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ABSTRACT
                Arguments for the inclusion of computers in the
schools and guidelines for the effective use of computers in
educational settings introduce this outline of a college course
designed to train students and teachers to successfully utilize
microcomputers in prekindergarten through third-grade classrooms. The
argument is made that, since computers are being touted as a
revolution in pedagogy, teachers must become knowledgable about the
potential of computer technology. Only when equipped with such
knowledge will teachers be able to assess proponents' claims and to
lead in appropriately introducing computer technology into
educational settings. Specifically, it is asserted that teachers must
consider the context in which computer technology is introduced and
the various potential uses of computers. In line with this
recommendation, the course described, entitled "Teaching with
Microcomputers: The Early Years," offers undergraduate and graduate
students the opportunity to use the computer as a tutor, a tool, and
a tutee. Tutored by the computer, they experience, evaluate, modify,
and write instructional/managerial programs across early childhood
subject matter domains. Using the computer as a tool, they learn
about word processing and information management for themselves and
children. Using the computer as tutee, they "teach the computer,"
learning to program and to teach young children to program in Logo.
Finally, teachers are advised that others will take leadership in
providing instruction with computers, if they do not. (RH)

MICROCOMPUTERS IN EARLY EDUCATION:
RATIONALE AND OUTLINE FOR TEACHER TRAINING

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MICROCOMPUTERS IN EARLY EDUCATION:
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Abstract

This paper provides teacher trainers who have varying
levels of knowledge of microcomputer applications to
education with a model for the justification and planning of
a college course for teachers: Teaching with
Microcomputers--The Early Years. It includes
rationale/background, consideration of the educational
context, alternative solutions and their consequences, and
the need for critical evaluation. There is an increasing
acceptance of the critical necessity for children to become
computer literate and for teachers to become capable not
only of teaching about computers, but of teaching with
computers to improve the quality of education and meet
contemporary educational objectives and problems. Early
childhood educators need training in the use of the computer
as an instrument for assisting and managing instruction, as
a general purpose tool, as a prosthetic device for the
handicapped and enrichment device for the gifted, and as a
tool for teaching programming in a child-oriented computer
language. Effective use of this tool demands consideration
of the context of that use; training must take into
consideration the content of the early childhood curriculum
and the characteristics of the young child.
Promises made in the name of computer technology are
numerous. Educators need to fulfill these promises whenever
possible, yet guard against uncritical acceptance of these
promises and the pedagogical implications drawn from them.

MICROCOMPUTERS IN EARLY EDUCATION:
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Background and Rationale for the Course

There is an increasing acceptance of the critical
necessity for children to become computer literate. Over
half the labor force holds information-related jobs; by
1985, over 75% of all occupations will deal with computers
in some way (Molnar, 1981). Ignorance of computers will
render people as functionally illiterate as ignorance of
reading, writing, and arithmetic (Michaels, 1968).
Therefore, educational organizations (National Council of
Supervisors of Mathematics, 1978; National Council of
Teachers of Mathematics, 1980) have advocated computer
literacy for all children. Professionals have stressed the
need for teaching computer literacy in the schools, citing
it as the next great crisis in American education
(Luehrmann, 1980; Molnar, 1981; Papert, 1980).

There are other arguments for the inclusion of
computers in the schools. Teachers need to not only teach
about computers, but teach with computers to improve the
quality of education for children and meet the demands and
problems of contemporary education. Research demonstrates
that the computer can effectively manage and conduct
instruction. However, the most powerful use of the computer
is the least studied—the child's use of the computer as a
tool. Many authorities have extolled the virtues of this
approach. From word processing to programming, this use has
the potential of expanding the intellectual capabilities of
learners, making us all inventors of our own intellectual
tools (Molnar, 1981; National Institute of Education, 1980;
Olds, 1981); amplifying the powers of humanity and
liberating human potential (Dwyer, 1980). However, it is
just as important to note that these claims have not yet
been substantiated. As has happened with so many
innovations, computer use is being touted as a revolution in
pedagogy. Education has a history of embracing a simplistic
interpretation of such innovations and then, when practice
reveals weaknesses, completely rejecting the theory. So
that they will not blindly endorse nor needlessly reject
computer technology, teachers need to be knowledgable of its
potential and application.

The educational context. Effective use of any tool
demands consideration of the context of that use. For
teachers to effectively exploit the potential of the
microcomputer, their training must take into consideration
(a) the content of the curricula they are to teach, (b) the

psychological characteristics and capabilities of children in the grades they teach, and (c) their previous experience and orientation. With these considerations in mind, how might teachers of young children utilize these technological capabilities? The computer might serve both teachers and their students as a tutor, a tool, and a tutee (Taylor, 1980).

