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The Development of Cai Programs for Teaching Music Fundamentals to Undergraduate Elementary Education Music Methods Classes.

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THE DEVELOPMENT OF CAI PROGRAMS FOR TEACHING MUSIC
FUNDAMENTALS TO UNDERGRADUATE ELEMENTARY
EDUCATION MUSIC METHODS CLASSES

A Dissertation

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

in

The School of Music

by

Mary Louise Price Wilson
B.M., North Texas State University, 1972
M.M.E., North Texas State University, 1973
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ABSTRACT

The purpose of this project was to develop a sequence of computer-assisted instruction programs in the area of music fundamentals designed for the non-music major in an elementary music methods class. First, the sequence of concepts was defined; secondly, specific programs needed to enhance the understanding of the concepts were defined. A Xitan Z-80 microcomputer, with 32 K and cassette bulk storage, Hitachi 12-inch CRT video monitor, and an ASCII keyboard were the hardware employed in programming. System software included BASIC and assembly language. Programs were then tested for accuracy and logic by sample runs, often revised, and finally stored on magnetic tape.

The musical abilities and knowledge of music fundamentals possessed by elementary education majors upon entering a music methods class are varied. A few students are musically literate, but most have limited or little background in the rudiments of music. For the majority of the students, repetitions in practice with fundamentals, such as scales and key signatures, are necessary. Time spent on these numerous drills, often boring to the musically talented student, could be more efficiently used in musical activities.
Computer-assisted instruction (CAI) has been utilized in many fields of education to solve the repetition drill problem. Drill-and-practice computer programs have been found to be successful in helping students meet their individual needs. The individualized instruction, along with immediate feedback and increased student motivation have been positive learning tools. In constructing CAI materials, an attribute surfaced for the educator enhancing the learning experience for the student: the educator had to rethink and reformulate the educational practice and specify the conditions of learning in a precise manner.

Rhythm, melody, harmony, and terminology were the four major subdivisions of music theory chosen for development. Most programs are random, give a score following each run, are in a question and answer format, and some use graphics. The programs constructed are as follows:

**Rhythm** - Fill in the missing note in various meters, rhythm values and equivalents, concepts of rhythm, syncopation, and rhythm syllables

**Melody**

*Pitch Notation* - Pitch names (treble clef, bass clef, grand staff, and keyboard), half and whole
steps and enharmonic pitches

Key signatures - Major, minor, and major and minor combined: sharps, flats, sharps and flats combined (name the key, how many sharps or flats, name the sharps or flats in order [easy and difficult versions])

Scales - Major (sharps, flats, sharps and flats combined [easy and difficult versions]), natural minor (sharps, flats, and sharps and flats combined [easy and difficult versions]), harmonic minor, and melodic minor

**Harmony** - Intervals, major and minor thirds, major and minor chords, primary chords (I, IV, and V\(^7\))

**Terminology** - Randomly and non-randomly sequenced question and answer format questions

Music educators should become aware of the current state of technology in CAI and also of the studies on the subject of CAI in music. Those musicians already engaged in research and programming should conduct accurate statistical studies involving a large population. Some projects have been documented and reported, but many more statistical studies are needed to fully document CAI's benefits to students, as well as to discover and report its disadvantages and misconceptions.
Interactive use of computers in instruction is increasing rapidly. IBM has been exploring computer-assisted instruction (CAI) in their research laboratory since 1967.¹ "Ten years ago [1959] the use of computers as instructional devices was only an idea that was being considered by a handful of scientists and educators. Today that idea has become a reality."²

The growth of CAI has evolved from earlier interest and experience with programmed instruction. Research and study by the behaviorist B. F. Skinner in the 1960s stimulated research and development on the application of the principles of the reinforcement learning theory and individualized instruction. The shortcomings of this method and early teaching machines led to research with the computer to aid programmed instruction.³


Other factors can be cited as contributing to the growth of CAI. Electronic data processing in general has proliferated. The University of Illinois was an early pioneer in the field. Increasing aid to education by the federal government—the National Science Foundation and various funding agencies which came into being under the 1965 Elementary and Secondary Education Act—contributed substantially.  

Statement of the Problem

It is fairly well established that humanities and related arts courses are desirable at virtually every level of school experience. Music Educators National Conference recommended, in a 1972 report, that music be taught by music specialists; however, they also agreed that this may not be feasible for every school.

The classroom teacher plays a vital role in the child's musical education. Despite recommendations for more music specialists, the classroom teacher may be the only one available to teach music. According to Nye and Nye, "Music learning takes place in many situations other

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4 Atkinson and Wilson, p. 4.


than in the music period, and regardless of how much or how little teaching responsibility a specialist may be assigned, the impetus of the classroom teacher in creating an overall learning environment results in that person being an indispensable figure in the total music program.  

To be an effective music educator, the classroom teacher must possess the knowledge of basic music fundamentals. Many colleges and universities combine music fundamentals and methods of teaching children music into a single course. Musical abilities and experiences among these undergraduates vary widely. They range from the students with excellent musical backgrounds to those with little or none. Valuable classroom contact hours, that could be spent in musical experiences, are spent reviewing basic fundamentals--boring the musically intelligent student. The student with little musical knowledge requires more reinforcement than can be met in class time.

**Significance of the Study**

Educational technology is being developed at an accelerating pace. Many recent developments in education have been computer-oriented; the computer is a powerful tool

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for improving education at all levels. The rapid development of CAI is partly attributable to its potential for individualizing instruction.

Music education has not been overlooked in these developments, but it appears that computers in education have been utilized more in the sciences than in the humanities. The unique problem in individualizing the study of music and music instruction can perhaps be solved through CAI. Therefore, this project consisted of the development of CAI drill-and-practice programs in music theory fundamentals.

The completed work is a sequence of computer programs in music fundamentals to fulfill the individual needs of elementary education majors. It is designed to supplement classroom instruction through practice and drill. The programs are not in a printed text form but are stored electronically on magnetic tape.

**Delimitations**

Research literature on computers in education and computer applications in music instruction, and music fundamentals texts were drawn from the holdings in the

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Louisiana State University Library, personal collections, dissertations, and inter-library loan.

The hardware utilized was a Xitan Z-80 microcomputer with 32 kilobytes (32K) and cassette bulk storage, Hitachi 12-inch cathode ray tube (CRT) video monitor, and ASCII keyboard.

**Definition of Terms**

Definitions are given here to clarify computer terms used throughout the paper.

**BASIC** - A programming language or set of instructions to bridge the gap between the programmer and computer, allowing him to express his instructions in a convenient form. BASIC—Beginner's All-Purpose Symbolic Instruction Code—is the language most often used with microcomputers.

**Bit** - (Binary Digit) A single digit in the binary number system—either 0 or 1; the smallest possible unit of information.

**Branching** - The electronic process by which individualization in a CAI program is accomplished. Students are branched or directed to one or more sets of materials—remedial or advanced—on the basis of a response or a series of responses made in previous materials.

**Byte** - A small group of adjacent binary digits considered as a single unit. A byte usually contains
eight binary digits and is the smallest amount of memory that can be accessed as a unit by a computer.

**CAI** - Computer-Assisted Instruction - using the computer as a tutor as in drill-and-practice exercises.

**CRT** - Cathode Ray Tube - a video screen (similar to a TV) that can display output from or input to a computer.

**Drill-and-Practice** - A learning technique in which the student is presented with a structured succession of exercise questions designed to give him practice in a particular subject area. The sequence of examples can be arranged so as to provide questions of a certain difficulty, or graded to probe the student's learning difficulties, and may be interspersed with teaching materials to provide remedial help in areas of weakness.

**Flowchart** - A diagram used by computer programmers to indicate branching decisions and the general sequencing of materials within a CAI program.

**Hardware** - The physical equipment that makes up the computer or its peripheral equipment.

**Microcomputer** - Refers to a concept of a complete computer central processor, sometimes defined as a single-chip computer.

**Program** - A series of steps that directs the computer to perform in a certain way.
Program Listing - A sequential listing (numbered) of all directions the programmer has input to be stored.

Real-Time Interaction - The method by which the user communicates with the computer through a terminal and obtains a very rapid response from the computer, typically within a second, to the messages he sends.

Software - The program used in a computing system.

Tutorial-System - A form of CAI-like programmed instruction in which the student is led through the learning materials via a structured question and answer dialogue. The focus of the instruction is on the student's mastery of various concepts within it.

Method of Investigation

Descriptive, historical, and developmental research methods were utilized for the preparation of the study. Gathering reported research in the field of CAI and CAI in music was followed by its assimilation and documentation. Music fundamentals texts were then reviewed and compared according to content and approach. The developmental method of research consisted of arranging the rudiments of music into four major divisions, followed by the choosing of the most efficient form of question and answer drills. The programs were then written, typed into the computer, tested for accuracy and logic by
sample runs, often revised, and finally stored on cassette tapes.

Development of Remainder of Report

Chapter II contains a review of selected published literature on computer-assisted instruction in both education and music; unpublished papers, speeches, and conferences; and music fundamentals texts. Presentation of the CAI materials developed comprises chapter III. This sequential presentation is divided into four categories: rhythm, melody, harmony, and terminology. A summary, conclusions, and recommendations are contained in chapter IV.
CHAPTER II

REVIEW OF RELATED LITERATURE

Introduction

Computers have been used for CAI ever since educators learned to combine Skinner's programmed instruction techniques with the features of Skinner and Pressey's teaching machines. Although CAI has made its impact on education only for the past two decades, several types of literature on the subject have been written. Books written on the subject of CAI, as well as books on educational technology, including the CAI subject area, are available. The first part of this literature review concerns itself with specific books on the subject of computer-assisted instruction.

Computer-oriented educational technology is being developed at an accelerating pace. To accommodate this growth and ever-changing technology, many authorities have channeled their knowledge into periodicals. The Journal of Computer-Based Instruction is devoted to CAI; Educational Technology and Audiovisual Instruction often devote large portions to the subject of computers in education. Numerous periodicals

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appear each month dealing with computer hardware and software; they often include articles on CAI. For educators to keep abreast of current trends, as well as see the paced growth, these periodicals provide excellent sources.

The next part of this review describes the impact of computers on the music curriculum. Sources include music journals, dissertations, and papers. Books on the subject of computers in music (Lefkoff\textsuperscript{2}, Lincoln\textsuperscript{3}, Chamberlin\textsuperscript{4}, and Bateman\textsuperscript{5}) do not address the subject of CAI.

The goal of this study is in the development of CAI materials to teach the fundamentals of music to classroom teachers. Numerous texts are available for the purpose of teaching these concepts; a review of some notable music fundamentals texts comprises the final section of the literature review.

\begin{itemize}
\item \textsuperscript{2}Gerald Lefkoff, ed., Computer Applications in Music (Morgantown, West Virginia: West Virginia University Library, 1967).
\item \textsuperscript{3}Harry B. Lincoln, The Computer and Music (Ithaca: Cornell University Press, 1970).
\item \textsuperscript{4}Hal Chamberlin, Musical Applications of Microprocessors (Rochelle Park, New Jersey: Hayden Book Company, Inc., 1980.)
\item \textsuperscript{5}Wayne Bateman, Introduction to Computer Music (New York: John Wiley & Sons, 1980).
\end{itemize}
In 1969, Atkinson and Wilson of Stanford University assembled a book of readings covering many disciplines in the area of CAI. Their goal was to bring together in an easily accessible form a set of papers reflecting the current trends in research and development in this field. The collection was not intended to cover the scope of all problems and activities but to represent readable papers of a general interest to students without a CAI background.⁶

The paper by Atkinson and Wilson revealed the state of the art in 1969 and briefly reviewed its growth from 1959 to 1969. They summarized

The use of computers as educational tools is still extremely limited when one considers their potential for improving the instructional process. Many problems need to be solved; the obvious problem of hardware and costs as well as the deeper problem of understanding the learning process more fully, and applying that knowledge in both curriculum development and evaluation.⁷

Problems and attributes of CAI are topics covered by several contributors. Silberman, in his paper "Applications

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⁷Ibid., p. 13
of Computers in Education," assessed the three main problems as (1) facilitating non-media communications, (2) cost efficiency, and (3) user acceptance. Forcing educators to specify the conditions of learning in a precise manner, leading to identification of problems for research, was given as CAI's main contribution by Stolurow. Individualized instruction in the educational process was stressed in Colley and Glaser's paper.

Another collection of articles by scientists and educators appeared in 1970. Edited by Margolin and Misch, these papers were the culmination of a traveling seminar, in which members viewed the problems and issues facing education in its use of this technology. They projected technological effects on education in the 1970s and offered recommendations and a variety of approaches to dealing with forseen problems. The authors and editors presented their views at a time when the areas of CAI, instructional

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television, electronic video recording, videotape recording, satellite communications, and other "non-book media" were pursuing parallel but separate lines of development. Margolin and Misch concluded

We have voiced the needs for overall planning in educational technology, and the convergence of the separate technologies to solve educational problems. It is our belief that this will eventuate. When it does, "it will be a new ballgame."\^11

An index published in 1970 showed the infancy of CAI software. The hardware seemed to be available, or could be easily developed; as recently as 1967 there were fewer than 100 programs available, many of which had never been adequately evaluated. According to Lekan, this index, in its second edition, identified 910 programs, compared with 456 references in the 1968 edition. The editor predicted this productive pace of software to continue, if not accelerate, and the replacement of this type of index with several indices on special subjects or levels.\^12

When confronted with the possibility of computers being used in schools, some educators in the early 1970s became extremists in their beliefs. To some the machine


was a symbol of inhumanity which could dehumanize the schools. To others, the computer was a device offering new pedagogical sophistications. Both groups reacted strongly to the other; both were wrong and right.13

A 1973 Ford Foundation report continued with the idea of computers in education, applied to instructional technology as a whole. The concept was described as a moving target, in part because of the changing nature of the technology itself, and in part because of the varying integrations of its effectiveness and importance.14

To some, the concept was supplementary; others saw it as a replacement for the teacher. Strong emotions were aroused among advocates and adversaries of computers in education.

Replacing optimism with doubt, regarding the computer's promise for education, was suggested by Ellis. "This is not to suggest, however, that the computer holds no promise for education. ... we have a unique opportunity to meaningfully rethink and reformulate educational practice."15 One risk given was in the thin line that exists


between automating a process that is procedural and automating a process because it is procedural—choosing a "candidate" for computerization.\(^\text{16}\) Other risks were in distortion: distortion of limitation—limiting what is to be included—and distortion of oversimplification—oversimplifying what remains.\(^\text{17}\)

The attributes, as well as problems, can easily be seen in the literature about computers in education. Some benefits synthesized by 1979 from findings by Doerr are discussed below.

1. Relevant education - Students need to understand the role of the computer in modern society, its construction, operation, and language programming

2. Great teaching opportunity - The computer is not to replace the teacher, but the two combined create a powerful teaching force

3. Increased student motivation - The nonthreatening and noncompetitive nature of the learning environment is a positive stimulus. The novelty does not appear to wear off, and some students stop at nothing, even serious study, to "beat the machine"

\(^\text{16}\)Ellis, The Use and Misuse of Computers in Education, pp. 46-50.

\(^\text{17}\)Ibid., pp. 55-62.
4. Feedback - Immediate feedback is a critical factor in learning, and the average teacher cannot correct each paper within seconds of completion—the computer can.

