FOUNDATION, ORGANIZATION, AND PURPOSE OF THE NATIONAL CONSORTIUM FOR COMPUTER-BASED MUSICAL INSTRUCTION[1]

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The primary objective of developers of computer-based systems for musical instruction is the improvement of education in music. Student interest and enthusiasm for this new computer-based instructional medium has generated nationwide excitement. The active participation of music students in design, implementation, and evaluation has made the development of computer-based instructional systems a rewarding experience. For these reasons, it is fitting that the student membership of the Music Educators National Conference has provided the motivation for this discussion of the foundation, organization, and purpose of the National Consortium for Computer-Based Musical Instruction (NCCBMI).

This paper begins with a look at the present state of computer applications to music education. Instructional systems for instrumental music, music fundamentals, ear-training, set theory, composition, analysis, information retrieval, automated music printing, and computer-managed instruction are discussed. Attempts to combine these systems into comprehensive programs are reviewed. In the context of these activities, the functions of the National Consortium for Computer-Based Musical Instruction are described. Finally, a formal invitation to join the consortium is extended to all persons interested in the development and uses of computers in musical instruction and research in music education.

The applications of computers to education are generally divided into two main categories, namely, those in which the computer is used to present instructional materials, and those in which the computer serves as an interactive tool. Applications to music education are being developed in both areas. Instructional programs are helping students learn instrumental methods, fundamentals of music theory, ear-training, and set theory. Programs are also being written for composition, analysis, information retrieval, computer-managed instruction, and music printing. Preliminary results of all these efforts indicate that the application of computers to music education will be of great benefit to both students and teachers. For this reason attempts are being made to combine these programs into comprehensive computer-based music education laboratories. The following survey gives the state of these activities at the inception of the National Consortium for Computer-Based Musical Instruction.

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Instrumental Music Education

One of the earliest applications of the computer to music education was a program in articulation, phrasing, and rhythm for intermediate instrumentalists. Developed by Diehl (1971, 1973) at Penn State University on an IBM 1500 computer under a grant from the U.S. Office of Education, this project demonstrated that significant gains in student achievement can be obtained through computer-assisted instruction in instrumental techniques. The computer was used to display musical notation, to play pre-recorded musical examples, and to ask questions about the articulation, phrasing, and rhythm of the musical examples. The goal was to help students develop more sensitivity and accuracy in the recognition and performance of articulation, phrasing, and rhythm. The evaluation of this program consisted of a one-group, pre-test post-test design. Twenty-five junior high school students participated in the program. Instruments played by students in this group included flute, clarinet, oboe, saxophone, trumpet, and baritone. The results of this study showed impressive gains in student performance in all three areas, with the highest gain in phrasing and the lowest gain in rhythm. Table 1 gives the mean test scores for listening and performance in all three areas. The main limitation of this program was that the performance portion of the program had to be done independent of the computer, because at the time of this study the computer was unable to accept musical performances as input. Peters (1974) has shown that musical input to the computer is quite feasible now, and the development of such a device is one of the goals of the consortium.

Table 1. Summary of Student Scores in a Computer-Based Program for Improving Articulation, Phrasing, and Rhythm of Intermediate Instrumentalists

Group Averages	Listening Test Means	Performance Test Means
Pre-Test (*N*=25)	62.8%	38.8%
Post-Test (*N*=25)	92%	94%
Gains	30%	55.2%

More recently a library of programs for teacher-preparation in flute, clarinet, oboe, saxophone, bassoon, trumpet, horn, trombone, euphonium, tuba, and percussion instruments has been developed in the PLATO system at the University of Illinois under the direction of David Peters (1975). These programs are designed to fulfill a dual purpose: first, to provide instruction as part of the normal instrumental methods curriculum, and second, to serve as part of the review process in the music education student's senior year. Developed in a tutorial mode of instruction, these programs review basic instrumental materials and then ask students questions in order to assess their understanding of those materials. If the student does well, PLATO moves on to more advanced topics; if the student does poorly, PLATO presents remedial materials and asks questions again. Evaluation of the wind and percussion instrument programs has shown that significant gains in student understanding can be obtained when instrumental methods are reviewed in this manner. A PLATO program dealing with stringed instruments is being developed this year. A list of available PLATO music programs developed at the University of Illinois is given in Table 2.