The computer as tutor. As a tutor, the computer is used by the teacher to supplement the presentation of curricular material. Computer programs (software) which are directly relevant to preschool and primary grade curricula must be experienced, evaluated, modified, and written by teachers responsible for teaching these grade levels. While introductory courses and experiences providing contact with general Computer Assisted Instruction (CAI) materials are necessary, teachers can not, and will not, use CAI materials in their classrooms unless they appreciate and master the use of software which specifically address their instructional needs. Such software exists; furthermore, research is beginning to accumulate supporting its efficacy in developing ability in readiness skills (including attention span), the language arts, reading, mathematics, science, and social studies (e.g., Brebner, Hallworth, McIntosh, & Wontner, 1980; Cleary, Mayes, & Packham, 1976; Fletcher, 1976; Howe & O'Shea, 1979; Hungate, 1982; Kimmel, 1981; Lewis, 1981; Staples, 1981; Swigger, 1982; Swigger & Cambell, 1981; Tekawa, 1980). Teachers and students need resource material, guidebooks, project suggestions, and so on. The more specific the goals, the more detailed and extensive the materials needed (Watt, 1982); also, the more grade-level appropriate materials need be.

The appropriateness of CAI must also be addressed. Computers can be programmed so that, for example, three-dimensional representations of blocks appear on the screen to be counted. While this is interactive, and feedback is given, it may be that the traditional provision of real, movable objects constitutes a more complete and educationally meaningful experience for children whose logico-mathematical learning depends heavily on action sequences (Piaget, 1952). The essential question is: What experiences should and should not be computerized for young children (Thomas, 1981)?

Teachers can learn to use authoring languages (computer languages specifically designed to help teachers write CAI materials) such as PILOT (Programmed Inquiry, Learning Or Teaching). Within a few hours, even inexperienced teachers can begin to write short instructional programs (Camuse, 1982; see descriptions of other systems in Lubar, 1981, and

guidelines to the design of programs in Hartman, 1982;
Thomas, 1981).

Training in the use of Computer Managed Instruction
(CMI) must also be relevant to teachers. The programs
studied must be usable by young children and must meet the
needs of teachers for flexible grouping. Research comparing
classrooms with CMI and those without it has usually favored
the former, both in terms of students' achievement and
attitude toward the subject. There is some evidence that
children react favorably to the CMI systems themselves, as
have parents. Computer assisted testing has been shown to
be a better predictor of success in mathematics than
standardized testing, and students considered it more fair
(Brebner, Hallworth, McIntosh, & Wontner, 1980; Cartwright &
Dervensky, 1976; Haugo, 1981; Kieren,1973; McIsaac & Baker,
1981; Spuck & Bozeman, 1978). It is not certain if all
these results apply to early education. Consideration of
personal and psychological parameters will reduce the
likelihood of failure that threatens so many technological
applications (Bozeman, 1978).

The computer as a tool. As a tool, the computer
will be an invaluable aid in helping the teacher of young
children meet the needs of young handicapped children
(prosthetic devices, individualize and monitor instruction,
motivate, manage IEP's, etc.; Cleary et al., 1976; Papert &
Weir, 1978. Significantly, research indicates that special
needs children are motivated by computer-based instruction;
Cartwright & Derevensky, 1976). Managing information
through computer technology has rescued preschool programs
which must gather data on student background, health
services, evaluations, handicap services, food services,
attendance, social services, and parent participation
(Cogdill & Goldberg, as cited in Joiner, Vensel, Ross, &
Silverstein, 1982). Again, it can be noted that application
of computer technology must consider the needs of the
teacher and his or her students.

Students can also use the computer as a tool. Goals of
computer literacy, reading and writing abilities (as well as
all curricular areas), and study/organization skills will be
developed as children use the computer to help the teacher
keep records such as attendance, make graphs, compose music,
and create computer art. Yet these goals will be achieved
only if teachers are skilled in the use of software which is
appropriate for interactive use by young children. This
need is nowhere more important than in the last category of
computer use, the computer as a tutee.

