
5. m3, P5, m6, m7
6. m3, P5, m6, m7
7. P8, P5, m2, M7, M3, m3
8. P4, m6, M6, m2, m7, Tt
9. m6, M6, m7, M7, P5, Tt
10. m2, M2, m3, M3, P4, Tt
11. All Intervals
12. M7, m2, M6, m3, P4, Tt
13. m7, M2, m6, M3, P5, Tt
14. All Intervals
15. All Intervals

MELODIC DICTATION DRILL

1. One-part Scalewise Melodies
2. One-part Scalewise Minor Scales
3. Scalewise Melodies from Literature
4. Melodies with Leaps Outlining Tonic Triad
5. Melodies with Leaps Outlining I from Literature
6. Melodies with Leaps Outlining I and V Triads
7. Melodies with Leaps Outlining I and V From Literature
8. Melodies with Leaps Outlining I, IV, V, and vii
9. One-part Modal Melodies
10. One-part Modal Melodies from Literature

11. One-part Diatonic Melodies from Literature
12. One-part Diatonic Melodies from Literature
13. Two-part Dictation through Two Flats and Two Sharps
14. Two-part Dictation through Two Flats and Two Sharps
15. Two-part Dictation through Four Flats and Four Sharps
16. Two-part Dictation through Four Flats and Four Sharps
17. Two-part Dictation through Four Flats and Four Sharps
18. One-part Dictation with Sequences
19. One-part Modulating to Closely Related Keys
20. One-part Modulating to Closely Related Keys from Literature
21. Melodies with More Chromatic Movement

HARMONIC DICTATION

1. I and V Triads
2. I and V Triads
3. I, V, and vii^o Triads
4. I, IV, and V Triads
5. I, IV, and V Triads
6. I, IV, and V Triads
7. I, IV, V, and vii^o Triads
8. I, IV, V, and vii^o Triads
9. I, IV, V, and vii^o Triads
10. I, ii, IV, and V Triads
11. I, ii, IV, V, and vii^o Triads

12. I, ii, IV, V, and vii^o6 Triads
13. I, ii, IV, V, vii^o6, and V7 Triads
14. I, ii, iii, IV, V, vii^o6, and V7 Triads
15. All Triads and V7
16. All Triads and V7 and ii7 Chords
17. All Triads and V7 and ii7 Chords
18. All Triads and ii7, IV7 and V7 Chords
19. All Diatonic 7th Chords
20. All Triads and Diatonic 7th Chords
21. All Triads and Diatonic 7th Chords
22. Secondary Dominants of V
23. Secondary Dominants of IV and vi
24. Secondary Dominants of iii and ii
25. Secondary Dominants (Review Units)
26. Modulation to Closely Related Keys
27. Modulation to Closely Related Keys
28. Borrowed Chords
29. Neopolitan Chords
30. Sharp ii and vi Diminished 7th Chords
31. Italian Sixth Chords
32. German Sixth Chords
33. French Sixth Chords
34. All Augmented Sixth Chords

35. Chromatic Mediants
36. Modulation to Foreign Keys
37. Modulation to Foreign Keys
38. V9, V11, V13 Chords
39. All 9th, 11th, and 13th Chords
40. Chorale--Aus Meines Herzens Grunde (Bach)
41. Chorale-Meine Seele Erhebet Den Herrn (Bach)

RHYTHMIC DICTATION

1. Simple Meter--Duple and Triple
2. Simple Meter--Duple and Triple (Half Values)
3. Simple Meter--Duple and Triple (Quarter Values)
4. Review Unit
5. Melodies--Simple Meter
6. Simple Meter--Quadruple
7. Simple Meter--Quadruple (Quarter and Half Values)
8. Review Unit
9. Melodies--Unsyncopated Simple Meter
10. Syncopation in Simple Meter (Half Values)
11. Syncopation in Simple Meter (Quarter Values)
12. Simple Meter--Beat Unit Triplets
13. Simple Meter--Quarter and Half Beat Triplets
14. Simple Meter--Smaller Divisions of the Beat
15. Review Unit