Table 2. Available PLATO Music Programs Developed at the University of Illinois

	Program Name	Author(s)
1.	Tests and Measurements in Music Education	Richard Colwell and George Weimer
2.	Instrumentsl Methods Series (wind and percussion instruments)	David Peters
3.	Percussion Terminology	Frederick Fairchild
4.	Violin Fingering Drill (elementary school level)	Daniel Lind
5.	Viola Fingering Drill (elementary school level)	Daniel Lind
6.	Instrument Recognition (elementary school level)	Carol Holden
7.	Micro-Teaching in Music Education	Wayne Dvorak
8.	Critical Incidents in Music Education	John Cooksey
9.	Hand Signals for Music Teachers	John Flohr
10.	Elementary Music Fundamentals	Robert Placek and David Peters
11.	Part-Writing	Robert Rickman
12.	Jazz Chording	Terry Rucinski

Fundamentals of Music Theory

Four music schools are developing programs for instruction in the fundamentals of music theory, namely, the Crane School of Music at the State University College at Potsdam, and the Schools of Music at The Ohio State University, the University of Iowa, and the University of Georgia. W. Earle Hultberg and Mary Lou Hultberg, involved with project CLEF (Computer-Based Learning Experiences in Music Fundamentals) at the State University College at Potsdam since 1967, are developing CHORDAL (Crane Heuristic Organ Data Language), a programming language specifically designed for musical instruction on an Interdata 7/16 minicomputer. Burdette Green began Ohio State's CAI music program in 1970, employing IBM's COURSEWRITER system. More recently Marvin Thostenson has begun a CAI project at the University of Iowa using the BASIC programming language on a Hewlett-Packard 2000 minicomputer. These projects are similar in that they concentrate on the spelling of intervals, scales, keys, triads, and harmonies, and they all employ a tutorial drill-and-practice strategy with a record-keeping system whereby the instructor can monitor student progress. In addition, the Ohio State system allows the teacher to establish competencies which the student must meet at each level of instruction; the student is permitted to jump ahead to more advanced topics once those competencies are attained. The Iowa programs give students an opportunity to ask the computer questions, such as "Spell the V^6/IV chord in the key of F."

A limitation of these programs is that they use typewriter terminals and therefore cannot display musical notation for the student. Instead, the authors have designed printed learning packets which contain scores to which some of the programs refer.

Robert Placek of the University of Georgia has been developing programs which take advantage of the full graphic capabilities of the PLATO terminal. Placek's (1974) major emphasis has been on rhythm. The student is presented several measures and is asked to find the incomplete one. After doing this the student selects a note-value which would complete the measure, and inserts the note into its proper place by using directional arrow keys on the keyboard of the PLATO terminal.

Table 3 lists the names of programs which have been developed in the area of music fundamentals at all four schools.

Ear-Training

Two systems have been specifically designed for instruction and research in ear-training. Although they were independently developed, they have led to a common realization: that the computer is the solution to the many problems which students encounter in ear-training. One system was developed under the direction of Wolfgang Kuhn (1974) at Stanford University. The other was developed by Fred T. Hofstetter (1975) at the University of Delaware. The Stanford system is written in BASIC on a PDP-11 minicomputer. Musical examples are played by a Thomas Model 145 solid state organ under computer control. Studens interact with the computer by means of a Model 33 KSR Teletype terminal.

The Stanford ear-training system is divided into six

Table 3. Music Fundamental Programs Developed at the State University College at Potsdam, The Ohio State University, the University of Iowa, and the University of Georgia

State University College at Potsdam	The Ohio State University	University of Iowa	University of Georgia
Clefs	Grand Staff	Grand Staff	Notes & Rests
Intervals	Ledger Lines	Ledger Lines	Time Signatures
Trichords	Octave-Transposition Signs	Ascending Intervals	Complete the Measure
Tetrachords	Intervals	Descending Intervals	Keyspinner Game
Scales & Modes	Triads	Major & Minor Scales	Keyboard Notation
Key signature	Seventh Chords	Scale Keys & Signatures	
Triads	Placing Chords in Keys	Triads	
Progressions	Altered Chords	Primary and Secondary Triads	
	Modulation	V^7 Chord	
		Primary and Secondary V^7 Chords	
		Secondary 7th Chords	
		Primary and Secondary dimished 7th Chords	
		Neopolitan 6th Chord	
		Augmented 6th Chords	