5. Individualized instruction - The chance to increase the rate of learning by allowing students to proceed at their own pace is a great promise of CAI.\(^{18}\)

The computer was found to be as versatile and useful a tool in education as it had been in other fields, particularly in administrative chores. The computer as a teaching aid has been the last area to be affected. In the mid-seventies, many instructional applications were introduced and implemented. According to a study by the American Institute for Research, "the number of secondary schools using the computer for instructional purposes doubled between 1970 and 1975 (from 13 to 27 percent) and will double again (to 51 percent) by 1984."\(^ {19}\)

Doerr accounted for the slow pace of computers entering the world of education. Cost was a major factor, along with complex operating procedures, lack of teacher


training, no supporting curriculum, and the absence of significant research results. 20

The breakthrough for CAI in the past few years can be attributed to low-cost, easy-to-use microcomputers, according to Doerr. The early computers of the 1960s were massive—occupying several rooms. The development of the minicomputer, considerably smaller, offered only slightly less capability than the first generation of computers. The first microcomputer was produced in 1975 and is much smaller, but only slightly less capable than computers that are much more expensive. 21 Doerr predicted, "By 1980, we expect to see a computer priced well under $1,000 that will perform many educational tasks as well as computers selling in the mid-seventies could handle for a hundred times the cost." 22

Periodicals

An interesting, concise overview of the development of CAI can be seen in the Education Index. Between 1955 and 1959, under the heading "Computer," the Index directed the user to "See Calculating Machines." These articles

20 Doerr, Microcomputers and the 3r's, p. 3.
21 Ibid., p. 3.
22 Ibid.
were primarily math-related. The 1959-61 edition listed five articles under that subject heading. Some articles appeared in the 1961-63 edition for educational use but were mainly directed at administration for grading and scheduling. Editions of the next few years included articles of the same nature with the addition of research and retrieval. By 1966, the term "CAI" does appear; the 1967 edition broke down the CAI articles into various subject areas. Continuing to the present, the number of articles has become substantial.  

An early CAI article appeared in the NEA Journal during February of 1967. Suppes observed, "Educators have shown increasing interest in the use of computers for classroom teaching, especially during the last year or two [1965-66]." This article acquainted the educator with uses for the computer in the classroom and answered briefly some questions frequently asked about computer-assisted teaching in its infancy.

These questions first addressed individualized instruction—how can the computer help? The computer offers perhaps the most practical hope due to the rapid

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operation, lowering the cost per student. How might it change the teacher's role? Drill-and-practice systems will relieve some tedious duties, but tutorial systems will lead to more opportunities for personal interaction with students. As expected, the questions of impersonality of the machine and the likelihood of its replacing teachers were raised. Educators were assured that students would still be dealt with individually and the number of teachers would not be reduced. The conclusions emphasized that students would not spend most of their school day at the computer; perhaps no more than twenty to thirty percent.25

The state of the art in 1967 was described as constantly changing and evolving, along with the limited circulation of research reports.26 Most articles concerning CAI consisted of descriptive accounts of what an institution was doing or short statements of research findings. Twenty or more institutions across the country were recognized as centers where actual research was being conducted in 1967. At that time, some leaders at these centers were: Suppes (Stanford), Stolurow (Harvard, formerly at the University of Illinois), Zinn (University

25Ibid., pp. 15-17.

of Michigan), Mitzel and Wodke (Penn State), Loulson (Systems and Development Corporation), Bushnell (Brooks Foundation [California]), and Wing (Northern Westchester BOCES)\textsuperscript{27} Several of these names appeared in publications concerning CAI since the early 1960s.

A few early (1960) reported research conclusions follow.

1. There were no known limits for CAI in regards to subject content or levels\textsuperscript{28}

2. Students learned as well with CAI as with conventional instruction but usually in less time\textsuperscript{29}

3. Some researchers predicted that CAI would equal or surpass in effectiveness conventional methods, but subsequent studies did not support this prediction; traditional methods have proven to be more effective in some cases.\textsuperscript{30} Grubb and Selfridge reported that students have gained significant levels with CAI


\textsuperscript{28} Ibid., p. 348.

\textsuperscript{29} Ibid., p. 347.

\textsuperscript{30} Dence, "Toward Defining the Role of CAI: A Review," p. 50.
over conventional methods\textsuperscript{31}

4. The computer could be programmed to accommodate for individual differences\textsuperscript{32}

5. Students reacted favorably to CAI; however, some students became discomposed by the machinery. Their attitude was generally related directly to their performance with CAI\textsuperscript{33}

Numerous CAI research reports have been written in the last decade. Journals, periodicals, reports, and papers have addressed themselves to many variables. "The major focus has been on subject matter and global comparisons of CAI to traditional instruction."\textsuperscript{34} Several variables are discussed below.

1. Subject areas in which positive results occurred were: foreign languages and sciences (Koch, 1973);\textsuperscript{35}


\textsuperscript{32}Patrick Suppes, "Tomorrow's Education," Education Age 2 (January 1966):4-11.


\textsuperscript{34}Dence, "Toward Defining the Role of CAI: A Review," p. 51.

German and Arabic (Allen, 1972); Russian and math (Suppes and Morningstar, 1969); English and biology (Magidson, 1978); and medical sciences (Alpert and Bitzer, 1970)

2. Drill-and-practice provided a significant advantage over traditional instruction in foreign languages and sciences (Koch, 1973), but traditional instruction was found to be as effective in elementary school mathematics (Suppes and Morningstar, 1969)

3. Positive attitudes generally were found, as in earlier research (Mathis, Smith, and Hansen, 1970)

4. Immediate feedback was cited as advantageous

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5. Individualization was also found to be advantageous (Magidson, 1977 and 1978)

6. CAI was at least as effective as traditional instruction in fifty-five percent of studies and more effective in forty-five percent (Magidson, 1978)

7. Combined CAI and traditional instruction together produced better final examination grades than either technique did separately (Tsai and Pohl, 1978)

8. Learning by CAI took less time (Allen, 1972)

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47 Ibid.


9. Greater retention after CAI instruction was shown on a test given twenty-six weeks after instruction (Alpert and Bitzer, 1970)\textsuperscript{50}

A wealth of research has been conducted to determine the validity of CAI, but CAI is still not being used widely or effectively. Educators are still not familiar enough with its capabilities and its place in the curriculum. Many of the questions raised earlier remain largely unanswered. One recent article in \textit{Educational Technology} (1980) reiterated many of the same concepts presented in the 60s and 70s. McCulloch stated that CAI should be "encouraged rather than feared by those concerned to see the continued progress of education. . . . It enhances the understanding of teaching strategies, . . ."\textsuperscript{51} He assured educators that replacing teachers with computers is a myth.\textsuperscript{52} Meanwhile, computer technology is soaring; its use in education is increasing daily.

\textbf{CAI Applications in Music}

Computers have made an impact on music through new techniques in computer-assisted instruction, composition, composition,

\textsuperscript{50}Alpert and Bitzer, "Advances in Computer-Based Education,"p. 1584.


\textsuperscript{52}Ibid.
analysis, information retrieval, computer-generated sound, and management systems. This review highlights published and unpublished literature on computer-assisted approaches to teaching music and is organized as follows: introduction (impact on American education), music theory, instrumental music, musical concepts, musicality and aural perception, music games, music education, and CAI versus traditional teaching methods.

Jones surveyed 434 institutions (1975), 429 of which were National Association of Schools of Music (NASM) affiliates. The purpose of his study was to determine the status of CAI in college music education and to identify and address issues surrounding its development.

Of these schools surveyed, twenty-three responded that they did have some involvement with CAI. These solicited opinions showed the following as inhibiting factors for the development of CAI and its acceptance in the field of music.

1. Lack of compatibility of computer systems
2. Lack of background concerning computer applications among faculty members
3. Lack of well-trained support personnel available to work with faculty members
4. Lack of availability of genuinely useful programs for music
5. Lack of understanding of the teaching and learning processes

6. Lack of a working program as a large-scale demonstration of CAI in music

7. Lack of a hierarchy of required musical learnings, definable in behavioristic terms

The following recommendations were gathered and summarized from the respondents. These were based primarily on the strengths of opinions of fourteen selected experts from the twenty-three schools.

1. That teams of specialists be the principal thrust behind program development

2. That there is no critical need for a unique or common program language for music

3. That interface devices capable of handling musical input and output be developed

4. That the feasibility of circumventing problems of incompatibility of languages by automatic machine translation be explored

5. That the development of functional curricular materials and research be concurrent processes

6. That efforts be made to find a vehicle to facilitate the exchange of CAI efforts

7. That drill-and-practice be continued as a viable mode of presentation of CAI materials, and that CAI move
away from the direction of programmed instruction

Findings also showed that the educational community has been reluctant to accept and develop CAI for music. (1) Few music educators were involved in using the computer for teaching purposes. (2) Few students were involved. (3) Few music educators and graduate students were involved in research with CAI. (4) Few quality course materials were available. (5) No formal means existed for sharing efforts of CAI in music. 53

Another survey showed nine NASM schools having developed CAI materials in music during the decade between the late 60s and late 70s. These schools concentrated on five major applications: performance, teacher-training, music fundamentals, ear-training, and set theory.

Teacher-training was developed most extensively at the University of Illinois. At the time of the study (1978), the university listed programs in tests and measurements, instrumental methods series (wind and percussion), percussion terminology, elementary violin and viola fingering drills, elementary level instrument recognition, micro-teaching, and hand signals for music teachers.

Four of the nine schools had developed programs for

teaching music fundamentals. Table 1 shows their areas of concentration.

Indiana University explored the use of computer-based learning in set theory. The school stressing performance was Penn State University, through programs in articulation, phrasing, and rhythm.

Two schools concentrated their efforts in ear-training. The GUIDO Ear-Training System at the University of Delaware included studies for intervals, melody, harmony, rhythm, and chords. Stanford University programmed the following ear-training activities: intervals, triads, melody, rhythm, chords, and modulation.

Through measuring the achievement and attitudes of students, Hofstetter summarized that the preceding computer-based learning materials have these capabilities: to individualize instruction, to emphasize the intrinsic joy of learning and to de-emphasize competition with persons as a motivating force, to encourage students to tailor their learning experiences to meet their own objectives, to give immediate feedback, and to save time. 54

An evaluative study of materials published in America through June of 1972 in non-compositional applications

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<tr>
<th>State University College (Potsdam)</th>
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<td>Grand Staff</td>
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<td>Intervals</td>
<td>Ledger Lines</td>
<td>Ledger Lines</td>
<td>Time Signatures</td>
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<td>Trichords</td>
<td>Octave-Transposition Signs</td>
<td>Ascending Intervals</td>
<td>Complete the measure</td>
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<tr>
<td>Tetrachords</td>
<td>Intervals</td>
<td>Descending Intervals</td>
<td>Keyspinner Game</td>
</tr>
<tr>
<td>Scales &amp; Modes</td>
<td>Triads</td>
<td>Major and Minor Scales</td>
<td>Keyboard Notation</td>
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<td>Key Signatures</td>
<td>Seventh Chords</td>
<td>Scale Keys and Signatures</td>
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<tr>
<td>Triads</td>
<td>Placing Chords in Keys</td>
<td>Triads</td>
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<td>Progressions</td>
<td>Altered Chords</td>
<td>Primary and Secondary Triads</td>
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<td>Modulation</td>
<td>V7 Chords</td>
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<td>Primary and Secondary V7 Chords</td>
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<td>Secondary 7th Chords</td>
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<td>Primary and Secondary Diminished 7th Chords</td>
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<td>Neapolitan 6th Chords</td>
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<td>Augmented 6th Chords</td>
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of the computer to music resulted in the following discoveries.

1. Good methods for representing musical notation for the computer already exist; researchers should use these if possible, rather than add to the confusion.

2. Lack of standardization is causing wasted effort.

3. Scholars have yet to standardize approaches for sorting programs to produce thematic indices.

4. Large scale, successful studies of analytical methods have not yet been produced, although a large number of very different analytical methods have been tried.

5. All attempts to develop complete systems for computer-assisted music studies seem to have been abandoned.

At an early stage in the history of CAI (1969), an article described the language and possibilities of computers in music education. Reich indicated that this new development could stretch the capability of music teachers, the capacity of the music classroom, and the achievements of students. This researcher stressed, "Computers are not a subject music educators can afford

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to ignore."  In the past, many music educators have not understood much of the technology of computers; in the future, he needs to become familiar with current research and computer vocabulary. This article proceeded to educate the musician by giving him the necessary background in computer language and possibilities for its use in music.  

Another article for music educators described one computer-instructional system (PLATO). PLATO was developed at the University of Illinois (1959) and consists of a central computer and a separate terminal and telephone. The user can choose lessons based on drills, a simulated laboratory experiment, a tutorial sequence, or a game situation. Graphics, both stationary and moving, consist of pictures including staff notation, keyboards, fingerboards of stringed instruments, and sound waves. The student can hear sounds, such as an interval or scale he is building, by attaching an audio device to the terminal. This same device also allows him to listen to and analyze selections from various periods in music history.


57 Ibid., pp. 47-49, 115-118.

The PLATO system described above is connected to a large central computer by telephone cables. The advances in the past decade with micro-computers have lowered costs and widened the applicability of computers in education. Hofstetter implied that there is no other discipline better suited for microelectronics than music education.59

One of the areas in which computers have made an impact on education is instruction by drill-and-practice. Kuhn stated that these facts should be considered

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 has just understood.
3. Neither teachers nor pupils enjoy the present kinds of drill enough to oppose its automation.
4. In drill, as in few other phases of teaching or learning, we can hope to obtain the masses of statistically homogenous behavior required to reveal the diverse effects and interactions we must have in order to understand the educational process.60

With proven effectiveness of CAI in drill-and-practice, "the development of an ear-training drill-and-practice is one of the logical outgrowths of CAI."61

61Ibid., p. 99.
Kuhn identified five basic needs for the construction of a system for teaching music dictation.

1. Need for Sound - to provide the primary stimulus
2. Need for Real-Time Interaction - to give immediate feedback
3. Need for Individualization - to tailor an individual curriculum
4. Need for Research - to use the system as a tool for basic research in the areas of how students learn and acquire skills
5. Need for Student Records - to keep detailed and accurate records of student performance

One of the earliest reported projects utilizing CAI in music was in 1967. With the use of a pitch extractor, researchers at Stanford University developed a teaching system to extract pitch information directly from each note of a subject's musical performance and make the pitch information available to a computerized teaching device for evaluating the student's performance. A sequence of sightsinging exercises, tests, and branching criteria was encoded in a computer language specifically designed for the use of music instruction sequences.

A preliminary investigation was conducted at the time the system became operational; the tentative and experimental nature of this initial research project was emphasized. Its principal objective was to study the interaction between student and machine, and numerous signs of emotional reactions were viewed. Another result was that subjects reported increased awareness of pitch.63

A computer program for teaching sightsinging to music students was designed and implemented on a small computer at the University of Utah (1973). The major feature was the employment of a technique for using the computer to generate instructional material. The level of difficulty was chosen by the student according to his individual needs.

Testing was undertaken to establish the instructional effectiveness. A sightsinging test developed and documented by Thostenson (University of Iowa) was administered as pretest and posttest. A questionnaire was developed to sample student reactions and attitudes. The results showed statistical significance at the .01 level, and it was considered that these students exhibited statistically

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significant improvement in the sightsinging of phrases with a constant rhythm after having received computer-assisted instruction when compared to the control group. 64

A study to measure student accuracy of simple harmonic and melodic interval identification used a sound source of complex (as opposed to "simple" sinusoidal) tones (1975). The results of this study showed several misconceptions on which teaching methods are often based. First, the study showed no significant difference when intervals were played at various speeds; slowing the playing speed did not affect results. Secondly, the belief that the perfect octave was extremely easy to identify was disproved—it was missed an average of twelve percent of the time. Finally, the study showed that there are differences of recognition related to the mode of presentation—harmonic, ascending, and descending. 65

For applying CAI to rhythm, Placek designed and programmed a computer-assisted lesson for the teaching of selected behaviors in the area of rhythm perception (1972).