The computer as tutee. As a teacher, the computer

represents a powerful tool; yet its real impact will be on
children who teach the computer. By programming the
computer to do what they want it to do, children must
reflect on how one might do the task oneself. "In teaching
the computer how to think, children embark on an exploration
about how they themselves think" (Papert, 1980). Computers
will serve as intellectual amplifiers. Marvin Minsky of MIT
has said: "Eventually, programming itself will become more
important even than mathematics in early education" (Minsky,
cited in Milner, 1980). It is essential, however, to once
again consider the characteristics of the young child.
BASIC is an excellent computer language for older children.
However, it was initially written for college students.
There are alternate languages, like Logo, that are
appropriate for young children in that they are high-level,
interactive, "natural" (English language oriented),
"user-friendly," and procedural. This means that children
can build their own commands, program in units of words and
sentences, write meaningful programs within minutes of
sitting down in front of the computer, and "debug" their
programs and their own thinking. Logo is a language for
learning. That in fact young children can learn to, and
learn from, programming in Logo has been substantiated in at
least pilot work (Howe & O'Shea, 1979; Papert, 1980; Papert,
diSessa, Watt, & Weir, 1979). It appears possible to
integrate this into the school day; however, to do this,
teacher training is critical (Watt, 1982).

Here again, however, quality teacher training is also
necessary to guard against uncritical acceptance of
ideas and promises such as these. A leading exponent of the
use of computer programming to expand children's
intellectual power, Seymour Papert (1980), based his ideas
on the theories of Piaget, with whom he studied. However,
Papert has not addressed certain Piagetian hypotheses which
would tend to argue against the notion of the revolutionary
potential of the computer. For example, that no
environmental conditions can allow young children to deal
with abstract concepts before they reach the period of
Formal Operations. Similarly, the claim that computer
programming will restructure the way children think is not
supported by the Piagetian notion that thinking progresses
according to fixed biological laws, in conjunction with, but
never determined by interactions with the environment
Rousseau & Smith, 1981). Also ignored are some lessons from
history, notably the Progressive Education Movement, which
demonstrated that children in complete control of their own
learning may limit themselves to a relatively narrow range
of interests. Lastly, for very young children, several
questions must be addressed: What is the effect of computer
use on their development? Are other, possibly more

valuable, experiences supplanted? Such issues and
controversies must be studied and discussed if teachers are
to use computer technology wisely.

Many have advocated that all teachers "be required to
take a course in computer programming" (Milner, 1980, p.
546). BASIC may be an appropriate language for teachers of
older children. However, languages such as Lógo provide a
problem-solving environment which permits young children to
play with powerful ideas. They provide a natural,
humanistic approach which matches the orientation of most
early childhood educators. Therefore, they are much more
appropriate languages for teachers of young children to
learn. Once again this argues for teacher training which is
specific to the grade level and needs of the teacher.

Summary. Not only do we need computer literate
teachers to produce computer literate children; but teachers
who are not computer literate are not fully prepared to help
children develop in any of the many areas of concern in
education. They cannot effectively use these technological
tools to help children learn subject matter content,
interact socially, and further their intellectual
development. Teachers will have computing resources at
their disposal (Beck, 1980); they need to know how best to
use them. To learn this requires that they receive
continued support and training (Watt, 1982). "The failure
of schools to make a major commitment to computer literacy
now can have disastrous consequences for the public and for
public education" (Watt, 1981, p. 87).

Thus if we do not produce teachers capable of using
this tool, we do an injustice to those teachers as
professionals and ultimately to children.

Alternative Solutions and Their Consequences

Computers are proliferating in business, industry, and
the home. If colleges of education do not take
responsibility for leadership in computer education, others
will. If this happens, computer education will be in the
hands of those without dedication to, and expertise in, the
provision of educational opportunities befitting a
democracy. The first ramification is the possibility of a
decrease in the quality of education for every child. The
second is the possibility of a societal movement toward
overreliance and submission to the "expert" (either computer
or technocrat), what Hansgen (1982) has termed "the tyranny
of expertise."

It might be thought that microcomputer sales people

could provide this training. This presents several
disadvantages. They are not well versed in educational
theory, practice, or software--they are inclined not to
dispel the myth that educators can purchase a computer and
"someone" can write programs for it. They tend not to
emphasize possible complications. They are not particularly
able to ally the apprehensions teachers have, dispelling the
mystique of the computer. This, is a necessary first step.
Without a teacher educator with a knowledge of
microcomputers and software, computers in the schools will
fall into disuse or misuse.

Finally, as the preceding section has emphasized,
courses must take into consideration the characteristics of
the teachers and the students they will teach. Thus, they
must be tailor-made to meet the needs of both. No
"umbrella" course for all education majors can meet these
needs. However, both undergraduate and graduate students
have these needs. Few early childhood education majors have
expertise in this area; even those who have had some contact
with computers are relatively inexperienced in early
childhood applications. Therefore, undergraduate and/or
graduate courses can be recommended.

<u>Objectives</u>

Teachers will:

1. experience, evaluate, and modify instructional programs
    dealing with early childhood curriculum.

