
Microcomputer Report of the Minnesota Educational Computing Consortium

by
MECC Instructional Services Division

Background

The use of microcomputers is a relatively recent phenomenon that has occurred in a variety of application areas on a nationwide basis. Interest in microcomputers is high, and it is difficult to stay abreast of an exploding knowledge-base. During 1979, the microcomputer industry has been stabilizing. The phenomenal growth of retail sales and distribution outlets that occurred in 1978 has slowed, but 1980 will see the industry begin to escalate and touch practically every dimension of society. Microcomputer manufacturing should catch up to the demand for equipment in 1979. Distribution channels and retail outlets will be handling selected equipment lines rather than whatever is available, and the public's expectations about microcomputers tend to be ahead of capabilities and the knowledge required to effectively use these technological devices.

Since education tends to pick up on technological advances after business and industry, a significant increase in the sale of microcomputers can be expected during 1979-80. This is particularly true for systems costing less than \$2,000. Inexpensive systems are well suited for

activity in introductory programming and small instructional simulations. The current number of microcomputers in education is estimated to be 25,000 and will swell to 100,000 by 1982. Radio Shack's "Introduction to Microcomputers" packet sent to every school district in the country, Commodore's "Three for the Price of Two" sale, and APPLE's feature magazine on "Computers in Education" are examples of events which have familiarized the educator with the potential for obtaining and using microcomputers.

Software development and related instructional support for the promotion of classroom computer activities will not keep pace with the initial movement toward microcomputer usage. In the case of many of the systems, use will be impeded because of a lack of hardware/software features. In order to meet the expanding need for assistance with microcomputer hardware and software, it is necessary for educational service agencies to broaden support in these areas. Microcomputer companies will be able to promote sales by providing materials and methods for incorporating computer technology into the classroom. Textbook publishers are just beginning to explore the potential of producing learning materials based on microcomputer technology.

The 1978 Microcomputer Report

In December 1977, the MECC board of directors established the Microcomputer Task Force for the purpose of advising the Executive Director and MECC member systems on matters related to the evaluation and utilization of microcomputers for instructional computing services. Three general recommendations resulted from the task force activity and each is summarized below:

Acquisition of Microcomputers

It was recommended that MECC release an invitation for bid for the acquisition of microcomputer systems by any non-profit, education-related organization. The statewide bid defined for manufacturers and vendors the specifications for a microcomputer to be used in the educational environment. The bid also served as a guide to educators needing assistance in acquiring a system to meet their needs. Bids were received and APPLE Computer, Inc. was the successful tender. The resulting statewide contract for purchase of microcomputers allowed MECC members and others to purchase the APPLE II microcomputer system at a cost reduced by APPLE's education grant.

Support

It was recommended that MECC provide support services to Minnesota's educational users of microcomputers. Support for the 1978-79 school year concentrated on the APPLE II system which was awarded the statewide contract. This support fell into four general categories: 1) purchase,

installation, maintenance, and documentation of the system; 2) training in system operation and use of applications packages and programming languages; 3) acquisition, conversion, development, maintenance, documentation, and dissemination of applications packages; and 4) response to questions, problems, and requests for assistance.

Microcomputer Technology and Instructional Computing

It was recommended that MECC continue to analyze microcomputer hardware and software technology and continue to disseminate the resulting information to the Minnesota educational computing community. As that report was being written, new advances in microcomputer hardware and software were released which enabled educators to do more computing in ways not possible on then-existing microcomputers, and at reduced costs.

Microcomputer User Considerations

The 1979-80 school year will be one of transition for users of computers in Minnesota schools and colleges. The move will be from almost exclusive use of large mainframe systems delivering timesharing services to a combination of timeshare systems and microcomputers.

To date, the actual number of Minnesota school districts experienced in the use of microcomputers is small. Less than 10 percent of the schools have used microcomputers. This is rapidly changing. By fall, 1979, 50 percent of the school districts currently using computers, and all of the colleges, will have some

microcomputers in their educational programs. Some of the specific modes of microcomputer use in schools and colleges are given in the table following. Teachers and instructors expect to use microcomputers in three different aspects of their educational programs.