16. Melodies Simple Meter
17. Compound Meter
18. Compound Meter (Half and Quarter Values)
19. Syncopation in Compound Meter
20. Compound Meter--Duplet and Quadruplet
21. Melodies in Compound Meter
22. The Supertriplet
23. The Supertriplet--Simple and Compound Meter
24. Melodies with Triplets
25. Irregular Subdivisions of the Beat
26. Mixed Meter
27. Asymmetric Meter
28. Melodies with Asymmetric and Mixed Meter
29. Difficult Rhythmic Exercises
30. Review Unit
31. Review Unit

TEST ROUTINES

1. Repeat a Melody
2. Tap Out a Rhythm
3. Repeat Four Notes

APPENDIX F

A SURVEY OF STUDENT ATTITUDES ABOUT
COMPUTER-ASSISTED INSTRUCTION

The key for responding to the questions concerning attitude about the computer program was as follows:

- 1 -- Strongly Agree
- 2 -- Agree
- 3 -- Neutral
- 4 -- Disagree
- 5 -- Strongly Disagree

Question 1. The use of synthesized sound in the program hindered my ability to correctly judge intervals, rhythms, triads, and chords.

Response: Most students strongly disagreed.

<u>Code</u>	<u>Frequency</u>	<u>Per centage</u>
2	2	5.0
3	5	12.5
4	12	30.0
5	21	52.5
Total	40	100.0

Question 2. It was difficult to adjust my habits to the use of computer material.

Response: Most students strongly disagreed.

<u>Code</u>	<u>Frequency</u>	<u>Percentage</u>
3	5	12.5
4	15	37.5
5	20	50.0
Total	40	100.0

Question 3. My work load for this course was greatly increased by including the computer-oriented materials.

Response: Most students disagreed.

<u>Code</u>	<u>Frequency</u>	<u>Percentage</u>
3	3	7.5
4	21	52.5
5	<u>16</u>	<u>40.0</u>
Total	40	100.0

Question 4. I was apprehensive of the technical difficulties of using the computer at the outset of the term.

Response: Most students were either not strongly apprehensive or were neutral.

<u>Code</u>	<u>Frequency</u>	<u>Percentage</u>
1	1	2.5
2	3	7.5
3	15	37.5
4	11	27.5
5	<u>10</u>	<u>25.0</u>
Total	40	100.0

Question 5. Learning how to use the computer detracted from the study of music.

Response: Most students strongly disagreed.

<u>Code</u>	<u>Frequency</u>	<u>Percentage</u>
2	1	2.5
3	8	20.0
4	11	27.5
5	<u>20</u>	<u>50.0</u>
Total	40	100.0

Question 6. The computer is an important part of learning about music.

Response: Most students agreed.

<u>Code</u>	<u>Frequency</u>	<u>Percentage</u>
1	11	27.5
2	22	55.0
3	6	15.0
4	<u>1</u>	<u>2.5</u>
Total	40	100.0

Question 7. If I enroll in another music course I would prefer that computer materials be included.

Response: Most students either agreed or strongly agreed.

<u>Code</u>	<u>Frequency</u>	<u>Percentage</u>
1	17	42.5
2	17	42.5
3	5	12.5
4	<u>1</u>	<u>2.5</u>
Total	40	100.0

Question 8. The concepts I learned using the computer materials made me more interested in the study of music.

Response: Most students agreed.

<u>Code</u>	<u>Frequency</u>	<u>Percentage</u>
1	9	22.5
2	25	62.5
3	<u>6</u>	<u>15.0</u>
Total	40	100.0

Question 9. From taking this course I would like to know more about how the computer is used in other ways.

Response: Most students agreed.

<u>Code</u>	<u>Frequency</u>	<u>Percentage</u>
1	15	37.5
2	22	55.0
3	1	2.5
4	<u>2</u>	<u>5.0</u>
Total	40	100.0

Question 10. I feel the computer materials were a valuable addition to this course.

Response: Most students strongly agreed.

<u>Code</u>	<u>Frequency</u>	<u>Percentage</u>
1	27	67.5
2	11	27.5
3	<u>2</u>	<u>5.0</u>
Total	40	100.0

Question 11. Computer instruction is just another step toward depersonalized instruction.