main areas: intervals, triads, melody, rhythm, chords, and modulation. In order to provide maximum flexibility for both instruction and research, Professor Kuhn has designed special options which allow free movement by the student throughout the curriculum. Students may enter the curriculum where they left off at a previous session, restart any program from its origin, change from one program to another, or increase and decrease the level of difficulty. In addition, students have the option of constructing musical examples which can be stored in the program and played on request. Studies by Herrold (1973) and Killam and Lorton (1974) document the effectiveness of this system for instruction. The most recent development in the Stanford project has been the analysis of student responses collected during the CAI program. Killam, et al. (1975) have completed a study of student accuracy in identifying harmonic and melodic intervals. In the past, similar studies had to be done by hand, and research efforts were hampered by the complicated record-keeping which they entailed. As a result, very little is known about how music students develop aural skills, and about the order in which concepts should be introduced. With the help of the computer, record-keeping has become automatic, and much more research can be done in student learning.

The University of Delaware's ear-training system is called GUIDO (Hofstetter, 1975). GUIDO stands for *G*raded *U*nits for *I*nteractive *D*ictation *O*perations; this acronym refers to the curriculum which is generated and stored in the GUIDO system. The basic design of the GUIDO system is the same as that of the Stanford system, although there are some differences: The GUIDO system was written in ALGOL on a Burroughs 6700 computer. It uses Tektronix 4010 graphics terminals and has a complete music notational display package. Students are asked questions in musical notation, and they respond in musical notation. The GUIDO system is now being transferred to the PLATO system where it has obtained a significant improvement: music students are now able to construct their own musical examples in a touch-sensitive playing mode. In this way, beginning music students can explore complex musical procedures on an experiential basis. For example, a freshman oboe major with no keyboard skills is able to play a complex harmonic progression such as I V^6_5/IV IV G^6 I^6_4 V^7 I by just touching the appropriate Roman numerals on the PLATO screen.

The evaluation of the GUIDO system has provided the only results to date of a controlled experiment comparing a computer-based ear-training laboratory to the traditional tape recorder laboratory. During the fall semester of 1974, thirty-three freshman music majors at the University of Delaware received the same course of instruction in ear-training, with all drill-and-practice done in the tape laboratory. At the beginning of the spring semester of 1975, the class was randomly split into two groups. Seventeen students were assigned to an experimental GUIDO group which practiced ear-training at the computer terminals, and 16 students were assigned to a control TAPE group which practiced in the tape laboratory. The same dictation tests were administered to both groups at the end of the fall semester (*before* GUIDO) and then again after three weeks and after seven weeks with GUIDO used by the experimental group.

Table 4 summarizes the results of the experiment which indicate that whereas the scores of the two groups were not significantly different before GUIDO, the students who used GUIDO performed significantly higher at the end of the experiment.

Table 4. GUIDO Evaluation: Comparison of Experimental and Control Group Performances

Student Groups	Test 1 (before GUIDO)			Test 2 (after three weeks of GUIDO)			Test 3 (after seven weeks of GUIDO)		
	Mean	Standard Deviation	t	Mean	Standard Deviation	t	Mean	Standard Deviation	t
GUIDO	77	9.9	N.S.	83	13.3	N.S.	86	12.4	$p < .05$
TAPE	76	11.1		75	16.1		75	14.4	

Set Theory

The analytical procedures defined by Allen Forte (1973) for describing the pitch organization of atonal music are referred to as *set theory*. These procedures have been found to be helpful in teaching atonal music to college-level music majors. Gary Wittlich (1974) of Indiana University has developed a PLATO program which teaches set theory. Topics included in this program are as follows:

a) Definition of set: a definition of pitch class set using musical examples
b) Normal form: a definition of and algorithm for determining normal form (after Babbitt); includes an exercise to test the student's comprehension
c) Numerical set: a description of pitch class numbers and numerical sets; includes exercises
d) Transposition: mod12 addition of pitch class numbers to effect transposition of sets; includes exercises
e) Inversion (simple): a description of and formula for obtaining mirror inversion in which the first pitch class is fixed
f) Inversion (relative to zero): a description of mod12 complementation of pitch class members; includes exercises for topics e) and f)
g) Transposed inversion: two methods of determining transposed inversion of pitch class sets; includes exercises
h) Interval class: a description of the six interval classes (after Forte) is given along with an example
i) Inverval vector: this topic is not yet completed within the lesson.

More recently Professor Wittlich has been developing PLATO programs which teach music fundamentals using pitch class concepts of set theory.