Since the study was designed for students preparing to be elementary teachers, the researcher also wished to determine the lesson's effect on such students. Two program objectives were stated: (1) the student can demonstrate a knowledge of the function of basic rhythm notation, and (2) the student can demonstrate a knowledge of the relation of rhythmic notation to aural rhythm patterns. The six students involved in testing the project scored a combination of thirty points on the pretest and seventy-five on the posttest, out of a possible eighty-four points.66

A computer-based ear-training system at the University of Delaware has led to a significant improvement of instruction in core music theory courses. Ear-training students using this system scored one letter-grade higher than before.67 This system, GUIDO, developed during 1974-75 and named for the eleventh-century monk and music educator, is an acronym for Graded Units for Interactive Dictation Operations. The units, stored in the computer, contain a complete curriculum for aural drill-and-practice

in rhythm, melody, harmony, intervals, and chord qualities.  

Using the GUIDO system an experiment was conducted, during the 1974-75 academic year, to determine the impact of this system on student achievement in harmonic dictation. The results at the end of the experiment indicated that the difference between the two groups of freshman ear-training students—one group using GUIDO, the other a control group—was significant at the .05 level.  

Hofstetter conducted another study (1975-76 academic year) using record-keeping features of the GUIDO system to identify perceptual patterns in harmonic dictation exercises. Examination of the results led to the identification of seven principles of chord confusion that accounted for errors that occurred at least ten percent of the time. These seven were: bass line confusions, confusions by inversion, confusions of chord functions, confusions of chord quality, unperceived seventh, unperceived


root, and favorite response (frequently guessing the V chord if the student had no idea of what to name the harmony). 70

During the 1977-78 academic year, Hofstetter measured the achievement of eighteen freshman music majors in a GUIDO chord quality program and determined the pattern of student response to chord quality dictation exercises. Correlated t-test comparisons of pretest and posttest scores showed significant learning gains. A transfer of learning also occurred between the study of chords in close and open position. Results further showed that students more often confused major and minor chords when the chords were inverted and confused augmented and diminished chords exclusively with each other. The researcher noted that the sample was small and others should seek to determine if the perceptual patterns would occur in other groups. 71

The success of CAI programs is often attributed to


the logical and orderly system of revision. Revising materials is timely, and in many cases, the program continues to have flaws. A dissertation concerned with the formulation of a model for the revision process in the development of CAI materials was written in 1976. Through the study of the revisions in music theory, this study listed guidelines for the development of CAI instructional materials.72

In the area of instrumental music, Deihl and Radocy (1967-69) worked to develop computer-assisted instruction in musicianship. Under this USOE funded grant, the on-line program involved aural concepts and was coordinated with an off-line program in which the aural concepts were implemented in performance. The program took approximately seven hours of on-line instruction and was piloted by fourteen clarinetists from public schools.73

The feasibility of the preceding study led to a sequel, conducted by Deihl and Zeigler. This project, under the auspices of another USEO grant, proposed to


expand the program from clarinet to all treble clef wind instruments and to develop and implement criterion-referenced tests to evaluate results of twenty-five subjects taking the revised program. Results showed significance beyond the .001 level from the gain scores. Almost all of the subjects reached the established criterion level on both listening and performance.74

At the University of Illinois, Peters developed a program, utilizing PLATO, for students preparing to teach instrumental music. The lessons reviewed basic information on various aspects of woodwind and brass instrumental pedagogy. The content was structured to review problems in three major areas: tone production, articulation, and intonation.

The results were evaluated in two ways—according to student reaction to the computer and student success or retention of materials. Students tended to learn material faster and more efficiently with the CAI program than in "normal classroom" or "laboratory" situations. The average gain score was 5.3 (.05 level of significance) indicating that the programs were successful in helping

students to review methods materials. Student reaction to the PLATO system and the music program was favorable.75

MUSCON programs were designed at Cleveland State University for use in music methods, K-6. Their purpose was to (1) help students identify specific musical concepts that are developed in elementary school, (2) acquaint students with the terminology associated with the concepts, and (3) review basic music materials related to the concepts. Four programs included pitch, harmony, and two on duration. Programs dealing with form and tone color were projected.76

To determine the effectiveness of a CAI program designed to teach the student to verbalize his perceptions of musical examples after listening was the purpose of Lee's study (1975). Conclusions from findings were

1. CAI could offer a way to teach musical perception.
2. The CAI program as presented in this study was as effective as classroom teaching.
3. The females appeared to do better on the technical musical perception test while the males appeared to do better on the


non-technical musical perception test regardless of instructional mode.

4. Instructional technique used in a short term study has no effect on attitude toward music.77

The aim of another computer approach to music study was to nurture in students the quality of musicality, for a musical ear or an individual's ability to give a musical performance. With this goal in mind, researchers at MIT developed a learning environment in which students could handle, manipulate, and transform ideas about music that intertwine directly with the creation of their own music facts and artifacts. This self-paced approach rested on the fundamental idea that studies of cognitive growth and its relation to perception should also be relevant to teaching and learning music.78

"The competitive aspect of gaming adds a new dimension to normal instructional motivation."79 Musical game programs, written as early as 1971, gave no advantage to


the computer. The student was always able to succeed if he gained command of the content. Hullfish and Pottebaum described the process for writing a game (much the same as any other instructional logic): (1) objectives must be written, (2) a method of achieving those objectives must be devised, and (3) evaluation must be carried out. The game could be constructed in which the student and computer alternate responses in a heuristic approach toward concept learning—probably more challenging than a drill or tutor program.  

Parrish proposed a course of study in computer research specifically for music and music education. The purpose of his study (1977) was to develop and evaluate a course of study which would provide music educators with the knowledge and skills necessary to evaluate and utilize the computer as a research tool. The final version of the course, after evaluation and restructure of two pilot courses, consisted of four units, each made of individual modules based on behavioral objectives. The four units were (1) Introduction to computers and music, (2) Readings,

80 Hullfish and Pottebaum, "Take On A Digital Assistant: The Computer as a Teaching Aid," p. 86.
(3) (Algorithms and Flowcharts) goals, and (4) Interaction with the computer.\textsuperscript{81}

Three applications of the computer in the education of music teachers were planned and pilot tested at the Eastman School of Music (1974-75). The first application was a mini-course in CAI. The second was a computer game called TEACH--for students enrolled in theory pedagogy. The third application was a computer-administered examination--used as a midterm exam by students enrolled in Measurement and Evaluation. The computer selected different test questions randomly for each student, it then scored each test immediately, reported the score to the student, and reported to the instructor the mean and standard deviation of the score distribution together with a standard score for each student.\textsuperscript{82}

A dissertation study comparing the efficacy of CAI with the traditional teacher-taught technique compared the two methods in teaching selected musical concepts


in a standard public school. Conclusions based upon a t-test were

1. Computer-assisted instruction is as effective as teacher classroom techniques.
2. Computer-assisted instruction as designed by this study does not affect the achievement scores of students that possess high initial achievement scores.
3. Computer-assisted instruction is significantly effective in teaching students that possess low initial achievement scores.
4. Computer-assisted instruction teaches equally as well as teacher classroom technique but in thirty percent less time.\(^8^3\)

As the applications of computers to music education have continued to increase, and the cost of computer hardware has continued to plummet, more music schools have been taking a look at the advantages of computer-assisted instruction in music education. Several schools of music not mentioned above have experienced breakthroughs in CAI in recent years.

North Texas State University (NTSU) has developed an effective method for presenting drill-and-practice in music theory. The system was described as providing these four requirements designed to fit each student's needs economically.

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

The first results at NTSU were encouraging after implementing the program for one semester (Fall 1977) with only one terminal. One section of a freshman music theory class used the drill-and-practice facility, while another did not. Both sections were taught by the same teacher, and both had the lowest placement scores on a standardized examination. On a mid-term examination, students using the computer had a median score of twenty percentage points higher in ear-training skills than those who did not. At the end of the semester, a significantly larger proportion passed, and with higher grades, than the other group, according to R. Killam of the NTSU School of Music faculty.  

A. Hunkins has developed theory drills at the University of North Carolina at Greensboro entitled "Basic  

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Ibid., p. 9.
Musicianship Drills." For ear-training drill-and-practice, he has also developed CAI with sound using a PET computer. G. Wittlich (Indiana University), M. Thostenson (University of Iowa), and J. Taylor (The Florida State University) are just a few other representative examples of musicians who have researched and developed CAI in music education.

The Tanglewood Symposium (Summer 1967), in a documentary report, made a statement concerning the impact of technology. It suggested that the music faculty must be able to use computers in teaching at all academic levels. The student must also be given the opportunity to apply the techniques of data processing in his own course work. To achieve these aims, it was recommended that (1) various training programs be established in computer concepts or programming for deans of music schools, music supervisors, and music teachers; (2) a committee on computer technology or computer applications be set up within a framework of MENC; (3) a task force of music educators develop a set of guidelines for computer-assisted instruction in music; and (4) the MENC establish a continuing working relationship with the computer industry in order to take advantage of this new tool.  

Music Fundamentals Texts

Numerous music fundamentals texts exist. Those designed for elementary classroom teachers are varied in format and content. Two approaches seem to prevail—a programmed approach and an activities approach. Texts developed for self-instruction or programmed instruction often include songs and activities leading to the understanding of theoretical concepts. Some books provide total experiences for the student—introducing a combination of elements as they relate to a specific song or activity being presented. Another activity-oriented approach is in the presentation of fundamentals by separate chapters, usually followed by, or interjected with, chapters involving musical activities.

Three programmed texts were examined; the text by Pound shows the reader how quickly to develop a functional understanding of the elements of musical notation through the use of self-instructional techniques. Each of the twenty-three lessons has an accompanying assignment for the user to demonstrate his understanding of the objective. The inclusive materials are limited to such basic fundamentals as the staff, treble clef, pitch, rhythmic notation, meter, and key signatures through the introduction of
chords, but these fundamentals do not extend to scales.  

Music for Elementary Teachers is concerned with basic theory as it functions in the acquisition of simple musical skills. The content is based on the premise that fundamental concepts of tonal organization are most easily and rapidly learned with the help of a keyboard instrument. The first seven chapters introduce the keyboard, staff, diatonic tonal system, diatonic intervals, and major and minor scales. Not until the eighth chapter, "The Notation of Songs," do elementary songs appear for the reinforcement of concepts. These songs continue through the following sections on transposition, chords, and the notation of rhythm.

To give elementary teachers a practical knowledge of music is the goal of a programmed text by Andrews and Wardian. To achieve this goal, the book is organized on the basis of a step-by-step acquisition of knowledge, combined with immediate practical work in singing and playing the piano to develop skills. The major sections are (1) programmed textbook, (2) song supplement, (3)

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glossary, (4) self test, and (5) flash cards.  

The second style of format, providing a total experience, can be seen in the texts of Knuth and Knuth; Hackett, Linderman, and Harris; and Swanson and Sannerud. The fourteen chapters of the Knuth and Knuth text are each divided into three sections—concepts, skills and activities, and associated music. In chapter two, for example, concepts introduced include mood, rhythm, melody, harmony, form, the staff, and clefs. Accompanying skills and activities are rote singing, line notation, and accompanying an easy song on the autoharp. Three elementary songs, along with a symphony movement, are musical examples for association with the preceding concepts and activities.  

The Musical Classroom enables students to develop skills in music teaching, while at the same time providing introductory experiences in playing and reading music. Each of sixty-one model experiences focuses on a single concept about music, within a framework of musical

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elements.\textsuperscript{91}

The purpose of the text by Swanson and Sannerud is to facilitate instruction through the actual making of music. Significant musical details are introduced and students expand their understanding of music and its notation through the use of folk song materials. The first chapters identify sequential bits of information about rhythm, melody, harmony, form, dynamics, and style, with song material to accompany each chapter.\textsuperscript{92}

Some representative examples of the third format type include texts by Newman, Austin, Winslow and Dallin, Nye and Bergethon, and Wachhaus and Kuhn. Separate chapters are devoted to the elements. The activities approach is also employed, with most authors intermingling songs within content and including chapters on musical activities following the introduction of the fundamentals.

Chapters one through four of the Newman text include (1) Rhythm (the beat through complex rhythms), (2) Melody (pitch and various scales), (3) Harmony


(texture, rounds, and chords), and (4) Form and Expression. Musical experiences and activities comprise the remaining chapters. This book emphasizes theory in regard to application--putting theory into practice.  

The Austin text approaches the fundamentals of music from several perspectives, namely activity, discussion, music making, and participation. Each chapter is a separate entity; the first four identifying rhythmic concepts, followed by pitch, scales, key signatures, tonal concepts, minor mode, intervals, chords, bass clef, and advanced rhythms. Activity chapters center around reading music and creativity.  

Music Skills for Classroom Teachers (Winslow and Dallin) again combines the study of fundamentals with performance activities. The latter portion helps the user develop skills required of teachers in the primary and intermediate grades for an effective music program. It includes these sections: playing the piano, classroom percussion instruments, and the recorder; accompanying

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with the autoharp and guitar; creating music; singing in harmony; and listening. The beginning portion teaches rhythm, pitch and combining sounds, together with chapters on singing.  

Activity chapters are interjected between those on fundamentals in the Nye and Bergethon text. The format is (1) rhythm, melody, harmony and form; (2) meter and rhythmic notation; (3) intervals, scales, and chords; (4) major scales and chording; (5) creating parts to songs; (6) expressive singing; (7) pentatonic scales; (8) minor scales and chording; (9) variety in piano chording; (10) harmonizing chords; (11) composing songs; (12) form; (13) style periods; and (14) instruments and voices. Songs and musical activities are mingled among the fundamentals.

A recent music fundamentals text (1979) identifies its objective as teaching the student to read music to help enable him to make music. His task is to learn


simultaneously the representation of music and the appropriate performance practices associated with the music. The authors suggest beginning classes with the first two chapters (reading rhythm and pitch) and following this with one of several approaches. The remaining chapters provide instructional materials for these approaches: playing the recorder, the bells, a keyboard instrument, the autoharp, the guitar (accompaniments), and percussion instruments; understanding scales, key signatures, lead sheet notation, intervals, chords, and transposition; singing songs and song leading; and developing listening skills with instruments.\footnote{Gustav Wachhaus and Terry Lee Kuhn, \textit{Fundamental Classroom Music Skills} (New York: Holt, Rinehart and Winston, 1979).}

CAI programs in music theory do exist, as can be seen in the preceding review. The mainstream of materials appears to be written for music theory courses and does include programs for fundamentals, as well as ear-training and sightsinging. Drills, tutorial programs, and games dealing with theoretical concepts have been devised, and many have been tested.

A void does exist in music fundamentals computer programs for non-music majors. Although many programs
are essentially the same for the music major and the non-major, the vacuum exists (1) in the sequential presentation of the concepts, and (2) in the completeness of the total program.
CHAPTER III

DEVELOPMENT OF CAI PROGRAMS FOR TEACHING MUSIC FUNDAMENTALS

Introduction

The elementary education major needs to become familiar with and have an understanding of the rudiments of music to enable him to effectively teach music in the classroom. Inculcating these principles in the non-musician can be most rapidly accomplished through drill and practice. The amount of repetition needed is determined by each student's individual needs.

The objective of the computer programs was to fulfill the needs of these non-music majors. The programs supplement the traditional teacher-taught environment; their purpose is not tutorial. They do not teach but simply drill material already understood. Through individualized practice and immediate feedback, the student will receive reinforcement.

Concepts common to a widespread number of fundamentals texts for elementary teachers are the basis for computerization. Being able to function in any fundamentals course, regardless of its approach, is another aim of the programs. Thus, the developed CAI materials can be utilized to
complement the theoretical portion of an elementary methods class, regardless of its approach or text.

Rhythm, melody, and harmony are the concepts developed. Duration, meter, syncopation, and rhythm syllables comprise the rhythm portion. Melody is divided into three major sections: pitch notation, key signatures, and scales. Intervals, major and minor chords, and primary triads are subconcepts to enhance the understanding of harmony. A final section provides drills for terminology.