Response: Most students strongly disagreed.

<u>Code</u>	<u>Frequency</u>	<u>Percentage</u>
1	1	2.5
2	2	5.0
3	5	12.5
4	10	25.0
5	<u>22</u>	<u>55.0</u>
Total	40	100.0

Question 12. I found using the computer in this course to be an inefficient use of my time.

Response: Most students disagreed or strongly disagreed.

<u>Code</u>	<u>Frequency</u>	<u>Percentage</u>
2	4	10.0
3	2	5.0
4	18	45.0
5	<u>16</u>	<u>40.0</u>
Total	40	100.0

Question 13. The "Computer Method" seems superior to classroom experience for some portions of the course.

Response: Most students agreed, were neutral, or strongly disagreed.

<u>Code</u>	<u>Frequency</u>	<u>Percentage</u>
1	8	20.0
2	18	45.0
3	11	27.5
4	2	5.0
5	1	2.5

APPENDIX G

PLACEBO FACSIMILE

STUDENT DATA SHEET

Name _____ Date _____
 last first middle month day year

College _____ Age _____
 to nearest birthday

Year in College
 Freshman
 Sophomore
 Junior
 Senior
 Graduate
 Other _____
 specify

	Raw Score	"T" Score	Percentile
Total score	_____	_____	_____
Melodic score	_____	_____	_____
Harmonic score	_____	_____	_____
Rhythmic score	_____	_____	_____

Major sequence 1) Music Education Major 3) Liberal Arts, Music Major 5) Undeclared
 2) Music Education Minor 4) Liberal Arts, Music Minor 6) Other _____
 specify

APPLIED STUDY

major instrument or voice	years of private study	amount of class instruction	minor instrument or voice	years of private study	amount of class instruction
_____	_____	_____	_____	_____	_____

THEORETICAL STUDY

	years	semesters	quarters	List other studies:	years	semesters	quarters
Elements of music	_____	_____	_____	_____	_____	_____	_____
Theory (ear training, sight singing, dictation)	_____	_____	_____	_____	_____	_____	_____
Harmony	_____	_____	_____	_____	_____	_____	_____
Music appreciation	_____	_____	_____	_____	_____	_____	_____
Music history	_____	_____	_____	_____	_____	_____	_____

PERFORMING EXPERIENCE

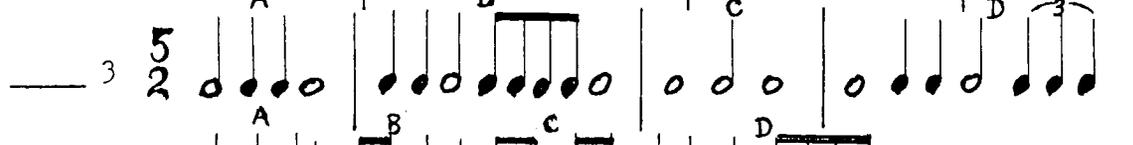
Band: marching	_____	_____	Choir, a cappella	_____	_____
concert	_____	_____	Glee club	_____	_____
Chorus	_____	_____	Ensemble: vocal	_____	_____
Orchestra	_____	_____	instrumental	_____	_____

COMMENTS

IDENTIFY THE INCOMPLETE MEASURE ANSWER A, B, C, D

1 

2 

3 

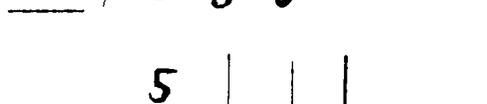
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5 