Composition

A most promising application of the computer to music education is its ability to help students explore the world of sound through composition. The developmental work of Godfrey Winham (1968), Wayne Slawson (1969), Max Matthews (1969), John Chowning (1972) and Leland Smith (1970), Hubert Howe (1972), and Barry Vercoe (1973) has given the computer the capability of producing almost any sound. Efforts to apply this technology to compositional purposes in music education are being made at the Oberlin Conservatory of Music, Iowa State University, and Dartmouth College. At Oberlin, Gary Nelson has developed a program called COMPOSE. Written in the APL programming language, it includes routines for manipulation of serial structures, probability models, syntax through directed graphs, and list processing. The Iowa State Computerized Music System (ISMUS) was developed under the direction of Gary White. The ISMUS project allows students in music, computer science, and engineering to interact in the creation of musical compositions played on an ARP synthesizer under the control of a PDP-8 minicomputer.

Whereas these systems are intended for use by college-level music students, the Dartmouth system developed by Jon Appleton and Sydney Alonso (1975) can be used by beginners. This system consists of a 16-channel synthesizer which is driven by a NOVA minicomputer. Up to four students can use the system simultaneously in learning to perceive musical structure by trying to compose. The compositional exercises begin with a limited sound vocabulary, and as the students learn to manipulate sounds, the vocabulary is increased until the students are given complete compositional freedom. The first exercise gives the students a vocabulary of twelve sounds and a silence. Sound objects such as glissandos, pitch sets, clusters, and tones of fixed durations are used instead of the twelve notes of the Western scale so that students can concentrate on structure independent of traditional melodic and rhythmic considerations. The second exercise deals with the concept of repetition. The third exercise allows students to explore the role of silence in composition. Each successive exercise adds a compositional concept until the student has free use of any sound. The Dartmouth system also contains drill-and-practice exercises for ear-training, but at the present time does not contain a musical display package, nor does it have a response-saving research capability. These features have been excluded from the system in order to keep its cost low. The system is commercially available from Norlin Music, Inc.[3] It is the most versatile stand-alone sound synthesis system available today, and it provides a model for future design of sound synthesis systems for use in computer-based musical instruction.

[3]Norlin Music, Inc., 7373 N. Cicero Avenue, Lincolnwood, Illinois 60646.

Analysis

During the past decade the computer has proven to be a useful tool in analytical research. Twelve coding languages have been developed whereby musical notation can be represented to the computer. Robison's (1967) Intermediate Musical Language and Bauer-Mengelberg's (1970) Digital Alternate Representation of Musical Symbols are alphanumeric codes designed so that the encoder need not understand musical notation. Codes which assume a knowledge of notation have been more frequent. They include Gould and Logemann's (1970) Alphanumeric Language for Music Analysis, and MUSICODE (Hofstetter, 1972), extensions of Brook's (1970) "Plaine and Easie" code; the numeric coding systems of Roller (1965) and Meylan (1967); Jackson and Bernzott's (1970) fixed-field coding language; Wenker's (1970) MUSTRAN and Bernstein and Olive's (1969) Chicago Linear Music Language, designed to include ethnomusicological and sixteenth-century chanson symbols, respectively; and languages which employ special coding sheets (Lefkoff, 1967) and mark-sense cards (Duerrenmatt, Gould, and Larue, 1970).

Twelve projects have dealt with the development of analytical programs. Maurita and Ronald Brender (1967) wrote programs for describing part or voice crossing, melodic intervals, and triads. Youngblood (1970) wrote a program to perform Hindemithian analyses of root progressions. Suchoff (1968) computerized Bartok's method of folk-song analysis. Gabura (1970) and Forte (1966) developed programs to study pitch and interval relations. Lefkoff (1970) wrote a program to find correlations among the 48 permutations of a twelve-tone row. Fuller (1970) and Mendel (1969) developed simultaneity-analysis programs. Winograd (1968) wrote programs for the analysis of harmony as a linguistic system. Programs by Roller (1965) deal with harmonic intervals, chord repetitions, Hindemith roots, and melodic intervals. And Patrick (1974) developed a program to study suspension-formations in the Masses of Josquin des Prez.

All of the above efforts have been concerned with analytical research of music. Collectively they constitute the beginnings of what will become an important tool for the sylistic research of music of all periods. Attempts to apply this technology to undergraduate instruction are being made at The Ohio State University.