Programs are constructed to put the user at ease. No previous experiences with computers is necessary. Programming techniques are incorporated to accommodate common errors (such as misspellings or added spaces made by pressing the space bar) the user might encounter in his first CAI experiences. Basic typing skills are clearly relevant. Users without such skills might experience some degree of frustration; however, with practice in drill mechanics, responses should improve. No time limits are imposed.

Some CAI materials of other authors are constructed sequentially, and the user can not proceed to a higher step until the preceding step is mastered. In the materials developed for this project, the user can advance to any available practices. Also, this set of programs does not give the user more than one try to complete the
problem; others often allow two or three chances. Computa-
tions of scores, on the basis of ten questions per set and ten points per question, provide additional feedback for many of the drills.

Directions, as short and precise as possible, are provided for each drill, together with an example in the format in which it will appear on the CRT. The user must always press the RETURN key after entering an answer. Most exercises are random; by typing 'run' and pressing the RETURN key, additional questions will become available.

Upon entering an answer, the computer judges the response and gives immediate feedback. If correct, the output on the screen reads 'CORRECT.' 'Your answer is not correct. The correct answer is ....' appears for incorrect responses.

Some authors put personality into their computer responses and add a more personal communication between man and machine. Asking the user's name and communicating on this first-name basis provides interaction between the tutor and pupil. "Catchy" responses are also intended to humanize the process. A sample run of this type might read

Hi! I'm XITAN. . . What's your name?  
(student types name, as John)  
Nice to see you, John. I'm here to drill you on major scales.
You will need to know a little about my musical notation.
Use capital letters for the pitch names, the symbol # for sharps, and the small b for flats (Easy enough!)
Ready?
For practice, type F#.
(student types F3)
Whoops! Try again.
(student types F#)
Right on!
(program continues)

A number of responses are available (FABULOUS!!, YUK, You're Terrific!, Bad News) and appear randomly to accompany correct and incorrect responses. Using PLATO, a rhythm program by Placek (University of Georgia) gratifies the student with a picture, provided by a slide. (See figure 1.) The CAI materials developed for this project are "impersonal" as compared to the preceding examples.

Chapter III describes the programs developed in the four major subdivisions: rhythm, melody, harmony, and terminology. Sample runs, program listings, and flowcharts demonstrate their use and effectiveness.

**Rhythm**

Activities for crystallizing concepts of rhythm utilize graphics and random questions. The first program presents measures with an incomplete number of counts per measure. The student must decide which rhythmic value will complete each measure. Various meters are employed. The second drill (random) tests the student's knowledge
Add this note to the incomplete measure by pressing the arrow keys on your keyset.

\[ \frac{5}{4} \] \[ \frac{2}{2} \] \[ \frac{6}{8} \]

You will receive a gratifying sign when the note is correctly placed.

Figure 1. Rhythm program.

\[ \text{Robert W. Placek, "Design and Trial of a Computer-Assisted Lesson in Rhythm," p. 11. (Mimeographed.)} \]
of rhythmic values and their equivalents. Another random drill asks questions involving a number of rhythmic concepts—conducting, meter, accents, note values. Examples of syncopated and non-syncopated rhythmic patterns are presented in graphic form. The user discriminates between the two and answers "YES" if syncopation occurs or "NO" if the example is not syncopated. Rhythm syllables, expressions of durations, are practiced by placing the correct rhythm syllable beneath its corresponding note. Rhythm syllables to be used are given in the instructions of the program.
Sample Run

FILL IN ONE NOTE

This is a program to test your knowledge of rhythm. You will be given several measures of notes. Each measure has one note missing. Fill in the missing note using the following:

W=whole note   H=half note    Q=quarter note
E=eighth note   S=sixteenth note

Use a period for a dot.

Sample answers:  H (half)     Q. (dotted quarter)

Press RETURN to begin and after each answer.

For 3 more measures, press RETURN.
For 3 more measures, press RETURN.
RHYTHM EQUIVALENTS

This is a program to test your knowledge of rhythm. You will be given a score after 10 questions. All questions can be answered with one or two words. Press SHIFT LOCK so all answers will be capital letters. Press RETURN after each answer and to begin.

Sample: 2 quarter notes = what kind of note? HALF
   A quarter + an eighth = what kind of note?
      DOTTED QUARTER

A half + 2 quarters = what kind of note? WHOLE
CORRECT

2 sixteenth notes = what kind of note? EIGHTH
CORRECT

2 dotted quarter notes = what kind of note? DOTTED HALF
CORRECT

3 sixteenth notes = what kind of note? DOTTED QUARTER
CORRECT

A half = 2 eighths = what kind of note? DOTTED HALF
CORRECT

2 sixteenth notes = what kind of note? EIGHTH
CORRECT

A dotted eighth + a sixteenth + an eighth = what kind of note? DOTTED QUARTER
CORRECT
4 quarter notes = what kind of note? WHOLE
CORRECT

2 eighth notes = what kind of note? QUARTER
CORRECT

2 sixteenths + 1 eighth = what kind of note? QUARTER
CORRECT

Your score is 100.

For 10 additional questions, type run. Press RETURN.

READY:
Sample Run

RHYTHM

This is a program to test your knowledge of rhythm. You will be given a score after 10 questions. All questions can be answered with one word unless otherwise indicated. Use capital letters for answers or numbers. Press RETURN after each answer and to begin.

Sample: In 4/4 meter, what note receives 1 beat? QUARTER

Would you conduct a piece in slow 6/8 in 2 or 6? 6 CORRECT

In 3/8 meter, what kind of note receives 2 counts? QUARTER CORRECT

In 2/4 meter, a half note receives how many counts? 2 CORRECT

Would you conduct a piece in slow 6/8 in 2 or 6? 6 CORRECT

In slow 6/8 a dotted quarter receives how many beats? 3 CORRECT

In 3/4 meter, a half note receives how many counts? 3 Your answer is not correct. The answer is 2.

Which beat is accented in 3/4 meter (1, 2, or 3)? 1 CORRECT

A dotted half note receives how many beats in 3/4 meter? 3 CORRECT
A dotted half note receives how many beats in 3/4 meter? 3  
CORRECT
What letter of the alphabet indicates 4/4 meter? C  
CORRECT
In 2/4 meter, a half note receives how many counts? 2  
CORRECT

Your score is 90.

For 10 additional questions, type run. Press RETURN.

READY:
Sample Run

SYNCOPATION

This is a program to test your knowledge of syncopation. You will be given several measures of notes. If the measure is syncopated, type YES beneath the measure after the question mark. Type NO if it is not syncopated.

Press RETURN to begin and after each answer.

3/4 \( \text{c} \) \( \text{e} \) \( \text{g} \) \( \text{c} \) \( \text{e} \) \( \text{g} \) \( \text{c} \) \( \text{e} \) \( \text{g} \) \( \text{c} \) \( \text{e} \) \( \text{g} \) \( \text{c} \) \( \text{e} \) \( \text{g} \) \( \text{c} \)

? NO ? YES ? YES

For 3 more measures, press RETURN.

2/4 \( \text{c} \) \( \text{e} \) \( \text{g} \) \( \text{c} \) \( \text{e} \) \( \text{g} \) \( \text{c} \) \( \text{e} \) \( \text{g} \) \( \text{c} \) \( \text{e} \) \( \text{g} \) \( \text{c} \) \( \text{e} \) \( \text{g} \) \( \text{c} \)

? NO ? NO ? NO

YES

For 3 more measures, press RETURN.
Figure 2. Syncopation Flowchart
Sample Run

RHYTHM SYLLABLES

This is a program to test your knowledge of rhythm syllables. Fill in the syllable of each note under the note and after the question mark. Use the following: quarter note = ta eighth note = ti half note = ta-a whole note = ta-a-a-a 2 sixteenths = tika

Press RETURN after each answer. Press RETURN to begin.

For more practice press RETURN.

For more practice press RETURN.
Melody

Pitch notation, key signatures, and scale programs comprise the melody portion of the CAI materials. Capital letters are used in all programs to indicate pitch names. The symbol '#' and the small 'b' are used for sharps and flats, respectively. An outline of the programs and program listings follows.

I. Pitch notation

A. Pitch names
   1. Treble clef
   2. Bass clef
   3. Grand staff (+ Program Listing)
   4. Keyboard

B. Half and whole steps

C. Enharmonic pitches (+ Program Listing)

II. Key signatures

A. Major
   1. Sharps
      a) How many sharps? (+ Program Listing)
      b) Name the key
      c) Name the sharps in order (+ Program Listing)
   2. Flats
      a) How many flats?
      b) Name the key (+ Program Listing)
      c) Name the flats in order
3. Sharps and flats
   a) How many sharps or flats?
   b) Name the key
   c) Name the sharps or flats in order

B. Minor
   1. Relative
      a) Name the relative minor key
         (+ Program Listing)
      b) Name the relative major key
   2. Sharps and flats
      a) How many sharps or flats?
         1) Easy
         2) Difficult
      b) Name the key
         1) Easy
         2) Difficult
      c) Name the sharps or flats in order
         1) Easy
         2) Difficult

C. Major and minor
   1. How many sharps or flats?
      a) Easy
      b) Difficult
2. Name the sharps or flats in order?
   a) Easy
   b) Difficult

III. Scales

A. Major
   1. Sharps (+ Program Listing)
   2. Flats
   3. Sharps and flats
      a) Easy
      b) Difficult

B. Minor
   1. Natural
      a) Sharps
      b) Flats
      c) Sharps and Flats
         1) Easy
         2) Difficult
   2. Harmonic
   3. Melodic

C. Major and minor
   1. Easy
   2. Difficult
Pitch Notation

Practice in identifying pitches involves both the treble and bass clefs and the keyboard. Stationary graphics are designed to enhance the learning experience. The first three programs, practice with the treble clef, bass clef, and grand staff, are random; the keyboard drill is non-random.
Sample Run

PITCH NAMES - TREBLE CLEF

This is a program to test your knowledge of pitch names. Ten pitches will appear on the screen. Type the pitch names in the spaces below the pitches. Press SHIFT LOCK so all answers will be capital letters. If the answer is incorrect, the correct answer will appear below your answer. Press RETURN after each answer.

Press RETURN to begin.

For 10 more pitches type run. Press RETURN.

READY:

For 10 more pitches type run. Press RETURN.

READY:
PITCH NAMES - BASS CLEF

This is a program to test your knowledge of pitch names. Ten pitches will appear on the screen. Type the pitch names in the spaced below the pitches. Press SHIFT LOCK so all answers will be capital letters. If the answer is incorrect, the correct answer will appear below your answer. Press RETURN after each answer.

Press RETURN to begin.

For 10 more pitches type run. Press RETURN.

READY:

For 10 more pitches type run. Press RETURN.

READY:
Figure 3. Bass Clef Flowchart
Sample Run

PITCH NAMES - GRAND STAFF

This is a program to test your knowledge of pitch names. Ten pitches will appear on the screen. Type the pitch names in the spaces below the pitches. Press SHIFT LOCK so all answers will be capital letters. If the answer is incorrect, the correct answer will appear below your answer. Press RETURN after each answer.

Press RETURN to begin.

For 10 more pitches type run. Press RETURN.

READY:
For 10 more pitches type run. Press RETURN.

READY:
Program Listing

10 PRINTCHR$(12)
15 PRINT:PRINT
20 PRINT"   PITCH NAMES - GRAND STAFF"
25 PRINT:PRINT
30 PRINT"This is a program to test your knowledge of pitch names. Ten pitches will appear on the screen. Type the pitch names in the spaces below the pitches. Press SHIFT LOCK so all answers will be capital letters.
31 PRINT"If the answer is incorrect, the correct answer will appear below your answer. Press RETURN after each answer."
35 PRINT:PRINT
40 PRINT"Press RETURN to begin."
45 WAIT&9E,&80,0
50 DR=&80
55 PRINT CHR$(12)
60 'Draw staff
65 FOR Y=25 to 55 step 3
125 'Draw Clefs
310 FOR I=1 TO 10
315 P=INT(7*RND(1)+1)
320 N(I)=P
325 OC=INT(4*RND(1))
330 CALL DR,0,X,6
335 Y=(OC*7+P)/2
340 IF Y-INT((OC*7+P)/2)=0 THEN Y=(Y-1)*3+20 ELSE Y=INT(Y)*3+18
345 CALL DR,0,X,1
355 'Draw Notehead
360 CALL DR,0,X,3
365 FOR YL=YL+2 TO YTOX+3
370 CALL DR,0,XL,Y
375 CALL DR,1,XL,YL
380 CALL DR,1,XL,YL
385 'Draw a line through middle C
390 IF Y>39 and Y<57 THEN GOTO 510
391 IF Y>21 and Y<39 THEN GOTO 510
392 IF Y=39 THEN GO SUB 900
393 IF Y=57 THEN GO SUB 900
394 IF Y=21 THEN GO SUB 900
395 IF Y=60 THEN GO SUB 950
396 IF Y=59 THEN GO SUB 975
497 IF Y=20 THEN GO SUB 1000
498 IF Y=18 THEN GO SUB 1050
510 NEXT:NEXT
514 'Stems
515 IF Y>29 AND Y<40 THEN GO SUB 620
520 IF Y>47 THEN GO SUB 620
525 IF Y>30 THEN GO SUB 650
530 IF Y<39 THEN GO SUB 650
535 Y3=10
540 FOR X3=X-4 TO X+6
545 CALL DR,1,X3,Y3
550 NEXT
555 X=X+14
560 NEXT
565 Y=12
570 X=17
575 FOR I=1 TO 10
580 CALL DR,0,X,Y
585 INPUT A$
590 'check their answer
595 IF A$<MID$(S$,N(I),1) THEN GO SUB 675
600 X=X+14
605 NEXT I
610 PRINT PRINT"For 10 more pitches type run. Press RETURN."
615 PRINT PRINT PRINT "For 10 more pitches type run. Press RETURN."
619 END
611 'Subroutines
615 'Stems Down
640 'Stems Up
670 'Draw lines under notes for answers
685 'Ledger Lines
1056
This is a program to test your knowledge of keyboard pitch names. You will be given 7 pitches. Identify the pitches in order; place the pitch names after the ?. Use capital letters for pitch names and # for sharps (do not use flats). Sample answers: ? C ?A# (not Bb)

Press RETURN to begin.

For 7 more pitches press RETURN.
Sample Run

HALF AND WHOLE STEPS

This is a program to test your knowledge of half and whole steps. Use capital letters for pitch names and the symbol # for sharps.
Use only plain pitch names or sharps - not flats.
Sample: What pitch is 3 half steps above C? D# (not Eb)
What pitch is 1 whole step below G? F

Your answer is not correct. The answer is F.

What pitch is 3 half steps above A? C
CORRECT

What pitch is 1 whole step below B? A
CORRECT

What pitch is 1 whole step above G? A
CORRECT

What pitch is 1 whole step above D? E
CORRECT

What pitch is 1 whole step below A? G
CORRECT

What pitch is 2 half steps above C? D
CORRECT

What pitch is 2 half steps above F? G
CORRECT

What pitch is 1 half step above F? F#
CORRECT

What pitch is 3 half steps above E? G
CORRECT

Your score is 90.

For 10 more questions type run. Press RETURN.