First, microcomputers will be used to provide equipment for the teaching of computer programming. In general, the BASIC computer language is taught. In the past, 50 percent of the use of computers in schools and colleges was in computer programming.

The second use of microcomputers is execution of computer program applications ranging from mathematics

drills to science simulations. The greatest growth in the use of computers in education is expected in the area of applications. The majority of current microcomputer purchases are being made for special education services, and various subject area departments in high schools and colleges.

Third, microcomputers are used to teach about computers in the "introduction to computer" course taught in colleges and in specific "computers and society" courses taught in secondary schools. For example, the computer is sometimes used as a part of a social studies class in which students may study the role of computers in society.

Educational Applications for Microcomputers

Art

- Graphic techniques
- Form
- Color and medium mixing
- Art production and art history in CAI

Business

- Data processing
- Management
- Programming
- Financial courses
- Accounting courses
- Statistics
- Economic simulations
- Marketing simulations

Industrial Arts

- Variable dimensions
- Stress analysis
- Cost and time computations
- Use of tools, construction techniques, wood furnishing, planning layout, and safety in CAI

Language Arts

- Language structure simulations and operations
- Translation problems
- Individualized units on grammar, vocabulary, spelling, and sentence structure

Mathematics

- Computer applications
- Routine calculations
- Variables in complex relationships
- Conic sections
- Graph functions
- Number-line operations
- Geometric figures
- Real-life simulations with a mathematical base

Music

- Computer-generated music critique
- Music form, harmony, rhythm, compositional techniques, transposition, and music history in CAI

Physical Education

Defences, plays, and strategies
Team statistics
Game rules

Pre-Medical and Medical School

Biological or medical diagnostics
Data reduction

Reading

Self-paced instruction
Reader progress management
Diagnosis and prescription
Individualized reading
Multi-modal

Resource Centre

Information retrieval
Media equipment scheduling
and checkout
Cataloging
Records for acquisitions,
supplies, reserve books,
budgets

School Management

Attendance records
Budget control
Computation of grades

Data processing
Inventory management
Progress of programs
mandated by PL 94-142
Scheduling
School calendar
Test scoring
Trend analysis

Science

Chemistry
Chemistry and physics simulations
Laboratory equipment testing
Theory examination
Computer technology
Electrical engineering theory

Social Science

Human/environmental interactions
History drill
Government interactions

Special Education

Individualization with progress data
Self-pace instruction with branching

*This table is based on information compiled by Bell & Howell Audio/Visual Division (distributors of microcomputers).

Appeal of Microcomputers

Educators in Minnesota are taking great interest in microcomputers. They see the microcomputer solving some problems posed by large-scale computers: the need for and cost of

telecommunications, timeshare hardware costs, and lack of local control of computing resources.

The terminal to timeshare computer connection requires the use of telephones. Telephones are not located in every classroom and thus the

use of computers in instruction has been in restricted and often limited locations. The cost of the telephone communications can be high. In addition, there is the use of the telephone with shared access to the computer, which can mean the frustration of busy signals.

The low cost of microcomputers means that computers can now be introduced into curriculum areas where they were once too expensive. Particularly notable is the number of microcomputers available now in the elementary schools. Also, microcomputers are being used to add computer resources to programming classes where a shared terminal for 30 students has long been a problem. Colleges are finding that microcomputers provide an inexpensive and practical way to add computer resources to their increasingly popular introductory courses. Voice input/output capabilities generate new uses for computers in schools and colleges. Graphics and the faster rate of information-display interest both experienced and inexperienced computer users.

Many schools prefer to do and to control their own computing. Paying a service fee and sharing a resource with other institutions is not as popular as paying a one-time purchase price and having control over the equipment. When a microcomputer fails, the failure is easier for the user to understand and accept than the "downs" on remote systems. However, if the microcomputer requires repair, the owner pays the cost and waits while the machine is at the repair shop.