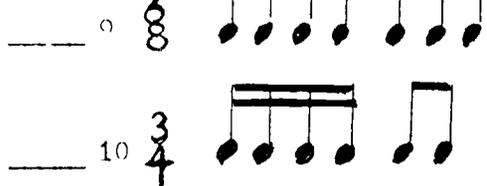
SELECT THE NOTE REQUIRED TO COMPLETE EACH MEASURE ANSWER A, B, C, D

6 

7 

8 

9 

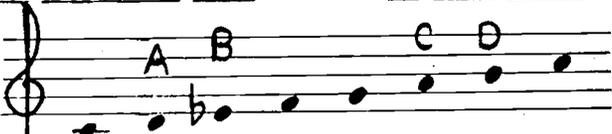
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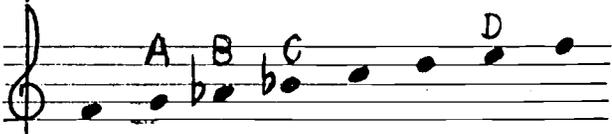
SELECT FROM THE FOLLOWING NOTES

A  B  C  D 

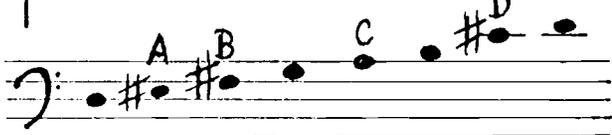
IDENTIFY THE INCORRECT NOTE (PITCH) IN EACH SCALE (ALL SCALES ARE MAJOR)

ANSWER A, B, C, D

11 

12 

13 

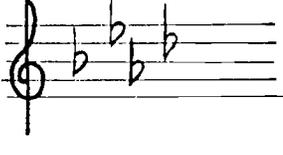
14 

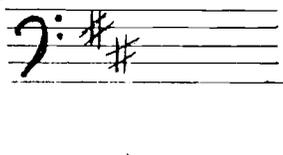
15 

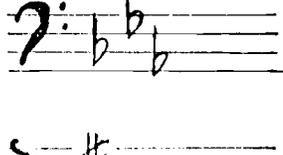
IDENTIFY THE CORRECT KEY SIGNATURE

ANSWER A, B, C, D

16  A. D minor C. C Major
B. A Major D. E minor

17  A. C minor C. A minor
B. B Major D. A^b Major

18  A. B minor C. B^b Major
B. C Major D. G Major

19  A. D Major C. E^b Major
B. G minor D. A^b Major

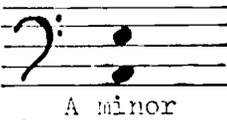
20  A. B minor C. F minor
B. C^{##} Major D. E minor

IDENTIFY THE MISSING NOTE IN EACH TRIAD

ANSWERS ARE SAME AS NOTES

A, B, C, D

21 
C Major

22 
A minor

23 
G Major

24 
E minor

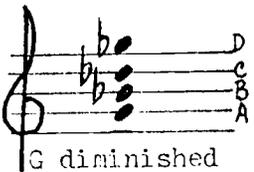
25 
C minor

IDENTIFY THE INCORRECT NOTE (PITCH) IN EACH CHORD

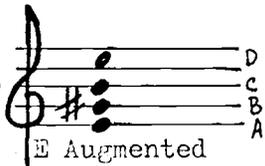
ANSWERS A, B, C, D

26 
F Major

27 
A minor

28 
G diminished

29 
A major

30 
E Augmented

PROCEDURES

FORM E

The procedures to be followed in this study are:

1. Administer a pretest (Aliferis-Music Achievement Test) to determine the level of competency in the areas of (a) melodic elements, (b) harmonic elements, (c) rhythmic elements. The test requires approximately 45 minutes to complete.
2. Administer instruction consisting of two (2) one-half hour sessions each week utilizing the PLATO (Program Logic for Automatic Teaching Operations) programs related to materials presented in the class. Instruction using the computer will continue for six weeks.
3. Administer a posttest (Aliferis-Music Achievement Test) to determine the relative achievement gain, if any, due to the instruction. The test requires approximately 45 minutes to complete.

The following guarantees are made to each participant relative to the conducting of the study:

1. Participation in the study will in no way have an effect on the final grade received in the class.
2. All scores and other personal information will be considered confidential and may be reviewed only by the individual and the researcher. All written communication will be accomplished by the use of a student identification number rather than by the student's name.
3. An individual may discontinue participation in the study at any time.
4. No student names will be used in any documents related to the study.
5. All inquiries relative to procedures and findings will be addressed as candidly and thoroughly as possible. Inquiries should be directed to Art Vaughn, Project Coordinator.