Since 1970, Professors Norman Phelps and William Poland have directed the development of a library of SNOBOL programs which perform analyses of twelve-tone rows and their permutational relationships in twelve-tone compositions; identify nonharmonic tones and modulations in tonal music; recognize melodic, harmonic, and note-value patterns; compute pitch-class and melodic-interval frequency tables; perform Hindemith (1970) chord-tension analysis; and create magic squares—an analytical aid developed by Babbitt which identifies the 48 permutations of a twelve-tone row (Austin, 1966). The system which makes these programs accessible by college-level music students is called SLAM, a Simple Language for the Analysis of Music (Whitney, 1975). By using SLAM, music students can interactively explore the stylistic traits of encoded musical compositions. The data base of encoded compositions presently consists of 120 Bach chorales and selected compositions by Beethoven, Chopin, Jelinek, Krenek, Mozart, Palestrina, Schoenberg, Stravinsky, Tschaikovsky, and Webern.

A sample SLAM program written by a music student is as follows:

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SELECT THE SOPRANO PARTS FROM CHORALES 218, 229, AND 284;
DO A MELODIC INTERVAL ANALYSIS; CALL THE RESULT 165.
SELECT THE SOPRANO PARTS FROM CHORALES 209, 237, AND 244;
DO A MELODIC INTERVAL ANALYSIS; CALL THE RESULT 185.
PERFORM A CHI-SQUARE COMPARISON FOR 165 AND 185.
GIVE ME A COPY OF THE INTERVAL ANALYSES AND THE CHI-SQUARE COMPARISON.
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Within fifteen minutes after submitting this program to Ohio State's IBM 370/165 computer, the student had a complete interval analysis of the two groups of chorale tunes, and a chi-square comparison of their interval distributions. The results showed the student that significant differences do exist. The first group, composed around 1551, was more scalewise than the second group which had been composed around 1730. The second group had more thirds and changed melodic directions more often than the first group.

Information Retrival

In addition to its potential for instruction, composition, and analysis, the computer can assist the music student in searching the literature in music education. Since 1968 a series of related storage and retrieval projects in music have been developed and tested at the University of Georgia under the direction of Robert John (1969, 1971). These include a key-word in context index of music research done in the Southern division of the Musical Educators National Conference from 1913-1968, an index and catalog of the Irving Lowens Collection of Early American Hymn and Tune Books located at the Moravian Music Foundation at Winston-Salem, North Carolina, a system for cataloging and indexing sheet music, and a system for computerized searching of the contents of 15 early American shape note hymn books according to title, key, time signature, poetic meter, voice parts, book source, page number, opening melodic line, and first words of the hymn.

In 1972, an extensive indexing and abstracting project was begun. This project, entitled Materials of Music (MOM), was designed to encompass all document types found in music. At present, MOM includes bibliographic and keyword indexing for approximately 3500 journal articles from five music journals. The index is available both in hard copy print-out and in machine researchable form on magnetic tape.

Figure 1. Musical Score Printed by a Computer at Stanford University's Artificial Intelligence Laboratory

The data base may be searched for the following data elements:

1. Primary Citation: title of journal, date, pagination.
2. CODEN: journal title abbreviation.
3. Primary Document Date: year of journal publication.
4. Primary Document Title: title of journal.
5. Secondary Citation: indexing and abstracting publication.
6. Secondary Journal Title: title of indexing publication.
7. Secondary Journal Volume: volume number of indexing publication.
8. Secondary Journal Issue: issue number of indexing publication.
9. Secondary Journal Publication Date: year of indexing publication.
10. Secondary Journal Abstract Number: document accession number.
11. Title: title of indexed document.
12. Author: author or authors of indexed document.
13. Free Index Terms: keywords describing document content.

In addition to the above specified searchable fields, one may ask for a Free Index Term search that will retrieve documents on words in titles, key-word areas, or abstracts. The system is designed to allow almost indefinite expansion of the data elements to include those items necessary to accomodate other document types or to add elements to the existing tape file.

Automated Music Printing

A rapidly advancing technology is the work in Automated Music Printing conducted by Leland Smith (1973) at Stanford University. The ability of the computer to print a musical score will be helpful to music students and composers who use the computer as an aid to musical composition. Smith is developing his system at Stanford's Artificial Intelligence Laboratory using a PDP-10 computer and a Xerox digital printer (See Figure 1).