READY:
Sample Run

ENHARMONIC PITCHES

This is a program to test your knowledge of enharmonic pitches. Use capital letters for pitch names, the small b for flat, and the symbol # for sharp.
Sample: What pitch is enharmonic to E#?
F

What pitch is enharmonic to A#?
? Bb
CORRECT

What pitch is enharmonic to F#?
? Gb
CORRECT

What pitch is enharmonic to Eb?
? D#
CORRECT

What pitch is enharmonic to E#?
? F
CORRECT

What pitch is enharmonic to G#?
? Ab
CORRECT

What pitch is enharmonic to Eb?
? D#
CORRECT
What pitch is enharmonic to G#?
? Ab
CORRECT
What pitch is enharmonic to B#?
? Ab
Your answer is not correct. The answer is C.
What pitch is enharmonic to Gb?
? F#
CORRECT
What pitch is enharmonic to A#?
? Bb
CORRECT
Your score is 90.
For 10 more questions type run. Press RETURN.
READY:
Program Listing

10 PRINTCHR$(12)
20 PRINT:PRINT
30 PRINT"ENHARMONIC PITCHES"
40 PRINT:PRINT
50 PRINT"This is a program to test your knowledge of enharmonic pitches. Use capital letters for pitch names, the small b for flat, and the symbol # for sharp."
60 PRINT"Sample: What pitch is enharmonic to E#? F"
70 PRINT
80 B$="B#C#D#F#G#A#C DbEbF GbAbBb"
90 C$="C DbEbF GbAbBbB#C#D#E#F#G#A#"
100 FOR I=1 TO 10
110 R=INT(14*RND(1)+1)*2-1
120 Q$=MID$(B$,R,2)
130 A$=MID$(C$,R,2)
140 IF MID$(Q$,2)=" " THEN Q$=MID$(Q$,1,1)
150 IF MID$(A$,2)=" " THEN A$=MID$(A$,1,1)
160 PRINT"What pitch is enharmonic to ";A$; ";?"
170 PRINT
180 INPUT I$
190 PRINT
200 IF I$=A$ THEN PRINT"CORRECT" ELSE PRINT "Your answer is not correct. The answer is ";A$; ";."
210 PRINT
220 IF I$=A$ THEN S=S+1
230 NEXT I
240 PRINT"Your score is ";S*10; ";."
250 PRINT
260 PRINT"For 10 more questions type run. Press RETURN."

READY:
Key Signatures

Three divisions exist for practice in naming key signatures. Separate programs are provided to give the student practice with major, minor, and major and minor mixed key signatures. Subdivisions are also furnished for sharps and flats, as well as easy and difficult versions for several programs. Easy versions test key signatures with zero to four sharps or flats; difficult versions test key signatures encompassing all sharps or flats.
Sample Run

MAJOR KEY SIGNATURES - SHARPS

This is a program to test your knowledge of Major Key Signatures which use only sharps. You will be given a score after 10 questions. Press RETURN after each answer and to begin.

Example: How many sharps are there in the key of D? 2

How many sharps are there in the key of E Major?
? 4
CORRECT

How many sharps are there in the key of B Major?
? 5
CORRECT

How many sharps are there in the key of D Major?
? 2
CORRECT

How many sharps are there in the key of B Major?
? 5
CORRECT

How many sharps are there in the key of E Major?
? 5
Your answer is not correct. The answer is 4.

How many sharps are there in the key of B Major?
? 5
CORRECT

How many sharps are there in the key of A Major?
? 3
CORRECT
How many sharps are there in the key of A Major?
? 3
CORRECT

How many sharps are there in the key of C# Major?
? 7
CORRECT

How many sharps are there in the key of G Major?
? 1
CORRECT

Your score is 90.
For 10 more questions type run. Press RETURN.
READY:
Program Listing

10 PRINT CHR$(12)
20 PRINT:PRINT
30 PRINT" MAJOR KEY SIGNATURES - SHARPS"
40 PRINT:PRINT
50 PRINT"This is a program to test your knowledge of Major Key Signatures which use only sharps."
60 PRINT"You will be given a score after 10 questions. Press RETURN after each answer
70 PRINT"Example: How many sharps are there in the key of D#? 2"
80 PRINT
90 FOR I=1 TO 10
100 R=INT(7*RND(1)+1)*2-1
110 B$="G D A E B F#C#"
120 B1=INT(R/2+1)
130 A$=MID$(B$,R,2)
140 PRINT"How many sharps are there in the key of ";A$;" Major?"
150 PRINT
160 INPUT A
170 IF A=B1 THEN PRINT "CORRECT"
180 PRINT
190 IF A=B1 THEN S=S+1
200 IF A≠B1 THEN PRINT "Your answer is not correct. The answer is ";B1;"."
210 PRINT
220 NEXT I
230 PRINT "Your score is ";S*10;"."
240 PRINT
250 PRINT "Type run for 10 additional questions. Press RETURN."
This is a program to test your knowledge of Major Key Signatures which use only sharps. Use the symbol # for the sharp and a capital letter for the key.
Example: F# D G
You will be given a score after 10 questions. Press RETURN after each answer and to begin.

What major key has 4 sharp(s)?

? E
CORRECT

What major key has 7 sharp(s)?

? C#
CORRECT

What major key has 6 sharp(s)?

? F#
CORRECT

What major key has 6 sharp(s)?

? F#
CORRECT

What major key has 3 sharp(s)?

? A
CORRECT

What major key has 2 sharp(s)?

? D
CORRECT

What major key has 5 sharp(s)?

? B
CORRECT
What major key has 3 sharp(s)?

? A
CORRECT

What major key has 1 sharp(s)?

? G
CORRECT

What major key has 6 sharp(s)?

? F#
CORRECT

What major key has 2 sharp(s)?

? D
CORRECT

Your score is 100.

For 10 additional questions type run. Press RETURN.

READY:
Sample Run

MAJOR KEY SIGNATURES - SHARPS

This is a program to test your knowledge of Major Key Signatures which use only sharps. Use the symbol # for sharp and capital letters for pitch names. Sample: Name the sharps in order for D Major. F#C# Press RETURN after each answer and to begin.

Name the sharps in order for D Major.
? F#C#
CORRECT

Name the sharps in order for G Major.
? F#
CORRECT

Name the sharps in order for C# Major.
? F#C#G#D#A#E#B#
CORRECT

Name the sharps in order for B Major.
? F#C#G#D#A#
CORRECT

Name the sharps in order for E Major.
? F#C#G#D#
CORRECT

Name the sharps in order for F# Major.
? F#C#G#D#A#E#
CORRECT
Name the sharps in order for D Major.
? F#
Your answer is not correct. The answer is F#C#.
Name the sharps in order for A Major.
? F#C#G#
CORRECT
Name the sharps in order for G Major.
? F#
CORRECT
Your score is 90.
For 10 more questions type run. Press RETURN.
READY:
Program Listing

10 PRINT CHR$(12)
20 PRINT
30 PRINT"... MAJOR KEY SIGNATURES - SHARPS"
40 PRINT:PRINT
50 PRINT"This is a program to test your knowledge of Major Key Signatures which use only sharps. Use the symbol # for sharp and capital letters for pitches."
60 PRINT"Sample: Name the sharps in order for D Major. F#C#"
70 PRINT"Press RETURN after each answer and to begin."
80 PRINT:PRINT
90 C$="F#C#G#D#A#E#B#"
100 B$="G D A E B F#C#"
110 FOR I=1TO10
120 R=INT(7*RND(1)+1)*2-1
130 Q$=MID$(B$,R,2)
140 PRINT"Name the sharps in order for ";Q$; "Major."
150 PRINT
160 INPUT A$
170 PRINT
180 IF MID$(C$,1,R+1)=A$ THEN PRINT "CORRECT". ELSE PRINT "Your answer is not correct. The answer is ";MID$(C$,1,R+1) ;"."
190 PRINT
200 IF MID$(C$,1,R+1)=A$ THEN S=S+1
210 NEXT I
220 PRINT"Your score is ";S*10; "."  
230 PRINT
240 PRINT"For 10 more questions type run. Press RETURN."  

READY:
Sample Run

MAJOR KEY SIGNATURES - FLATS

This is a program to test your knowledge of Major Key Signatures which use only flats.
You will be given a score after 10 questions. Press RETURN after each answer and to begin.
Example: How many flats are there in the key of Bb Major? 2

How many flats are there in the key of Ab Major?
? 4
CORRECT

How many flats are there in the key of Db Major?
? 5
CORRECT

How many flats are there in the key of Eb Major?
? 2
Your answer is not correct. The answer is 3.

How many flats are there in the key of Db Major?
? 5
CORRECT

How many flats are there in the key of Bb Major?
? 2
CORRECT

How many flats are there in the key of Db Major?
? 5
CORRECT

How many flats are there in the key of F Major?
? 1
CORRECT
How many flats are there in the key of Eb Major?
? 3  
CORRECT

How many flats are there in the key of Cb Major?
? 7  
CORRECT

How many flats are there in the key of Gb Major?
? 6  
CORRECT

Your score is 90.

For 10 more questions type run. Press RETURN.

READY:
Sample Run

MAJOR KEY SIGNATURES - FLATS

This is a program to test your knowledge of Major Key Signatures which use only flats. Use the small b for the flat and a capital letter for the key. Example: Ab
You will be given a score after 10 questions. Press RETURN after each answer and to begin.

What major key has 1 flat(s)?

? F
CORRECT

What major key has 3 flat(s)?

? Ab
Your answer is not correct. The answer is Eb.

What major key has 3 flat(s)?

? Eb
CORRECT

What major key has 4 flat(s)?

? Ab
CORRECT

What major key has 1 flat(s)?

? F
CORRECT

What major key has 2 flat(s)?

? Bb
CORRECT

What major key has 7 flat(s)?

? Cb
CORRECT
What major key has 1 flat(s)?

? F
CORRECT

What major key has 5 flat(s)?

? Db
CORRECT

What major key has 7 flat(s)?

? Cb
CORRECT

Your score is 90.

For 10 more questions type run. Press RETURN.

READY:
Program Listing

10 PRINT CHR$(12)
20 PRINT:PRINT
30 PRINT" MAJOR KEY SIGNATURES - FLATS".
40 PRINT:PRINT
50 PRINT"This is a program to test your knowledge of Major
Key Signatures which use only flats. Use the small b for
the flat and a capital letter for the key. Example: Ab"
60 PRINT"You will be given a score after 10 questions. Press
RETURN after each answer to begin."
70 PRINT
80 FOR I=1 TO 10
90 R=INT(7*RND(1)+1)*2-1
100 B$="F BbEbAbDbGbCb"
110 Bl=INT(R/2+1)
120 A$=MID$(B$,R,2)
130 IF MID$(A$,2)=" " THEN A$=MID$(A$,1,1)
140 PRINT"What major key has ";Bl;" flat(s)?"
150 PRINT
160 INPUT C$
170 IF A$=C# THEN PRINT "CORRECT"
180 PRINT
190 IF A$=C$ THEN S=S+1
200 IF S$<C$ THEN PRINT "Your answer is not correct. The
answer is ";A$"."
210 PRINT
220 NEXT I
230 PRINT"Your score is ";S*10;"."
240 PRINT
250 PRINT "For 10 more questions type run. Press RETURN."
Sample Run

MAJOR KEY SIGNATURES - FLATS

This is a program to test your knowledge of Major Key Signatures which use only flats. Use the small b for flat and capital letters for pitch names. Sample: Name the flats in order for Ab Major. BbEbAbDb Press RETURN after each answer and to begin.

Name the flats in order for Cb Major.
? BbEbAbDbGbCbFb
CORRECT

Name the flats in order for Bb Major.
? BbEb
CORRECT

Name the flats in order for Gb Major.
? BbEbAbDbGbCb
CORRECT

Name the flats in order for Db Major.
? BbEbAbDbGb
CORRECT

Name the flats in order for F Major.
? Bb
CORRECT

Name the flats in order for Db Major.
? BbEbAbDbGb
CORRECT
Name the flats in order for Bb Major.
?  BbEbAb
Your answer is not correct. The answer is BbEb.
Name the flats in order for Ab Major.
?  BbEbAbDb
CORRECT
Name the flats in order for Eb Major.
?  Bb
Your answer is not correct. The answer is BbEbAb.
Name the flats in order for Cb Major.
?  BbEbAbDbGbCbFb
CORRECT
Your score is 80.
For 10 more questions type run. Press RETURN.
READY:
Sample Run

MAJOR KEY SIGNATURES

This is a program to test your knowledge of Major Key Signatures. Use the symbol # for sharp and a small b for flat. Use 00 (double zero) for no sharps or flats. Type RETURN after each question and to begin.
Sample answers:  2#  00  lb

What is the key signature for Gb Major?
? 6b
CORRECT

What is the key signature for F Major?
? 1b
CORRECT

What is the key signature for A Major?
? 3#
CORRECT

What is the key signature of Ab Major?
? 4b
CORRECT

What is the key signature for Cb Major?
? 7b
CORRECT

What is the key signature for Bb Major?
? 2b
CORRECT
What is the key signature for D Major?
? 2#
CORRECT

What is the key signature for Eb Major?
? 3b
CORRECT

What is the key signature for E Major?
? 3#
Your answer is not correct. The answer is 4#.

What is the key signature for G Major?
? 1 #
CORRECT

Your score is   90.

For 10 more questions type run. Press RETURN.

READY:
Sample Run

MAJOR KEY SIGNATURES

This is a program to test your knowledge of Major Key Signatures. Use the symbol # for sharp and small b for flat. Use capital letters for key names. 00 represents no flats or sharps. Press RETURN to begin and after each answer.

What Major key has the key signature of 3b?
? Eb
CORRECT

What Major key has the key signature of 2b?
? Bb
CORRECT

What Major key has the key signature of 2b?
? Bb
CORRECT

What Major key has the key signature of 6#?
? B
Your answer is not correct. The answer is F#.

What Major key has the key signature of 6#?
? F#
CORRECT

What Major key has the key signature of 7b?
? Cb
CORRECT
What Major key has the key signature of 7b?
? Cb
CORRECT

What Major key has the key signature of 1#?
? G
CORRECT

What Major key has the key signature of 1b?
? F
CORRECT

What Major key has the key signature of 3#?
? A
CORRECT

Your score is 90.

For 10 more questions type run. Press RETURN.

READY:
Sample Run

MAJOR KEY SIGNATURES

This is a program to test your knowledge of Major Key Signatures. Use capital letters for pitch names, the symbol # for sharp, and the small b for flat. Sample: Name the sharps or flats in order for E Major.

F#C#G#D#

Press RETURN after each answer and to begin.

Name the sharps or flats in order for Ab Major.

? BbEbAbDb

CORRECT

Name the sharps or flats in order for G Major.

? F#

CORRECT

Name the sharps or flats in order for Ab Major.

? BbEbAbDb

CORRECT

Name the sharps or flats in order for A Major.

? F#C#G#

CORRECT

Name the sharps or flats in order for D Major.

? F#C#

CORRECT

Name the sharps or flats in order for B Major.

? F#C#G#D#A#

CORRECT
Name the sharps or flats in order for Cb Major.
? BbEbAbDbGbCbFb
CORRECT

Name the sharps or flats in order for G Major.
? F#
CORRECT

Name the sharps or flats in order for Eb Major.
? BbEbAb
CORRECT

Name the sharps or flats in order for G Major.
? F#
CORRECT

Your score is 100.

For 10 more questions type run. Press RETURN.

READY:
RELATIVE MAJOR AND MINOR KEYS

This is a program to test your knowledge of major and minor relative keys. Use the symbol # for sharp and small b for flat. Use capital letters for all keys.
Sample answers: Gb  F#  C
Press RETURN after each answer and to begin.

What minor key is relative to C Major?
? Eb
Your answer is not correct. The answer is A.

What minor key is relative to Gb Major?
? eb
Your answer is not correct. The answer is Eb.