Hardware

The specific hardware requirements for microcomputers used by Minnesota schools vary according to the application. In general, the need for a hard-copy printer is much less

in an elementary school than in a high school programming class. Similarly, the elementary school may well need a larger system (more RAM storage) than the high school programming class since the elementary application programs are more complicated than those of the high school.

Colleges have a greater need to interface peripheral equipment with a microcomputer. In addition to adding hard-copy capability, there is also a need to interface with other computers and with laboratory devices, and to add other types of experimental modules.

Since distributing and sharing microcomputer software can be easily handled through a centralized computer system, it is important that microcomputers be able to communicate through standard modems to a host machine. The most practical interface is an RS-232. This interface is compatible with variable baud rates. New types of small modems allow for interesting and practical inter-microcomputer communication and microcomputer-timeshare connections.

User needs for microcomputer features also vary with experience. Initially, it was thought very satisfactory to have a BASIC-only microcomputer. As microcomputer technology advances it is becoming evident that other language capabilities are going to become essential in the educational computing environment. Users now expect their microcomputer to have some degree of graphic capability. Many expect the graphics to have a high resolution and also to be in color.

Perhaps the greatest concern for microcomputer hardware is that it be dependable. If there is a breakdown, service must be readily available so that the unit can be restored in a short period of time. It is assumed that as the number of microcomputers in schools and homes increases,

the number of service centres will also increase. Currently, schools are limited to the few retail dealers who also provide maintenance/repair service. Maintenance/repair service must increase to insure microcomputer reliability.

Software

The need for software falls into two categories: system software and applications software. The programming instructor finds a need for a good BASIC language. Currently, there is little interest in other higher level languages or in machine language at the secondary level. Colleges, on the other hand, find alternate languages such as PASCAL to be of value.

Educators are greatly concerned about the availability of applications software. Few are interested in purchasing a microcomputer without the assurance that software will be available. To date, there is very little commercial applications software which has any educational value.

The promise of the microcomputer is that many individuals and groups will be developing applications software. As this activity emerges the concern will be dissemination. Much has been said about the ease of disseminating via cassette or tape. True, it is a simple process, but until mechanisms for carrying out the process are in place, not much dissemination will occur. These mechanisms, whether commercial or cooperative, will have some real costs. Software will not be "free."

In addition to the obvious dissemination mechanisms there is transfer from one computer to another called off-loading. In Minnesota, off-loading is electronically moving computer programs and data files between a timeshare system and a micro-

computer. Off-loading works both directions, downloading being the transfer from the large statewide timeshare system to the microcomputer and uploading being the transfer from the microcomputer to the timeshare system. The off-loading capabilities provide an effective means for disseminating software statewide.

Downloading through a timeshare network offers some unique advantages to users as they build up program libraries on their microcomputer diskettes. Users of downloading have the advantage of being able to group programs on diskettes in an arrangement which best suits their needs. For example, programs relating to geography can be on one diskette, science programs can be on another diskette, and so on. This program transfer is done by the user without anything more than calling to obtain the most current copy of the rapidly changing software.

The downloading process offers tremendous dissemination potential but it can be time consuming. Even at 30 characters per second, programs which use special data files and chain to other programs may take several hours. Downloading binary special situations standardized program sets on discs will be available for distribution to users. (Microcomputer software availability is the focus of the third section of this article.)

Support

The new owner of a microcomputer in education is not like the average hobbyist, who enjoys tinkering with a system. Simply setting up a microcomputer, no matter how explicit the instructions, is a task some teachers are unwilling to perform. It is essential to have some support available to new users. This service has generally been more than a local

vendor can supply. MECC Instructional Coordinators have assisted Minnesota users by delivering and installing equipment, and providing initial training at the user's site. Also, MECC staff have written a "New User's Guide for the APPLE II" to assist the new user. This publication is available through the MECC Publications Department.