Computer-Managed Instruction

A conceptual problem faced by developers of computer-based instructional systems is the management of the students' use of those systems. In a truly individualized, performance-based situation, students are involved in diverse activities employing a variety of materials. They proceed at different rates of speed through the materials, and they experience their own personal successes and learning difficulties. It is through computer-managed instruction (CMI) that the teacher can receive assistance in organizing, monitoring, and interacting with student performance in these activities.

One of the first operational CMI systems was developed by the Systems Development Corporation for the Southwest Regional Educational Laboratory at Los Angeles; it was called the Instructional Management System (IMS). The system dealt with reading at the first-grade level, and allowed students to take individualized tests each day after completing modules of the reading curriculum. The teacher received reports from the computer according to which the next day's activities could be planned. Remedial activities were prescribed for students who performed poorly, and more advanced activities were recommended for students who did well (Baker, 1971). Other types of computer-managed instructional systems were developed soon after the success of the IMS system (Finch, 1972). In general, they all perform the following functions: 1) testing, 2) diagnosing, 3) prescribing, and 4) reporting, in a manner similar to that of the IMS system.

A system for computer-managed musical instruction is being designed by Michael Arenson (1975) at Iowa State University. The first course to use this system will be the one-quarter course in *Fundamentals of Music.* Primarily intended for non-music majors, this course concentrates on the basic materials of music. It includes both the notational aspects of music as well as the development of aural skills. During the 1974-75 academic year, the music department at Iowa State was given an Innovative Teaching Grant whereby the course was redesigned in a self-paced format employing individualized learning modules. After completing each module, the students took tests to evaluate their mastery of the material. In a controlled evaluation of this self-paced format, it was found that students using the individualized learning modules performed equally as well as students taking the traditional lecture course. However, this was not good enough for the faculty at Iowa State. They felt that the students in the self-paced course would have done better if their progress in the materials could have been more closely monitored.

Toward this end, Professor Arenson is developing a PLATO-based CMI package whereby the monitoring of student progress in the self-paced course will be assisted by the computer. In addition to improving the managerial process, the computer will enhance the course by permitting teachers to spend more time with students on an individual basis. Upon successful implementation of this program in the fundamentals course, the CMI approach will be extended to include the first two years of musicianship training for music majors.

TOWARD A COMPREHENSIVE PROGRAM

A computer-based educational laboratory containing all of the applications discussed in this paper would greatly benefit programs in muscicianship training, competency-based teacher education, and general research in music. The realization of such a laboratory is technologically feasible; the time needed to make such a laboratory available to music departments is a function of the level of support which universities and funding agencies will be able to afford.

Allvin (1970) formed a conceptual model for the operation of a comprehensive computer-based music laboratory. According to his plan the music student would work in a competency-based instructional setting with computer aids to analysis, composition, performance, bibliography, ear-training, and sight-singing. Each student's learning habits would be interpreted by the computer, and individualized instructional material would be presented to suit each student's learning needs. Allvin's model is given in Figure 2.

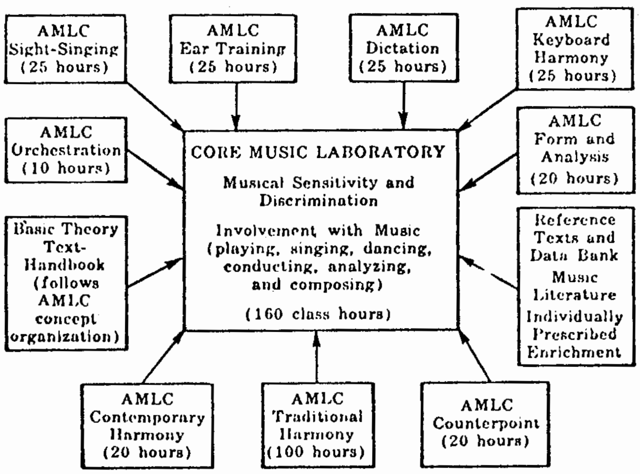

Figure 2. Allvin's Model for a Comprehensive Computer-Based Music Laboratory

Attempts to realize such a model are being made at the University of Utah, Arizona State University, and Indiana University. At Utah, Alan Ashton (1971) has developed a prototype system built around a computer-controlled organ. David Swanzy (1975) of Edinboro State College has reported that this system now contains programs for ear-training, dictation, class piano, and composition for children. A similar laboratory has also been established at Arizona State University under the direction of William English. Swanzy (1974) has indicated that this may become the first effort to create a state-wide computer network for music education, involving Arizona State University, the University of Arizona, Northern Arizona, and Mesa Community College.