I HAVE READ AND UNDERSTOOD MY RIGHTS

(Signature)

PROCEDURES

FORM C

The procedures to be followed in this study are:

1. Administer a pretest (Aliferis-Music Achievement Test) to determine the level of competency in the areas of (a) melodic elements, (b) harmonic elements, (c) rhythmic elements. The test requires approximately 45 minutes to complete.
2. Administer the normal instruction in music usually associated with the basic musicianship class.
3. Administer a posttest (Aliferis-Music Achievement Test) to determine the relative achievement gain, if any, due to the instruction. The test requires approximately 45 minutes to complete.

The following guarantees are made to each participant relative to the conducting of the study:

1. Participation in the study will in no way have an effect on the final grade received in the class.
2. All scores and other personal information will be considered confidential and may be reviewed only by the individual and the researcher. All written communication will be accomplished by the use of a student identification number rather than by the student's name.
3. An individual may discontinue participation in the study at any time.
4. No student names will be used in any documents related to the study.
5. All inquiries relative to procedures and findings will be addressed as candidly and thoroughly as possible. Inquiries should be directed to Art Vaughn, Project Coordinator.

I HAVE READ AND UNDERSTOOD MY RIGHTS

(Signature)

APPENDIX H

t-TESTS

A t-test was performed using the posttest scores of the two sections of the control group, i.e., group one having been pretested and group two having not been pretested, to examine for any pretest contamination on the posttest measure and upon the treatment.

Table 14. t-Test on posttest scores of the control group.

Variable	No. of cases	Mean	SD	DF	t
<u>Posttest Total</u>					
Group 1	20	30.90	7.115	38	0.94
Group 2	20	28.90	6.299		
<u>Posttest Melodic</u>					
Group 1	20	12.75	4.011	38	0.41
Group 2	20	12.30	2.793		
<u>Posttest Harmonic</u>					
Group 1	20	6.80	2.840	38	0.41
Group 2	20	6.45	2.544		
<u>Posttest Rhythmic</u>					
Group 1	20	11.35	3.514	38	1.11
Group 2	20	10.15	3.345		

Tabular $t = 2.021$

$\alpha = 0.05$

A t-test was performed using the posttest scores of the two sections of the experimental group, i.e. group three having been pre-tested and group four having not been pretested, to examine for any pretest contamination on the posttest measure and upon the treatment.

Table 15. t-Test on posttest scores of the experimental group.

Variable	No. of cases	Mean	SD	DF	t
<u>Posttest Total</u>					
Group 3	20	44.60	8.293	38	-0.70
Group 4	20	46.20	5.970		
<u>Posttest Melodic</u>					
Group 3	20	18.80	3.901	38	-0.38
Group 4	20	19.20	2.546		
<u>Posttest Harmonic</u>					
Group 3	20	9.70	3.063	38	-1.54
Group 4	20	11.30	3.511		
<u>Posttest Rhythmic</u>					
Group 3	20	16.10	3.291	38	0.43
Group 4	20	15.70	2.494		

Tabular $t = 2.021$

$\alpha = 0.05$

A t-test was performed using the pretest scores of the sections of the control and experimental groups having been pretested to examine for similarity at the beginning of the experiment prior to treatment.

Table 16. t-Test on pretest scores of the control and experimental groups.

Variable	No. of cases	Mean	SD	DF	t
<u>Pretest Total</u>					
Group 1	20	23.7000	7.861	38	-0.26
Group 3	20	24.3000	6.473		
<u>Pretest Melodic</u>					
Group 1	20	9.3500	3.951	38	0.99
Group 3	20	8.3000	2.598		
<u>Pretest Harmonic</u>					
Group 1	20	5.2500	2.807	38	-0.43
Group 3	20	5.6000	2.349		
<u>Pretest Rhythmic</u>					
Group 1	20	9.2000	3.334	38	-1.10
Group 3	20	10.4000	3.589		

Tabular t = 2.021

$\alpha = 0.05$