What minor key is relative to C# Major?
? A#
CORRECT

What minor key is relative to D Major?
? B
CORRECT

What minor key is relative to D Major?
? B
CORRECT

What minor key is relative to F Major?
? D
CORRECT
What minor key is relative to G Major?
? E
CORRECT
What minor key is relative to D Major?
? B
CORRECT
What minor key is relative to Db Major?
? Bb
CORRECT
Your score is 80.
For 10 more questions type run. Press RETURN.
READY:
Program Listing

10 PRINTCHR$(12)
20 PRINT:PRINT
30 PRINT"            RELATIVE MAJOR AND MINOR KEYS"
40 PRINT
50 PRINT"This is a program to test your knowledge of major and minor relative keys. Use the symbol # for sharp and small b for flat. Use capital letters for all keys."
60 PRINT"Sample answers: Gb  F#   C"
70 PRINT"Press RETURN after each answer and to begin."
80 PRINT:PRINT
90 B$="C F BbEbAbDbGbCbG D A E B F#C#"
100 C$="A D GbC F BbEbAbE B F#C#G#D#A#"
110 FORI=1TO10
120 R=INT(15*RND(1)+1)*2-1
130 Q$=MID$(B$,R,2)
140 A$=MID$(C$,R,2)
150 IF MID$(A$,2)=" " then A$=MID$(A$,1,1)
160 PRINT"What minor key is relative to ";Q$;" Major?"
170 PRINT
180 INPUTI$
190 PRINT
200 IF I$=A$ THEN PRINT "CORRECT" ELSE PRINT "Your answer is not correct. The answer is ";A$;"."
210 PRINT
220 IF I$=A$ THEN S=S+1
230 NEXT I
240 PRINT"Your score is ";S*10;"."
250 PRINT
260 PRINT"For 10 more questions type run. Press RETURN."
Sample Run

RELATIVE MAJOR AND MINOR KEYS

This is a program to test your knowledge of relative major and minor keys. Use the symbol # for sharp and small b for flat. Use capital letters for major keys. Sample answers: Bb G F#
Press RETURN after each answer and to begin.

What Major key is relative to C minor?
? Eb
CORRECT

What Major key is relative to D# minor?
? F#
CORRECT

What Major key is relative to B minor?
? D
CORRECT

What Major key is relative to C# minor?
? E
CORRECT

What Major key is relative to A# minor?
? C#
CORRECT

What Major key is relative to C minor?
? Eb
CORRECT
What Major key is relative to D minor?
? F
CORRECT

What Major key is relative to E minor?
? G
CORRECT

What Major key is relative to Bb minor?
? Db
CORRECT

What Major key is relative to A# minor?
? C#
CORRECT

Your score is 100.

For 10 more questions type run. Press RETURN.

READY:
Sample Run

MINOR KEY SIGNATURES

This is a program to test your knowledge of minor key signatures. Use the symbol # for sharp and 00 indicates no sharps or flats.
Sample answers:  1b  00  4#
Press RETURN to begin and after each answer.

What is the key signature of F# minor?
? 3#
CORRECT

What is the key signature of B minor?
? 2#
CORRECT

What is the key signature of C minor?
? 3b
CORRECT

What is the key signature of F minor?
? 4b
CORRECT

What is the key signature of A minor?
? 00
CORRECT

What is the key signature of D minor?
? 1b
CORRECT
What is the key signature of D minor?
? 1b
CORRECT
What is the key signature of G minor?
? 2b
CORRECT
What is the key signature of D minor?
? 1b
CORRECT
What is the key signature of F minor?
? 4b
CORRECT
Your score is 100.
For 10 more questions type run. Press RETURN.
READY:
Sample Run

MINOR KEY SIGNATURES

This is a program to test your knowledge of minor key signatures. Use the symbol # for and small b for flat. 00 indicates no sharps or flats. Sample answers: lb 00 4#
Press RETURN to begin and after each answer.

What is the key signature of Eb minor?
? 6b
CORRECT

What is the key signature of G minor?
? 2b
CORRECT

What is the key signature of B minor?
? 2#
CORRECT

What is the key signature of D minor?
? lb
CORRECT

What is the key signature of A# minor?
? 7#
CORRECT

What is the key signature of G# minor?
? 5#
CORRECT
What is the key signature of G minor?
? 2b
CORRECT
What is the key signature of Bb minor?
? 5b
CORRECT
What is the key signature of D# minor
? 6#
CORRECT
What is the key signature of C# minor?
? 4#
CORRECT
Your score is 100.
For 10 more questions type run. Press RETURN.
READY:
Sample Run

MINOR KEY SIGNATURES

This is a program to test your knowledge of minor key signatures. Use the symbol # for sharp and small b for flat. 00 indicates no sharps or flats.
Sample answers: A F F#
Press RETURN after each answer and to begin.

What minor key has the key signature of 4#?
? C#
CORRECT

What minor key has the key signature of 1#?
? E
CORRECT

What minor key has the key signature of 2b?
? G
CORRECT

What minor key has the key signature of 1#?
? E
Your answer is not correct. The answer is E.

What minor key has the key signature of 3b?
? C
CORRECT

What minor key has the key signature of 4#?
? C#
CORRECT
What minor key has the key signature of 1#?
? E
CORRECT
What minor key has the key signature of 3b?
? A
Your answer is not correct. The answer is C.
What minor key has the key signature of 1b?
? D
CORRECT
What minor key has the key signature of 2#?
? B
CORRECT
Your score is 80.
For 10 more questions type run. Press RETURN.
READY:
Sample Run

MINOR KEY SIGNATURES

This is a program to test your knowledge of minor key signatures. Use the symbol # for sharp and small b for flat. Use capital letters for key names. 00 indicates no sharps or flats.
Sample answers: A Cb F#
Press RETURN after each answer and to begin.

What minor key has the key signature of 1#?

? E
CPRRECT
What minor key has the key signature of 3#?

? F#
CORRECT
What minor key has the key signature of 7#?

? A#
CORRECT
What minor key has the key signature of 4#?

? C#
CORRECT
What minor key has the key signature of 3#?

? F#
CORRECT
What minor key has the key signature of 3b?

? C
CORRECT
What minor key has the key signature of 6#?
? D#
CORRECT
What minor key has the key signature of 7#?
? A#
CORRECT
What minor key has the key signature of 3b?
? C
CORRECT
What minor key has the key signature of 1#?
? E
CORRECT
Your score is 100.
For 10 more questions type run. Press RETURN.
READY:
Sample Run

MINOR KEY SIGNATURES

This is a program to test your knowledge of minor key signatures. Use capital letters for pitches, the symbol # for sharp, and small b for flat.

Sample: Name the sharps or flats in order for c minor.
BbEbAb

Press RETURN after each answer and to begin.

Name the sharps or flats in order for F# minor.
? F#C#G#
CORRECT

Name the sharps or flats in order for G minor.
? BbEb
CORRECT

Name the sharps or flats in order for C minor.
? BbEbAb
CORRECT

Name the sharps or flats in order for E minor.
? F#
CORRECT

Name the sharps or flats in order for G minor.
? BbEb
CORRECT

Name the sharps or flats in order for E minor.
? F#
CORRECT
Name the sharps or flats in order for C minor.
? BbEbAb
CORRECT

Name the sharps or flats in order for E minor.
? F#
CORRECT

Name the sharps or flats in order for F minor.
? BbEbAbDb
CORRECT

Name the sharps or flats in order for G minor.
? BbEbAb

Your answer is not correct. The answer is BbEb.
Your score is 90.

For 10 more questions type run. Press RETURN.

READY:
MINOR KEY SIGNATURES

This is a program to test your knowledge of minor key signatures. Use capital letters for pitches, the symbol # for sharps, and the small b for flats.

Sample: Name the sharps or flats in order for C minor.

BbEbAb

Press RETURN after each answer and to begin.

Name the sharps or flats in order for G# minor.

? F#C#G#D#A#

CORRECT

Name the sharps or flats in order for C minor.

? BbEbAb

CORRECT

Name the sharps or flats in order for D minor.

? Bb

CORRECT

Name the sharps or flats in order for C# minor.

? F#C#G#D#

CORRECT

Name the sharps or flats in order for E minor.

? F#

CORRECT

Name the sharps or flats in order for D# minor.

? F#C#G#D#A#E#

CORRECT
Name the sharps or flats in order for G# minor.
? F# C# G# D# A#
CORRECT
Name the sharps or flats in order for A# minor.
? F# C# G# D# A# E# B#
CORRECT
Name the sharps or flats in order for G minor.
? Bb Eb
CORRECT
Name the sharps or flats in order for G minor.
? Bb Eb
CORRECT
Your score is 100.
For 10 more questions type run. Press RETURN.
READY:
Sample Run

MAJOR AND MINOR KEY SIGNATURES

This is a program to test your knowledge of major and minor key signatures. Use the symbol # for sharp and small for flat. 00 represents no sharps or flats.

Sample: What is the key signature of E minor? 1#
         What is the key signature of E Major? 4#
Press RETURN after each answer and to begin.

What is the key signature of C# minor?
? 4#
CORRECT

What is the key signature of G minor?
? 2b
CORRECT

What is the key signature of F Major?
? 1b
CORRECT

What is the key signature of C minor?
? 00
Your answer is not correct. The answer is 3b.

What is the key signature of D Major?
? 2#
CORRECT

What is the key signature of E minor?
? 1#
CORRECT
What is the key signature of Ab Major?
? 4b
CORRECT
What is the key signature of Eb Major?
? 3b
CORRECT
What is the key signature of Bb Major?
? 2b
CORRECT
What is the key signature of G minor?
? 2b
CORRECT
Your score is 90.
For 10 more questions type run. Press RETURN.
READY:
Sample Run

MAJOR AND MINOR KEY SIGNATURES

This is a program to test your knowledge of major and minor key signatures. Use the symbol # for sharp and the small b for flat. 00 represents no sharps or flats.
Sample: What is the key signature of E minor? 1#
What is the key signature of E Major? 4#
Press RETURN after each answer and to begin.

What is the key signature of C# minor?
? 4#
CORRECT

What is the key signature of D minor?
? 1b
CORRECT

What is the key signature of B Major?
? 5#
CORRECT

What is the key signature of Db Major?
? 5b
CORRECT

What is the key signature of D Major?
? 2#
CORRECT

What is the key signature of Ab minor?
? 7b
CORRECT
What is the key signature of A# minor?
? 7#
CORRECT

What is the key signature of A Major?
? 3#
CORRECT

What is the key signature of E minor?
? 1#
CORRECT

What is the key signature of F minor?
? 4b
CORRECT

Your score is 100.

For 10 more questions type run. Press RETURN.

READY:
Sample Run

MAJOR AND MINOR KEY SIGNATURES

This is a program to test your knowledge of major and minor key signatures. Use the symbol # for sharp and small b for flat. Use capital letters for pitch names.

Sample: Name the sharps or flats in order for D Major.
F#C#
Name the sharps or flats in order for C minor.
BbEbAb
Press Return after each answer and to begin.

Name the sharps or flats in order for G minor.
? BbEb
CORRECT

Name the sharps or flats in order for C# minor.
? F#C#G#D#
CORRECT

Name the sharps or flats in order for F# minor.
? F#C#G#
CORRECT

Name the sharps or flats in order for F minor.
? BbEbAbDb
CORRECT

Name the sharps or flats in order for A Major.
? F#C#G#
CORRECT
Name the sharps or flats in order for Eb Major.
? BbEbAb
CORRECT

Name the sharps or flats in order for A Major.
? F#C#G#
CORRECT

Name the sharps or flats in order for E Major.
? F#C#G#D#
CORRECT

Name the sharps or flats in order for G minor.
? BbEb
CORRECT

Name the sharps or flats in order for Ab Major.
? BbEbAbDb
CORRECT

Your score is 100.

For 10 more questions type run. Press RETURN.

READY:
Sample Run

MAJOR AND MINOR KEY SIGNATURES

This is a program to test your knowledge of major and minor key signatures. Use the symbol # for sharp and small b for flat. Use capital letters for pitches.
Sample: Name the sharps or flats in order for D Major.
F#C#
Press RETURN after each answer and to begin.

Name the sharps or flats in order for E minor.
? F#
CORRECT

Name the sharps or flats in order for A# minor.
? F#C#G#D#A#E#B#
CORRECT

Name the sharps or flats in order for G Major.
? F#
CORRECT

Name the sharps or flats in order for E Major.
? F#C#G#D#
CORRECT

Name the sharps or flats in order for G Major.
? F#
CORRECT

Name the sharps or flats in order for A#.
? F#C#G#D#A#E#B#
CORRECT
Name the sharps or flats in order for G# minor.
? F#C#G#D#A#
CORRECT

Name the sharps or flats in order for G minor.
? BbEb
CORRECT

Name the sharps or flats in order for E Major.
? F#C#G#D#
CORRECT

Name the sharps or flats in order for A# minor.
? F#C#G#D#A#E#B#
CORRECT

Your score is 100.

For 10 more questions type run. Press RETURN.

READY:
Scales

Scale programs are divided into the same three divisions as the key signature programs—major, minor, and major and minor combined. Easy and difficult versions are also furnished, as well as separate drills for scales made up of sharps or flats.
Sample Run

MAJOR SCALES - SHARPS

This is a program to test your knowledge of Major Scales which use only sharps. Use capital letters for pitches and the symbol # for sharp.
Sample: Type the G Major scale. GABCDEFG#
Press RETURN after each answer and to begin.

Type the A Major scale.
? ABC#DEF#G#A
CORRECT

Type the E Major scale.
? EF#G#ABC#D#E
CORRECT

Type the B Major scale.
? BC#D#EF#G#A#B
CORRECT

Type the B Major scale.
? BC#D#EF#G#A#B
CORRECT

Type the E Major scale.
? EF#G#ABC#D#E
CORRECT

Type the B Major scale.
? BC#D#EF#G#A#B
CORRECT
Type the C# Major scale.
? C#D#E#F#G#A#B#C#
CORRECT

Type the E Major scale.
? EF#G#ABC#D#E
CORRECT

Type the A Major scale.
? ABC#DEF#G#A
CORRECT

Type the D Major scale.
? DEF#GABC#D
CORRECT

Your score is 100.

For 10 more questions type run. Press RETURN.

READY:
Program Listing

10 PRINTCHR$(12)
20 PRINT:PRINT
30 PRINT" MAJOR SCALES - SHARPS"
40 PRINT:PRINT
50 PRINT"This is a program to test your knowledge of Major Scales which use only sharps. Use capital letters for pitches and the symbol # for sharp."
60 PRINT"Type the G Major scale. GABCDEF#G"
70 PRINT"Press RETURN after each answer and to begin."
80 PRINT:PRINT
90 S$(1)="GABCDEF#G"
100 S$(2)="DEF#GABC#D"
110 S$(3)="ABC#DEF#G#A"
120 S$(4)="EF#G#ABC#D#E"
130 S$(5)="BC#D#EF#G#A#B"
140 S$(6)="F#G#A#BC#D#E#F#"
150 S$(7)="C#D#E#F#G#A#B#C#"
160 FOR I=1 TO 10
170 RI=INT(7*RND(1)+1)
180 R=INT(7*RND(1)+1)*2-1
190 IF MID$(S$(RI),2,1)="#" THEN NS=MID$(S$(RI),1,2)
ELSE NS=MID$(S$(RI),1,1)
200 PRINT"Type the "; NS; " Major scale."
210 PRINT
220 INPUT A$
230 X=INSTR(A$," ")
240 IF X>0 THEN A$=LEFT$(A$,X-1)+MID$(A$,X+1)
250 IF X=0 THEN GO TO 230
260 PRINT
270 IF A$=S$(RI) THEN PRINT"CORRECT" ELSE PRINT "Your answer is not correct. The answer is "; S$(RI); "."
280 PRINT
290 IF A$=S$(RI) THEN S=S+1
300 NEXT I
310 PRINT "Your score is "; S*10; "."
320 PRINT
330 PRINT"For 10 more questions type run. Press RETURN."

READY:
Sample Run

MAJOR SCALES - FLATS

This is a program to test your knowledge of Major Scales which use only flats. Use capital letters for pitches and the small b for flat.
Sample: Type the F Major scale. FGABbCDEF
Press RETURN after each answer and to begin.