Workshops are necessary to get users off to a good start. The workshop sessions cover many of the "tricks" of using a microcomputer system, the BASIC language, and special microcomputer programming features. As owners begin using microcomputers they find a need for answers to specific technical questions which cannot always be found in the manuals. These questions often require additional consultant help. MECC's User Service staff, including a user consultant who can be called on a toll-free telephone line, provides this service.

As needs change, the user often wishes to add peripherals to the system. The first such peripheral is often a hard-copy terminal. Sometimes the user wants advice on more exotic units. The MECC user has a need for competent advice on peripheral alternatives. At MECC such services are provided by the User Services staff.

Microcomputer Software Availability

The past decade of instructional computing experiences has convinced educators that computing hardware is only part of what is needed to make effective classroom use of the technology. Good quality software, for applications as well as systems, is vital. Applications software usually requires some complementary written materials. These materials may be in

the form of student worksheets, teacher guides, and resource booklets. The combination of these learning support materials and the applications programs (software) is referred to as instructional computing courseware.

High quality, educationally sound applications for microcomputers comprise a very real need in education. This section addresses the various sources for microcomputer software, summarizes what is happening in the area of software, and describes various methods of distribution. Types of current applications and near-future innovations are also discussed.

Sources for Applications

There are at least four major sources of instructional computing courseware development:

- 1) Commercial publishing or software houses.

There are indications that publishers' interest in microcomputer courseware is growing. A few companies, established in related businesses, are now in the microcomputer software business. In addition to small software companies established primarily for software development, some small educational publishers are preparing to release initial applications products. If these initial efforts are successful, then the larger education publishers may move into this field.

- 2) Hardware manufacturers.

Some major microcomputer vendors are expanding their software library offerings. This expansion, through some devel-

opment but mostly through author royalties offered to individuals and organizations, should bolster the quantity and quality of available courseware.

3) Educational cooperatives.

MECC and other educational cooperatives are a prime source of instructional computing applications. At the present time, most courseware from educational cooperatives deals with specific topics, and comprehensive units of study have not yet evolved. Many of these cooperatives have a reputation as providers of sound instructional computing software. The software developed at these locations may eventually be made available to microcomputer users, especially within the educational community, on a low cost or exchange basis.

4) Individual school districts.

There are many individuals and teams currently developing software in local districts. However, locally developed software is often written to meet the specific needs of a school and may have less applicability in other settings. It is often difficult to locate software developed by individual districts. A teacher may never hear about an excellent set of applications produced by a neighboring school.

Applications Currently Available From MECC

1) Converted Applications

At present, MECC staff has made available to MECC users

over 100 microcomputer applications programs. Many of these programs have related courseware materials available; that is, the software is complemented by appropriate written materials for the teacher and student. These programs are primarily conversions from the MECC Timeshare system to the APPLE II microcomputer. The conversion process from a timeshare terminal orientation to the screen oriented APPLE is generally a two-step process. After downloading the program into the microcomputer, the program is converted for correct syntax and good screen presentation. The second step is to take advantage of the animation, color, graphics, and sound capabilities of the microcomputer. These special feature capabilities are added to a program only if the effectiveness of the program is enhanced by such an addition.

2) Microcomputer Utilities

Utilities to aid in activities such as downloading programs from the timeshare system, generating high resolution shape-tables by keyboard entry, and creating and editing text files have been developed by MECC staff. These utilities aid MECC users in making more efficient use of their microcomputers. A special STARTER program, documented by a MECC publication, the *MECC/APPLE Authoring/Programming Guide*, includes most of the subroutines and utilities necessary to author and produce quality software efficiently.

3) New Development Efforts

Microcomputer capabilities such as graphics, sound, color, and animation have greatly increased the computer's potential as an instructional aid. The MECC community, both staff and users, have already begun development of many new instructional computing packages. Built around the microcomputer, the courseware will take advantage of this new and exciting potential. A comprehensive music theory package of seventeen programs is one example of a new application developed by MECC staff. This package was an impossibility before the graphics and sound capabilities were available. Additional applications, designed to be comprehensive units of study, are presently under development in geometry, elementary reading skills, and middle school science.