At the present time Indiana University has the most complete computer music system. Figure 3 contains a diagram of available programs (Wittlich, 1974). The most significant element in this system is an electronic link among the encoding, analysis, composition, music printing, and sound synthesis programs. Music can be composed, printed, performed, and analyzed within the same system. The obvious omission from this system is instructional computing, and Wittlich is adding this capability through his work with the PLATO system.

THE NATIONAL CONSORTIUM FOR COMPUTER-BASED MUSICAL INSTRUCTION

In his study of the current state of computer-based instruction in 429 music departments affiliated with the National Association of Schools of Music, Jones (1975) concluded that:

> Despite evidence of the computer's value for instructional uses, the educational community has been reluctant to accept and develop computer-assisted instruction for music. Reflections of this reluctance are manifold: (1) few music educators are involved in teaching by computer systems, (2) few students are involved in research in computer-assisted instruction as learners, (3) few music educators and graduate students are involved in research in computer-assisted instruction, (4) few quality course materials are available, and (5) no formal mechanisms exist for sharing computer-assisted instructional efforts in music.

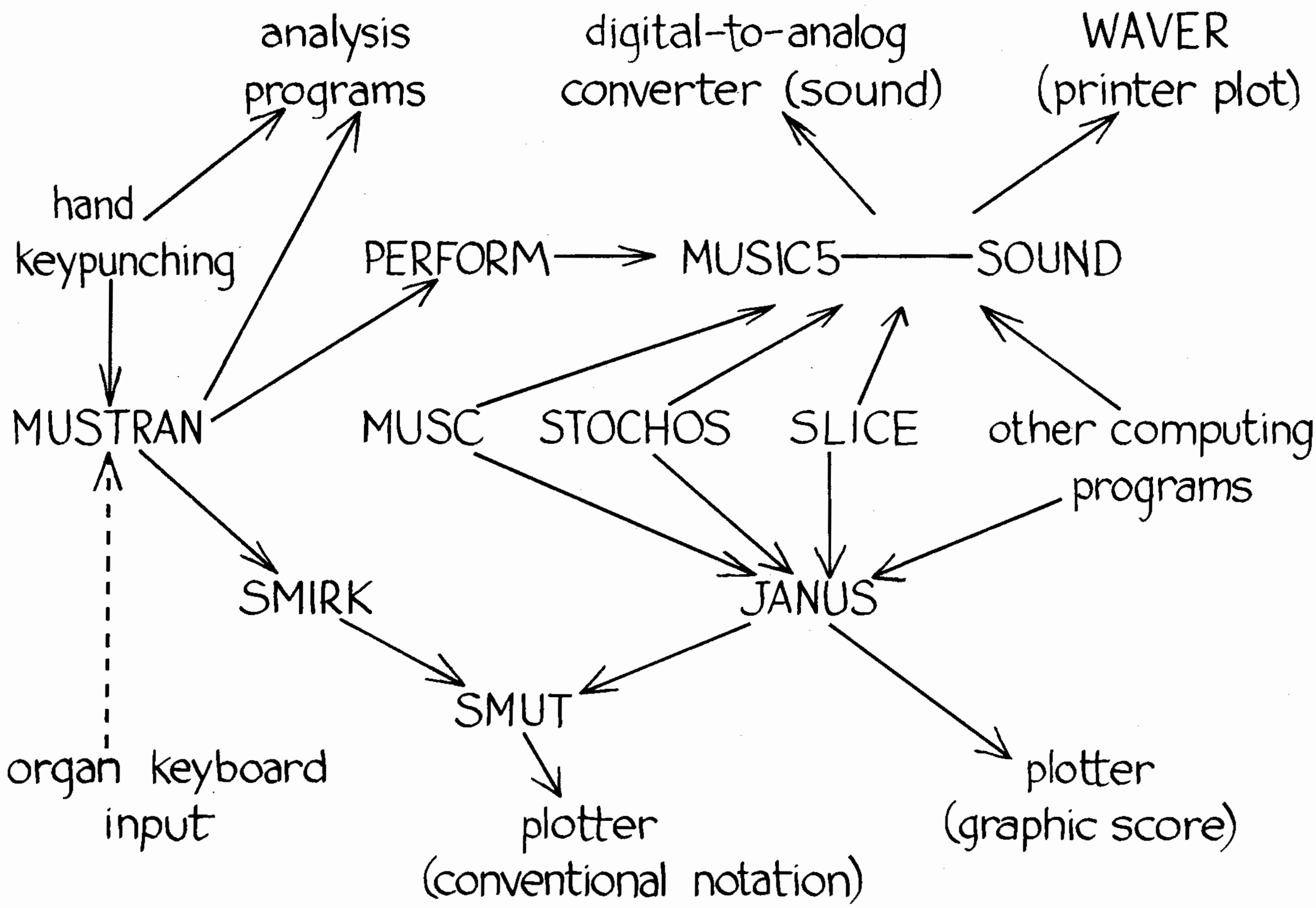

Figure 3. Music Programs Available at Indiana University's Wrubel Computing Center