Type the Bb Major scale.
? BbCDEbFGAbb
CORRECT

Type the Eb Major Scale.
? EbFGAbBbCDEb
CORRECT

Type the Cb Major scale.
? CbDbEbFbGbAbBbCb
CORRECT

Type the Db Major scale.
? DbEbFGbAbBbCDb
CORRECT

Type the Ab Major scale.
? AbBbCDbEbFGAb
CORRECT

Type the Db Major scale.
? DbEbFGbAbBbCDb
CORRECT
Type the Ab Major scale.
? AbBbCDBbEbFGAb
CORRECT

Type the F Major scale.
? FGABbCDEF
CORRECT

Type the Bb Major scale.
? BbCDEbFGABb
CORRECT

Type the Bb Major scale.
? BbCDEbFGABb
CORRECT

Your score is 100.

For 10 more questions type run. Press RETURN.

READY:
Sample Run

MAJOR SCALES

This is a program to test your knowledge of Major Scales. Use the symbol # for sharp, the small b for flat, and capital letters for pitches.
Sample: Type the F Major scale. FGAbCDEF
Type the E Major scale. EF#G#ABC#D#E
Press RETURN after each answer and to begin.

Type the Bb Major scale.
? BbCDEbFGAb
CORRECT

Type the Ab Major Scale.
? AbBbCDbEbFGAb
CORRECT

Type the Bb Major Scale.
? BbCDEbFGAb
CORRECT

Type the G Major scale.
? GABCDEF#G
CORRECT

Type the D Major scale.
? DEF#GABC#D
CORRECT

Type the G Major scale.
? GABCDEF#G
CORRECT
Type the D Major scale.
? DEF#GABC#D
CORRECT

Type the A Major scale.
? ABC#DEF#G#A
CORRECT

Type the Eb Major scale.
? EbFGAbBbCDEbF
Your answer is not correct. The answer is EbFGAbBbCDEb.

Type the E Major scale.
? EF#G#ABC#D#E
CORRECT

Your score is 90.

For 10 more questions type run. Press RETURN.

READY:
Sample Run

MAJOR SCALES

This is a program to test your knowledge of Major Scales. Use the symbol # for sharp, the small b for flat, and capital letters for pitches.
Sample: Type the F Major scale. FGABbCDEF
Type the E Major scale. EF#G#ABC#D#E
Press RETURN after each answer and to begin.

Type the Eb Major scale.
? EbFGAbBbCDEb
CORRECT

Type the Db Major scale.
? DbEbFGbAbBbCDb
CORRECT

Type the D Major scale.
? DEF#GABC#D
CORRECT

Type the Gb Major scale.
? GbAbBbCbDbEbFGb
CORRECT

Type the E Major scale.
? EF#G#ABC#D#E
CORRECT

Type the F# Major scale.
? F#G#A#BC#D#E#F#
CORRECT
Type the Ab Major scale.
? AbBbCDBdEbdFGAb
CORRECT
Type the G Major scale.
? GABCDEF#G
CORRECT
Type the Bb Major scale.
? BbCDEbFGABB
CORRECT
Type the C Major scale.
? CDEFGABC
CORRECT
Your score is 100.
For 10 more questions type run. Press RETURN.
READY:
Sample Run

NATURAL MINOR SCALES - SHARPS

This is a program to test your knowledge of minor scales. Use the symbol # for sharp and capital letters for pitch names. Sample: Type the B minor scale. BC#DEF#GAB Press RETURN after each answer and to begin.

Type the F# minor scale.

? F#G#ABC#DEF#
CORRECT

Type the C# minor scale.

? C#D#EF#G#ABC#
CORRECT

Type the A# minor scale.

? A#B#C#D#E#F#G#A#
CORRECT

Type the E minor scale.

? EF#GABCDE
CORRECT

Type the C# minor scale.

? C#D#EF#G#ABC#
CORRECT

Type the G# minor scale.

? G#A#BC#D#EF#G#
CORRECT
Type the F# minor scale.
? F#G#ABC#DEF#
CORRECT

Type the B minor scale.
? BC#DEF#GAB
CORRECT

Type the D# minor scale.
? D#E#F#G#A#BC#D#
CORRECT

Type the E minor scale.
? EF#GABCDE
CORRECT

Your score is 100.

For 10 more questions type run. Press RETURN.

READY:
Sample Run

NATURAL MINOR SCALES - FLATS

This is a program to test your knowledge of minor scales. Use the small b for flat and capital letters for pitches. Sample: Type the G minor scale. GAbbCdEbFg
Press RETURN after each answer and to begin.

Type the Ab minor scale.
? AbBbCbDbEbFbGbAb
CORRECT

Type the Eb minor scale.
? EbFgbAbBbCbDbEb
CORRECT

Type the F minor scale.
? FGAbBbCdEbF
CORRECT

Type the F minor scale.
? FGAbBbCdEbF
CORRECT

Type the Bb minor scale.
? BbCdbEbFgbAbBb
CORRECT

Type the G minor scale.
? GAbbCdBebFg
CORRECT
Type the Bb minor scale.
? BbCDbEbFGbAbBb
CORRECT
Type the F minor scale.
? F G AbBbCDbEbF
CORRECT
Type the Bb minor scale.
? BbCDbEbFGbAbBb
CORRECT
Type the C minor scale.
? CDEbFGAbBbC
CORRECT
Your score is 100.
For 10 more questions type run. Press RETURN.
READY:
Sample Run

NATURAL MINOR SCALES

This is a program to test your knowledge of minor scales. Use the symbol # for sharp, small b for flat, and large letters for pitches. Sample: Type the B minor scale. BC#DEF#GAB Press RETURN after each answer and to begin.

Type the F# minor scale.
? F#G#ABC#DEF#
CORRECT

Type the C# minor scale.
? C#D#EF#G#ABC#
CORRECT

Type the E minor scale.
? EF#GABCDEFG
CORRECT

Type the B minor scale.
? BC#DEF#GAB
CORRECT

Type the E minor scale.
? EF#GABCDEFG
CORRECT

Type the C minor scale.
? CDEbFGAbBbC
CORRECT
Type the D minor scale.
? DEFGBbCD
CORRECT
Type the C minor scale.
? CDEbFGAbBbC
CORRECT
Type the C# minor scale.
? C#D#EF#G#ABC#
CORRECT
Type the G minor scale.
? GABbCDEbFG
CORRECT
Your score is 100.
For 10 more questions type run. Press Return.
READY:
Sample Run

NATURAL MINOR SCALES

This is a program to test your knowledge of minor scales. Use the symbol # for sharp, small b for flat, and capital letters for pitch names.
Sample: Type the F minor scale. FGAbBbC DbEbF
Type the E minor scale. EF#G ABCDE
Press RETURN after each answer and to begin.

Type the D# minor scale.
? D#E#F#G#A#BC#D#
CORRECT

Type the G minor scale.
? GAbBbCDEbFG
CORRECT

Type the E minor scale.
? EF#G ABCDE
CORRECT

Type the F minor scale.
? FGAbBbC DbEbF
CORRECT

Type the G minor scale.
? GAbbCDEbFG
CORRECT

Type the G# minor scale.
? G#A#BC#D#E F#G#
CORRECT
Type the F# minor scale.
? F#G#ABC#DEF#
CORRECT
Type the Bb minor scale.
? BbC DbEbFGbAbBb
CORRECT
Type the F minor scale.
? FGAbBbCDbEbF
CORRECT
Type the E minor scale.
? E F#G ABCDE
CORRECT
Your score is 100.
For 10 more questions type run. Press RETURN.
READY:
Sample Run

HARMONIC MINOR SCALES

This is a program to test your knowledge of harmonic minor scales. Use the symbol # for sharp, small b for flat, and capital letters for pitch names. Sample: Type the A harmonic minor scale. ABCDEFG#A Press RETURN after each answer.

Type the D harmonic minor scale.
? DEFGABBbC#D
CORRECT

Type the E harmonic minor scale.
? EF#GABCD#E
CORRECT

Type the B harmonic minor scale.
? BC#DEF#GA#B
CORRECT

Type the D harmonic minor scale.
? DEFGABBbC#D
CORRECT

Type the C harmonic minor scale.
? CDEbFGAbBC
CORRECT

Type the G harmonic minor scale.
? GABBcDEbF#G
CORRECT
Type the D harmonic minor scale.

? DEFGAbC#D

CORRECT

Type the C# harmonic minor scale.

? C#D#EF#G#AB#C#

CORRECT

Type the A harmonic minor scale.

? ABCDEFG#A

CORRECT

Type the C harmonic minor scale.

CDEbFGAbBC

CORRECT

Your score is 100.

For 10 more questions type run. Press RETURN.

READY:
Sample Run

MELODIC MINOR SCALES

This is a program to test your knowledge of ascending melodic minor scales. Use the symbol # for sharp, small b for flat, and capital letters for pitches.
Sample: Type the A melodic minor scale (ascending).
     ABCDEF#G#A
Press RETURN after each answer and to begin.

Type the G melodic minor scale (ascending).
     GABbCDEF#G
CORRECT

Type the D melodic minor scale (ascending).
     DEFGABC#D
CORRECT

Type the E melodic minor scale (ascending).
     EF#GABC#D#E
CORRECT

Type the D melodic minor scale (ascending).
     DEFGABC#D
CORRECT

Type the G melodic minor scale (ascending).
     GABbCDEF#G
CORRECT

Type the C melodic minor scale (ascending).
     CDEbFGABC
CORRECT
Type the D melodic minor scale (ascending).
? DEFGABC#D
CORRECT
Type the C# melodic minor scale (ascending).
?C#D#E#F#G#A#B#C#
CORRECT
Type the A melodic minor scale (ascending).
? ABCDE#F#G#A
CORRECT
Type the C melodic minor scale (ascending).
? CDEbFGABC
CORRECT
Your score is 100.
For 10 more questions type run. Press RETURN.
READY:
Sample Run

MAJOR AND MINOR SCALES

This is a program to test your knowledge of major and natural minor scales. Use the symbol # for sharp, small b for flat, and capital letters for pitches.

Sample: Type the G Major scale. GABCDEFG#G
Type the C minor scale. CDEbFGAbBbC

Press RETURN after each answer and to begin.

Type the A Major scale.

? ABC#DEF#G#A
CORRECT

Type the A minor scale.

? ABCDEFGA
CORRECT

Type the D Major scale.

? DEF#GABC#D
CORRECT

Type the B minor scale.

? BC#DEF#GAB
CORRECT

Type the G Major scale.

? GABCDEFG#G
CORRECT

Type the D Major scale.

? DEF#GABC#D
CORRECT
Type the C Major scale.
? CDEFGABC
CORRECT
Type the G Major scale.
? GABCDEF#G
CORRECT
Type the A Major scale.
? ABC#DEF#G#A
CORRECT
Type the F# minor scale.
F#G#ABC#DEF#
CORRECT
Your score is 100.

For 10 more questions type run. Press RETURN.

READY:
Sample Run

MAJOR AND MINOR SCALES

This is a program to test your knowledge of major and minor scales. Use the symbol # for sharp, small b for flat, and capital letters for pitch names.
Sample: Type the G Major scale. GABCDEF#G
Type the G minor scale. GAbCdEbfG
Press RETURN after each answer and to begin.

Type the E Major scale.
? EF#G#ABC#D#E
CORRECT

Type the F Major scale.
? FGAbCdEf
CORRECT

Type the F Major scale.
? FGAbCdEf
Your answer is not correct. The answer is FGAbCdEf.

Type the B Major scale.
? BC#D#EF#G#A#B
CORRECT

Type the F# minor scale.
? F#G#ABC#DEF#
CORRECT

Type the Bb minor scale.
? BbCdEbfGAbBb
CORRECT
Type the A minor scale.

? ABCDEFGA

CORRECT

Type the A Major scale.

? ABC#DEF#G#A

CORRECT

Type the B minor scale.

? BC#DEF#GAB

CORRECT

Type the E Major scale.

? EF#G#ABC#D#E

CORRECT

Your score is 90.

For 10 more questions type run. Press RETURN.

READY:
Harmony

The first harmony drill tests the student's ability to identify intervals. Practice involving only the writing of major and minor thirds comprises drill number two. The remaining programs, chord drills, ask the user to spell major and minor chords and to identify primary triads (I, IV, and V). As with the preceding programs, capital letters are used for pitch names, the symbol # for sharp, and the small b for flat.
Sample Run

INTERVALS

This is a program to test your knowledge of intervals. Use capital letters for pitch names, the symbol # for sharp, and the small b for flat. Sample: What pitch is a minor 3rd above C? Eb
Press RETURN after each answer and to begin.

What pitch is a Major 7th above D? C
Your answer is not correct. The answer is C#.

What pitch is a minor 2nd above E#? F# CORRECT

What pitch is a Perfect Octave above D#? D# CORRECT

What pitch is a Major 2nd above E? F# CORRECT

What pitch is a Major 2nd above G#? A# CORRECT

What pitch is a minor 2nd above D? Eb CORRECT

What pitch is a Major 6th above D? B CORRECT

What pitch is a minor 6th below D? F Your answer is not correct. The answer is F#.

What pitch is a minor 2nd above E? F CORRECT

What pitch is a minor 6th above E? C CORRECT

Your score is 80.

For 10 more questions type run. Press RETURN.

READY:
Sample Run

MAJOR AND MINOR THIRDS

This is a program to test your knowledge of major and minor thirds. Use capital letters for pitches.
Sample: What pitch is a Major third above Eb? G
        What pitch is a minor third above D? F
Press RETURN after each answer and to begin.

What pitch is a minor 3rd above C#? E CORRECT
What pitch is a Major 3rd below B? G CORRECT
What pitch is a minor 3rd below Bb? G CORRECT
What pitch is a Major 3rd below E? C CORRECT
What pitch is a minor 3rd below D? B CORRECT
What pitch is a Major 3rd below G#? E CORRECT
What pitch is a Major 3rd above G? B CORRECT
What pitch is a Major 3rd above F? A CORRECT
What pitch is a minor 3rd below Ab? F CORRECT
What pitch is a minor 3rd above E? G CORRECT

Your score is 100.
For 10 more questions type run. Press RETURN.
READY:
Sample Run

MAJOR CHORDS

This is a program to test your knowledge of major chords. Use capital letters for pitches, the small b for flats, and the symbol # for sharps. Sample answers: CEG C#E#G# FA C Press RETURN after each answer and to begin.

Spell the B major chord.

? BD#F#
CORRECT

Spell the Db major chord.

? DbFAb
CORRECT

Spell the F major chord.

? FAC
CORRECT

Spell the D major chord.

? DF#A
CORRECT

Spell the Cb major chord.

? CbEbGb
CORRECT

Spell the Ab major chord.

? AbCEb
CORRECT
Spell the F major chord.
? FAC
CORRECT
Spell the Db major chord.
? DbFbAb
Your answer is not correct. The answer is DbFAb.
CORRECT
Spell the C major chord.
? CEG
CORRECT
Spell the Eb major chord.
? EbGBb
CORRECT
Your score is 90.
For 10 more questions type run. Press RETURN.
READY:
Instructions

Computer chooses question numbers randomly

? #1
? #2
? ...
? #15

Ask for and input answers

Their answer

Wrong answer

Right answer

Give correct answer

10th answer

no

yes

End

Figure 4. Major Chords Flowchart
Sample Run

MINOR CHORDS

This is a program to test your knowledge of minor chords. Use capital letters for pitches, the small b for flats, and the symbol # for sharps.
Sample answers: C Eb G C#EG# ACE
Press RETURN after each answer and to begin.

Spell the Ab minor chord.
? AbCbEb
CORRECT

Spell the C# minor chord.
? C#EG#
CORRECT

Spell the D minor chord.
? DF A
CORRECT

Spell the Eb minor chord.
? EbGbBb
CORRECT

Spell the C# minor chord.
? C#EG#
CORRECT

Spell the D minor chord.
? DFA
CORRECT
Spell the Ab minor chord.

? AbCbEb
CORRECT

Spell the B minor chord.