2. demonstrate competence in using "tool" programs such as
    word processing and classroom and information
    management; apply such programs in professional and
    managerial work and in helping children use these tools.

3. demonstrate competence in programming in Logo and in
    developing instructional approaches for teaching this
    language to young children.

4. develop plans for implementing a computer literacy
    program for young children.

5. develop plans for organizing computer use in the
    classroom, including the computer as a tutor, tool, and
    tutee for teacher and for child.

6. design instructional units for the curricular areas of
    early childhood education which incorporate computers.

7. describe the dangers and disadvantages of computers.

8. describe the use of microcomputers in instructing the special child.

9. design and construct a specific-application lesson in PILOT.

Course Abstract

The course is designed to train students to successfully utilize microcomputers in prekindergarten to grade 3 classrooms. Students will integrate course content with direct laboratory experience with microcomputer applications. The course design considers the characteristics of early childhood educators and young children. Students will learn to use the computer as a tutor, a tool, and a tutee. In its role as a tutor, they will experience, evaluate, modify and write instructional/managerial programs across early childhood subject matter domains. As a tool, they will experience the power of word processing and information management for themselves and children. As a tutee, they will "teach the computer"--learning to program and teach young children programming in Logo. This language for learning has powerful graphic and language arts capabilities, and the potential of expanding the intellectual capabilities of young learners. Special topics will include computer literacy for young children, dangers in the computer world, and microcomputers and the special child.

Course Outline

I. Why have computers in the preschool and primary school?
   A. The current place of the computer in the young child's world.
   B. For instruction: an introduction.
      1. Teaching about computers: computer literacy.
      2. Teaching how to use computers: computers as tools--e.g., Logo
      3. Teaching with computers: computers as tools for the teacher.
   C. Teaching special groups: the handicapped and gifted.

II. What is going on with computers in preschool and primary grades?
   A. Computer-Assisted Instruction (CAI): Some examples for the young child
      1. Drill and practice
      2. Tutorial
      3. Simulation
      4. Instructional games

          5. Problem solving
          6. Information retrieval; DBMS
     B. Computer-Managed Instruction (CMI)
          1. Testing, diagnosis, and prescription.
          2. Progress tracking.
     C. Other uses.
          1. Record keeping.
          2. Word processing (by the teacher).
          3. Developing original instructional materials.

III. Computer literacy: What should young children know about computers?

IV. What about programming?
     A. Do I have to know programming? (reducing anxiety).
     B. What do I do if I want to learn and teach programming?
          1. Lessons with Logo.
          2. Creative computing: Ideas on stimulating creative use of the computer in the classroom.
          3. Fostering cognitive development.
     C. Writing educational software: Lessons in PILOT.

V. How can computers help in teaching specific subjects?
     A. The language arts.
          1. Word processing: Its use in composition and reading.
          2. Programs to teach specific knowledge.
          3. Teaching the computer to compose.
     B. Science and social studies.
          1. Simulations.
          2. Inquiry: Solving problems utilizing the computer as a tool.
     D. Mathematics
          1. Inquiry: Logo and the exploring child.
          2. Instructional programs.
     E. The Arts

VI. Are There Dangers in the Computer World?
     A. Authoritarianism, experts, and the computer.
     B. The "addiction" of video games and the (positive) addiction to learning.
     C. Automation: How will it change our world; will it change us?
     D. What are the effects of microcomputer use on very young children? Are other important activities supplanted?

Course Evaluation

1. Topical outline tests--both written and performance criteria

2. Resource file of units and activities

3. Computer programs as developed by the students

4. Class participation--discussions and laboratory

Course Hardware and Software

Obviously, availability of funds limit purchasing. A moderately satisfactory solution would be the acquisition of enough microcomputers for half of the class. If this is not possible, three or four might be used for demonstration and then be available during the week for student laboratory use. Some college classes have been conducted in local microcomputer stores. If the curriculum does call for programming in Logo, make sure that this language is available for the microcomputers you will use. Several sources which present a guide to hardware selection are available (Braun, 1979; Thomas & McClain, 1979; Thorne, 1980).

Similarly, acquiring software can be an expensive proposition. Logo may be your first purchase. You can then choose from authoring languages (e.g., PILOT) or utility programs for word processing, filing, graphing, and the like. If you have the funding to purchase CAI and CMI materials, your time will be wisely spent in the study software reviews and evaluation guides (see the computing magazines in local computer stores and Douglas & Neights, n.d.; Dyer & Forcier, 1982; Heck, Johnson, & Kansky, 1981; Holznagel, 1981; Jaycox, 1979; MicroSIFT, 1981). Reviews can serve as substitutes for materials not purchased.

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