Methods of Distribution

Effective instructional use of microcomputers is very dependent upon dissemination of applications programs. The MECC staff has considered a variety of possibilities including tape or cassette shipping, mailing listings, and electronic transfer. While special cases will undoubtedly require the use of a variety of techniques, MECC has decided to use the previously described (see "Software" section) downloading technique as its primary means of disseminating applications programs within Minnesota. The written materials part of the courseware packages will be handled through the MECC Publications Department's order/shipping process.

Among the several methods of distributing microcomputer software, the most widely used method is cas-

sette tape. While inexpensive, this method is time consuming and, on a large-scale basis, may have serious reliability problems. Most educators prefer floppy diskettes over cassettes. This means of distribution, that is, duplicating and mailing diskettes/cassettes solves some problems. Even for the inexperienced user, duplicating diskettes is a relatively simple process. However, the user who wants only three of the 20 programs on a diskette or cassette is forced to buy something unwanted. Program enhancements, which are assumed to be frequent in these early development days, are impossible to keep up with in a large user-group. Simple program replacement probably requires the purchase of a whole new diskette.

Given that MECC already has in place a statewide mechanism for transfer, MECC has chosen to keep a library of APPLE II programs on the timeshare system, and MECC users are now able to download programs to their microcomputers. This process works quite well for some applications. However, others, such as the MECC/APPLE II Music Package, require the downloading of 17 programs. This process can take hours. As a practical matter, such packages may require disk duplication for the initial version while using downloading for enhancements or revisions.

The technology of distributing software through single program ROM cartridges has a bright future. The reliability and protection from unauthorized duplication make this method attractive to commercial vendors. Users are wary of the higher cost of the method and the system's general inability to make program modifications.

With increased availability of software and ease of distribution, duplication and copyright violation problems arise. Schools within an

educational cooperative generally have the right to use the software developed for them in the manner they choose. However, schools or individuals purchasing commercial software are not purchasing the right to duplicate or distribute programs. This prohibition holds even within districts or between colleagues. Good quality software is expensive to develop, and microcomputer users cannot expect commercial products to become available unless they are willing to pay. Commercial organizations need educators' encouragement to get into instructional computing courseware development. Educators must provide some encouragement by assisting in protection of software products.

MECC Courseware Distribution Policy

MECC is reviewing the various alternatives for distributing software to educational users throughout the country. MECC has an attractive timeshare system package of applications for sale and has distributed numerous copies. If interested in obtaining the "MECC Software Distribution Policy" booklet, send one dollar (\$1.00) to MECC Publications Office, 2520 Broadway Drive, Lauderdale, MN 55113, and ask for publication number 200-1. This booklet lists both the timeshare (CDC-CYBER 73) and microcomputer (APPLE II) software packages available for sale.

Software Summary

Early development of the instructional use of the microcomputer has focused on the ease of use and capability of quickly providing information to users. The microcomput-

er can only become a significant factor in education if high quality courseware is produced and made available to all users. Teachers will need background information, suggested methods of use, and user guides to help them make effective use of this new teaching/learning tool.

Instructional computing software for microcomputers is expected to become more abundant as protection against duplication increases. Educators looking for high-quality software should examine:

- 1) courseware packages that include the applications software and teacher/learner support material such as guides, resource booklets, and student worksheets;
- 2) software that effectively uses the special capabilities of the microcomputer;
- 3) courseware packages that are stand-alone, comprehensive lessons, or units that can meet the different needs of teachers and students;
- 4) courseware packages that are well packaged and attractively presented; and
- 5) courseware packages that include good user documentation.

The availability of high quality, educationally sound courseware for instructional computing will be greatly enhanced by local, state, and national educational decisions addressing the need for incorporating microcomputers into the classroom.