? BDF#
CORRECT

Spell the Db minor chord.

? DbFbAb
CORRECT

Spell the A minor chord.

? ACE
CORRECT

Your score is 100.

For 10 more chords type run. Press RETURN.

READY:
Sample Run

I, IV, AND V7 CHORDS

This is a program to test your knowledge of major chords. Use capital letters for pitches, the small b for flats, and the symbol # for sharps.
Sample answers: C F G F Bb C C#F#G#
Press RETURN after each answer and to begin.

Name the roots of the I, IV, and V7 chords (in order) for the key of E Major.

? E A B
CORRECT

Name the roots of the I, IV and V7 chords (in order) for the key of Db Major.

? DbGbAb
CORRECT

Name the roots of the I, IV, and V7 chords (in order) for the key of E Major.

? EAB
CORRECT

Name the roots of the I, IV, and V7 chords (in order) for the key of Ab Major.

? Ab Eb Eb
CORRECT

Name the roots of the I, IV, and V7 chords (in order) for the key of C# Major.

? C#F#G#
CORRECT
Name the roots of the I, IV, and V7 chords (in order) for the key of Gb Major.

? GbCbDb
CORRECT

Name the roots of the I, IV, and V7 chords (in order) for the key of Db Major.

? Db Gb Ab
CORRECT

Name the roots of the I, IV, and V7 chords (in order) for the key of Db Major.

? Db Gb Ab
CORRECT

Name the roots of the I, IV, and V7 chords (in order) for A Major.

? A D E
CORRECT

Name the roots of the I, IV, and V7 chords (in order) for the key of Bb Major.

? Bb Eb F
CORRECT

Your score is 100.

For 10 more questions type run. Press RETURN.

READY:
Sample Run

MAJOR AND MINOR CHORDS

This is a program to test your knowledge of major and minor chords. Use capital letters for pitches, the small b for flats, and the symbol # for sharps.
Sample answers: C E G     C#E#G#     A C E
Press RETURN to begin and after each answer.

Spell the C Major chord.
  ? CEG
CORRECT

Spell the Db Major chord.
  ? DbFAb
CORRECT

Spell the E Major chord.
  ? E G# B
CORRECT

Spell the C# Major chord.
  ? C#E G#
Your answer is not correct. The answer is C#E#G#.

Spell the A minor chord.
  ? ACE
CORRECT

Spell the B minor chord.
  ? BDF#
CORRECT
Spell the Cb minor chord.
? Cb Ebb Gb
CORRECT
Spell the F minor chord.
? FAbC
CORRECT
Spell the Db Major chord.
? DbFAb
CORRECT
Spell the E minor chord.
? EGB
CORRECT
Your score is 90.

For 10 more chords type run. Press RETURN.

READY:
Sample Run

MAJOR AND MINOR CHORDS

This is a program to test your knowledge of major and minor chords. Use capital letters for pitches, the small b for flats, and the symbol # for sharps. Sample answers: CEG ACE

Press RETURN after each answer and to begin.

Spell the G Major chord.
? GBD
CORRECT

Spell the B minor chord.
? BDF#
CORRECT

Spell the A minor chord.
? ACE
CORRECT

Spell the Eb Major chord.
? EbGBb
CORRECT

Spell the Bb Major chord.
? BbDF
CORRECT

Spell the E Major chord.
? EG#B
CORRECT
Spell the F# minor chord.
? F# A C#
CORRECT
Spell the B minor chord.
? BDF#
CORRECT
Spell the E minor chord.
? EGB
CORRECT
Spell the D Major chord.
? DF#A
CORRECT
Your score is 100.
For 10 more questions type run. Press RETURN.
READY:
Terminology

Fifty identifications comprise the two programs for terminology. One drill is non-random so the student can practice all the terms included in this program without repetitions and know when all fifty have been reviewed. The other version allows the student to practice random identification. All questions can be answered with one word unless otherwise stated to the user. Questions are constructed to give students the optimum chance of correctly answering the questions.
MUSIC TERMINOLOGY

This is a program to test your knowledge of music terminology. All questions can be answered with one word unless otherwise indicated. Press SHIFT LOCK so all answers will be capital letters. You will be given a score after each 10 questions. Press RETURN after each answer and to begin.

What is a term meaning rate of speed? TEMPO CORRECT

What is a term meaning to gradually get louder? CRESCENDO CORRECT

What is a term meaning 'end'? FINE CORRECT

Does andante mean moderately SLOW or FAST? SLOW CORRECT

Does the term con moto mean with MOVEMENT or EXPRESSİON? MOVEMENT CORRECT

What is a term meaning brisk and fast? VIVACE CORRECT

What is a term indicating that the note should be held or lengthened? FERMATA CORRECT

Does meno moso mean LESS or MORE movement? MORE Your answer is not correct. The answer is LESS.

What is a term meaning majestically? MAESTOSO CORRECT

What is a term meaning accented with force? FORZANDO CORRECT

Your score for the last 10 questions is 90.
Program Listing

10 PRINTCHR$(12)
15 PRINT
20 PRINT"    MUSIC TERMINOLOGY"
25 PRINT: PRINT
30 PRINT"This is a program to test your knowledge of music terminology. All questions can be answered with one word unless otherwise indicated."
35 PRINT"Press SHIFT LOCK so all answers will be capital letters. You will be given a score after each 10 questions."
40 PRINT
45 NQ=50
50 DIM A$(NQ)
55 FOR I=1 TO 10
60 READ A$(I)
65 NEXT I
70 INPUT"What is a term meaning rate of speed"; A$
75 GOSUB 690
   (input statements and gosubs through 165)
170 Print
175 PRINT"Your score on the last 10 questions is "; C*10
176 C=0
180 PRINT: PRINT
185 END
   (200-680 input statements)
690 R=R+1
695 IF S$<A$(R) THEN PRINT"Your answer is not correct. The answer is "; A$(R);".";
700 IF A$=A$(R) THEN PRINT "CORRECT"
705 IF A$=A$(R) THEN C=C+1
710 PRINT
715 RETURN
720 DATA TEMPO, CRESCEndo, ( . . . through all 50 answers)
725 DATA
Sample Run

MUSIC TERMINOLOGY

This is a program to test your knowledge of music terminology. All questions can be answered with one word unless otherwise indicated. Press SHIFT LOCK so all answers will be capital letters. You will be given a score after 10 question. Press RETURN after each answer and to begin.

What is a term meaning 'end'? FINE
CORRECT

Is the second half of the pulse the UP-BEAT or the AFTER-BEAT? AFTER-BEAT
CORRECT

Does the term diminuendo indicate that the music gradually gets SOFTER or LOUDER? SOFTER
CORRECT

When you see the word accelerando, it indicates a change in tempo. Does the tempo gradually get SLOWER or FASTER? FASTER
CORRECT

What is a term which describes 2 tones with the same pitch, such as C# and Db? ENHARMONIC
CORRECT

What is the lowest male voice? BASS
CORRECT

Does the term diminuendo indicate that the music gradually fets SOFTER or LOUDER? SOFTER
CORRECT

What term is used to tell the performer to perform as he wishes (2 words)? AD LIBITUM
CORRECT

What is a section added to the end of a composition? CODA
CORRECT
What is a term indicating that the note should be held or lengthened?  FERMATA
CORRECT

Your score is 100.

Type run for 10 additional questions. Press RETURN.

READY:
CHAPTER IV

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

As an educational tool, computers have been utilized during the last two decades. The accelerated pace of instructional technology has accounted for its growth.

Positive aspects that aid in the learning process are individualized instruction, immediate feedback, and increased student motivation. Another attribute of CAI involves the educational practice: the educator must rethink and reformulate this educational practice and specify the conditions of learning in a precise manner. The computer, combined with the teacher, was found to be advantageous as a powerful teaching force.

Negative characteristics were also discussed. Cost efficiency was a major factor. Other factors were the lack of software, no supporting curriculum, complex operating procedures, non-acceptance by users, and the lack of teacher-training. Also the absence of significant research results was cited.

CAI programs have been developed for many disciplines. Effectiveness was found in these subject areas: foreign

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languages, sciences, math, English, and biology. Greater retention of material, higher test scores, and efficiency of time were positive variables discovered and reported.

One area in which computers have made an impact on music is computer-assisted instruction. Affected areas are in theory, research, music education and teacher training, musicality, and aural perception. Surveys and published literature have shown some NASM schools involved with CAI; observation has shown many music schools utilizing or conducting research with computers for teaching.

Hofstetter (University of Delaware) stressed the impact of microcomputers in the advancement of CAI in music. He summarized its capabilities as individual instruction, time saving, immediate feedback, tailored learning experiences, and a joy of learning instead of competition as a motivating force. He has programmed units to improve ear-training in music theory including aural drill-and-practice in rhythm, melody, harmony, intervals, and chord-qualities. Several studies were conducted in harmonic dictation, and Hofstetter reported significant student gains.

A computer instructional-system (PLATO) has been implemented at several schools of music. Peters programmed lessons for instrumental music pedagogy at the University
of Illinois, and Placek developed rhythm perception programs. In the field of instrumental music performance, Deihl has programmed CAI studies. Kuhn reported perhaps the earliest research findings (1967) from Stanford University using a pitch extractor to drill and test sightsinging. Several dissertations have been written on CAI studies conducted in music during the past decade.

Music fundamentals texts reviewed were categorized as to format and content. Those primarily for programmed instruction usually included songs and activities. Taking the approach of providing a total experience combined the elements of music with songs and activities. The third approach, activity-oriented, presented the fundamentals by separate chapters, usually followed by or interjected with music activities.

Computer programs developed for this project were grouped into four divisions—rhythm, melody, harmony, and terminology. Directions for the user were included as a guide; no previous computer experience was needed for the student. Programming techniques were employed to put the user at ease and accommodate for common errors in drill mechanics. Sample runs, program listings, and flowcharts were included in chapter III also. All programs were stored on cassette tape.
Five rhythm programs were developed for drill-and-practice of this subject. Stationary graphics were incorporated to enhance the learning experience in three of the five programs. The other two were random question and answer programs.

The largest unit drilled the student's knowledge of melodic concepts, beginning with notating pitches and continuing through major and minor scales. Pitches were represented graphically on the treble and bass clefs, and on the grand staff, as well as the keyboard. Other drills involved half and whole steps and enharmonics.

Twenty-one key signature programs were subdivided by sharps and flats, easy and difficult, and major and minor. The final thirteen programs in the melody unit were also subdivided by sharps and flats, easy and difficult, and major and minor (including pure, harmonic, and melodic minor).

Intervals (including a program specifically for major and minor thirds), major and minor chords, and primary triads comprised the drills for testing harmony. The two programs written to test music terms commonly used in the elementary education methods class reviewed fifty terms; one program composed for random drill, the other non-random.
Conclusions

Elementary education majors do need a basis of theory fundamentals. The student is more likely to teach the elements of music when in an elementary classroom if he acquires an understanding of the rudiments of music. Not being acquainted with these basic fundamentals, he is not capable of fully grasping the concepts. For example, in order to teach form—even recognize the form of a piece—he needs at least the basic ability of being able to identify like and unlike melodic and rhythmic patterns and phrases. To accompany songs, with an autoharp for example, harmonic concepts are needed. A knowledge of minor keys is necessary if the teacher plans to introduce an elementary song which is in a minor key.

An expedient method is needed to teach these rudiments to enable the non-musician to teach musical concepts. The fact that some students already possess a knowledge of these fundamentals, others have some knowledge, and most have very little or none is evident that some means for reinforcement is vital. Wasted contact hours must be spent in drilling all students—regardless of their level—instead of preparing the students with the necessary methods, practices, and experiences for teaching music in their future elementary classrooms.
CAI appears to be a viable means to that end for the non-music major. Drill-and-practice through use of the computer should aid student's learning and provide immediate reinforcement. From research studies it can be concluded that students can learn various musical concepts through CAI. Many users also find this educational method exciting, fun, and motivating.

In constructing software to be utilized through CAI, the programmer, the teacher in most cases, must define objectives to be accomplished. Specific steps must then be crystallized before programming begins. Developing the program entails making logical decisions. The programmer must put himself in the user's place—how would he naturally and most likely respond to a particular question, what additional information does he need to correctly answer a question, what mechanical errors might he make even if he can correctly answer the problem. The more accommodations that can be made by the programmer, the more benefits the learner will receive. Reformulating the thinking process is vital.

The sequence of CAI programs developed in this report is unique. It represents a total program for the non-musician and is designed to complement the theoretical portion of any elementary music methods class—regardless of its approach or accompanying text. CAI programs
for teaching the rudiments of music have been developed and tested at several NASM schools across the country, but none appear to encompass a complete program for music fundamentals needed for elementary education music methods classes.

In addition to musicians employing CAI to improve instruction, there are other unlimited possibilities for the future. Some computer terminals are touch-sensitive. With this feature a more diverse population can participate in the unique learning experience. Young children without reading or typing or writing skills can respond to visual graphics. Instead of entering a typed (and correctly spelled) answer, the young child can simply touch the screen to identify his response. Some computers can read to the blind; the possibilities for various types of handicapped children are numerous.

The value of CAI for teaching music fundamentals, as well as other music subjects, has been evidenced by many studies. CAI cannot solve all the problems of music educators; however, the musicians should be aware of the tremendous scope of available possibilities for broadening their effectiveness as teachers.
Recommendations

Music educators should become aware of the current state of technology and also be aware of the studies on the subject of CAI in music. The teacher-training institutions need to be the impetus for this educational endeavor. Some course, or courses, should be offered at the undergraduate and graduate levels to introduce CAI, to teach the basic programming skills, and to provide basic information for planning CAI lessons.

For the teacher in the field, clinics or workshops should be provided by the schools. MENC should continue its efforts of providing computer sessions at conventions and disseminating information and research through their periodicals, and they should expand to provide more workshops and clinics. To be of the utmost value, separate learning sessions, with hands-on experience, should be geared to persons with various levels of experience with computers. Summer workshops are offered for musicians as a means of exposing the concepts and processes of computers in education to these teachers. More teachers should take advantage of the offerings and be encouraged to do so by their supervisors. At the same time, more music schools in the universities should provide specific workshops in CAI.
This teaching method is still in its infancy. Many musicians, although still a small percentage, are engaged in research and programming activities with computers. Some studies have been reported and most with positive results. Many more statistical studies are needed, however, to fully document CAI's benefits to students, as well as to discover and report its disadvantages, misconceptions, and drawbacks.

The implementation of the programs developed for this project is also recommended. Before adding the supplemental teaching aid to the curriculum, experimental studies, using a control and an experimental group of elementary education music methods students, need to be conducted. Statistics should be gathered and analyzed. Possible experimental studies might entail only the various units separately, such as melody, rhythm, or harmony, before implementing the entire sequence.
SELECTED BIBLIOGRAPHY

Books


Periodicals


**Dissertations and Papers**


Placek, Robert W. "Design and Trial of a Computer-Assisted Lesson in Rhythm." (Mimeographed.)


VITA

Mary Louise Price Wilson was born May 28, 1949, in Miami, Florida. She was educated in the public schools in Vidalia, Georgia, and graduated from high school there in 1967. She received a Bachelor of Music degree in 1972 and a Master of Music Education degree in 1973 from North Texas State University.

Ms. Wilson has had part-time music teaching experience in grades K-12, taught private piano lessons for ten years, and has been a church organist for several years. For the past four years, she has taught music methods courses for elementary education majors at Louisiana State University as part of a teaching assistantship. Her professional memberships include: Pi Kappa Lambda, Sigma Alpha Iota, and Music Educators National Conference; she has also been listed in Outstanding Young Women of America.
EXAMINATION AND THESIS REPORT

Candidate: Mary Louise Price Wilson

Major Field: Music Education

Title of Thesis: The Development of CAI Programs for Teaching Music Fundamentals to Undergraduate Elementary Education Music Methods Classes

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