In order that music educators might more efficiently realize the potential of computer-based musical instruction, Jones recommended that a vehicle be found whereby development of instructional programs, pursuit of instructional research, and design of musical input-output devices could occur in a cooperative exchange among those involved in computer-based musical instruction. Toward this end eleven universities have founded a National Consortium for Computer-Based Musical Instruction.

Organizational meetings were held on August 18-20 at the University of Delaware with funds provided by Delaware's College of Arts and Science. Founding members include Florida State, Indiana, Iowa State, Ohio State, Penn State, and Stanford Universities, Lewis and Clark College, the State University College at Potsdam, and the Universities of Delaware, Georgia, and Illinois.

The purposes of this organization are as follows: first, to provide a forum for the exchange of ideas among developers and users of computer-based systems for musical instruction; second, to establish and maintain a library of music courseware; third, to reduce redundant effort among courseware and hardware developers; fourth, to provide consultation for new users of computer-based musical instruction.

Functions of the Consortium

The National Consortium for Computer-Based Musical Instruction was formed in order that the development of computer aids to music education can continue in a well coordinated manner, with an active exchange of ideas among developers and a source of information for users of computer-based systems for musical instruction. In meeting its goals the consortium is taking the following actions:

Participation in ADCIS. The Association for the

Development of Computer-Based Instructional Systems (ADCIS) is an international, non-profit organization with members throughout the United States, Canada, and Europe representing elementary and secondary school systems, colleges and universities, business and industry, as well as military and government agencies.

The purposes of this organization are to: 1) advance the investigation and utilization of computer-based instruction and/or management; 2) promote and facilitate the interchange of information, programs and materials in the best professional and scientific tradition; 3) reduce redundant effort among developers; and 4) to specify requirements and priorities for hardware and software development, and encourage and facilitate their realization.

ADCIS and the NCCBMI have common goals. For this reason the NCCBMI has applied for special interest group status within ADCIS. The advantages of this affiliation with ADCIS are as follows: first, vendors of computing equipment will become more aware of the need for computer-based musical systems, and conversely, music educators will be informed of the most recent developments in computer-based instructional technology; second, members of the NCCBMI will be able to communicate on a regular basis through the ADCIS newsletter, which will contain a section on music; third, the costs of publishing the newsletter and holding annual conferences will be born by the association; and fourth, by their regular attendance at ADCIS conventions and reading of ADCIS publications, directors of educational computing centers throughout the country will be informed of the latest developments in computer-based musical instruction, and they will therefore be more able to help music teachers implement computer-based systems for music education.

Establishment of a National Library of Music Programs. As is the case with instructional computing in general, music programs have been developed in a variety of programming languages on a number of large and small computers employing many types of input and output devices. In establishing a central library of music programs, the consortium will formulate standards for the development and distribution of music programs and input/output devices. Music departments will be able to share their efforts in educational research and development, and much more will be accomplished than if each music school is required to begin anew when it starts a computer-based program.

Publication of a Journal. Beginning in January of 1977, the consortium will publish an annual *Journal of Computer-Based Musical Instruction.* This journal will contain articles dealing with the development, implementation, and evaluation of computer-based instructional systems. An editorial board is being established through the consortium.

Annual Conventions. The annual meetings of the NCCBMI are held as part of the ADCIS national conventions. All persons are welcome to attend these meetings, although only members of the consortium will vote in NCCBMI business meetings.

Invitation to Join

A formal invitation to join the NCCBMI is extended to all persons interested in the application of computer-based systems to music education.[4] New members will be placed on the consortium mailing list, and as ADCIS members, they will periodically receive copies of the *Journal of Computer-Based Instruction* and *ADCIS Newsletter,* which contains a section devoted to music.

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[4]Contact the author, Fred T. Hofstetter, President, NCCBMI, for membership application forms.

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