

# TECHNOLOGY COMPETENCIES FOR NEW TEACHERS: ISSUES AND SUGGESTIONS

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## ABSTRACT

This article discusses technology-related competencies for teacher education programs. A discussion of the difficulties inherent in defining computer literacy is included as well as a brief examination of the results from surveys of practicing teachers' use of and opinions about technology. The article concludes by proposing three minimal instructional technology competencies, along with suggestions for evaluating preservice teachers' performance of these competencies.

## DEFINING COMPUTER LITERACY

There are several problems in identifying the knowledge and skills required to be computer literate teacher. Not the least of these difficulties arises from the rapid change in educational technology that has resulted in an evolution of the meaning of computer literacy. A few years ago, this kind of literacy might have implied that a person understood how a computer worked and was able to write a computer program. Now, using a computer to accomplish a specific task might be all a person needs to know.

Instructors in schools of education need to consider what teachers need to know about the use of technology in instruction. Do they need to know how to use videodiscs and CD-ROM, even though these devices might not yet be in widespread use in schools? Do we, as preservice educators, instruct teachers in the use of outdated equipment that the schools might use, or show them how to use the latest technology? Defining computer literacy for preservice teachers is not a simple task.

Another reason for the difficulty in defining computer literacy is that computers can be used for many tasks. Which capabilities are important for preservice teachers to know? If a teacher can incorporate database searches as part of their students' class work, but doesn't know how to use a modem, is that person computer literate? What does a teacher need to know? What skills are essential?

Assuming a list of computer competencies could be created, there are other problems to consider. As in any skill assessment, levels of ability can be difficult to establish. If a person who uses a powerful word processor and does not take advantage of all its capabilities, is that person computer literate? This issue is complicated by the fact that some software is easier to use than other software. How many different word processors (on how many different computers) should be considered? If a teacher can use the keyboard efficiently, is it also necessary to know how to use a mouse?

The most difficult problems arise when we look at more encompassing issues such as curriculum integration and technology's impact on student cognition. How do teachers plan for using technology in their unique classroom settings? Can teachers use technology effectively if they aren't familiar with the cognitive and social effects of its use? These key issues will shape the way preservice teachers learn to use instructional technology.

Given the complexity of the situation, can we produce a list of competencies that can be demonstrated by the computer literate teacher? Clearly,

we should not be too specific in our requirements. Instead, we need to distill a set of educationally valuable tasks out of the endless possibilities technology offers. When creating this list, it would be wise to take into account the suggestions of practicing teachers.

## TEACHERS' COMPUTER LITERACY

Studies have shown that most teachers have an interest in learning more about using computers in their classes, but they are unhappy with the limited training they have received (Scrogan, 1989). A survey of over 1100 preservice teachers in Michigan indicated that 90% agreed or strongly agreed with the statement "I want more experience using computers" and 76% similarly felt that computer use enhances learning (Berger, Carlson, & Novak, 1989).

Nonetheless, the Office of Technology Assessment (1988) reports that the vast majority of those now teaching or planning to teach have had little or no computer education or training. Hurteau's 1990 survey of New York State computer-using teachers revealed that only 20% felt they had received sufficient preservice computer training. These feelings might be elicited because not only do aspiring teachers recognize that using technology can improve their instruction, but it can also help them get a job. Fratianni, Decker, and Korver-Baum (1990) found that nearly three-quarters of administrators consider knowledge of technology as a factor in the teacher hiring process.

A study by the National Center for Technology in Education (West, 1990) reports that most teachers who use computers in their classrooms are self-taught. But even though self-instruction has worked for some teachers, we cannot reasonably expect all new teachers to become computer literate on their own. Although teachers might be able to use computers, they might not be aware of the cognitive or social effects of its use on their students. If teachers are to take full advantage technology, and be aware of its limitations, they need to begin learning about technology during their preservice coursework.

## PRACTITIONERS' SUGGESTIONS

Several surveys have been conducted to learn how teachers have incorporated technology into their instruction. Hurteau's 1990 study has already been mentioned. Additionally, a small group of school district computer coordinators from western New York was asked a similar set of questions (Beichner, 1989). Results from both questionnaires are in striking agreement.

When asked to order a list of computer-related skills or knowledge for new teachers by importance, both groups listed word processing at the top and the integration of computers into the curricula of specific subject areas as the second highest priority. Interestingly, knowledge of databases and spreadsheets was near the top of the computer coordinators' rankings, but mid-way down in the rankings of computer-using educators. This might be due to a lack of clarity in the questions. It might be that teachers were thinking of training in the operation and "theory" behind database and spreadsheet programs, and so ranked them lower.

Computer coordinators, perhaps recognizing some of the uses of databases and spreadsheets in different content areas, might have placed greater value on the knowledge of these two generic types of software. This same argument might also explain why computer programming has a low ranking from both teachers and coordinators, but is held in high esteem by many educational researchers who are perhaps more aware of the powerful uses of programming for student modeling and analysis of complex situations and for the exploration of "microworlds" of the students' own creation.

Table 1. Rankings of Computer Skills Needed by New Teachers

Hurteau (1990) survey of New York State Teachers			
Training Area	All	Elem	Sec
Word Processing	1	1	2
Computer in Curriculum	2	2	1
Introduction to Computers	3	4	3
Subject Area Training	4	3	4
Teacher Utilities	5	5	8
Database Management	6	8	5
Desktop Publishing	7	7	6
Graphics	8	6	9
Spreadsheets	9	10	7
Minor Hardware Maintenance	10	9	11
DOS Commands	11	12	10
Logo	12	11	12
BASIC	13	13	14
Pascal	14	14	13

Beichner (1990) survey of NYS District Computer Coordinators

Training Area	All
Word Processing	1
Curricular Integration	2
Database	3
Spreadsheets	4
Software Evaluation	5
Vocabulary or "Jargon"	6 (tie)
Computer Assisted Instruction	6 (tie)
Computer Managed Instruction	6 (tie)
Knowledge of Source Materials	9
Telecommunications	10
Ethical Questions (privacy, piracy, etc.)	11
Social Impact of Computers	12
Computer Maintenance	13 (tie)
Programming in Logo	13 (tie)
History of Computers	15
Programming in BASIC	16

One area in which all agreed was the need for a general introduction to computers. Evidently, practicing teachers believe that beginning teachers don't understand the vocabulary associated with the new technology. However, simple hardware maintenance was consistently low ranked, perhaps implying that although teachers need to know how to use computers in their classroom, they don't need to be trained as technicians.

Comparing these recent New York State results with earlier national surveys, the differences in how teachers are currently using computers become apparent. In the two New York State surveys, programming was consistently ranked at the bottom of the list. Yet the 1983 National Education Association study cited in Stasz & Shavelson (1985) listed programming as the second highest priority for staff development. Dusseldorp (1984) also listed writing and running simple BASIC programs in the top third of computer competencies needed by preservice teachers. When these nationwide surveys were conducted, not nearly as much productivity and educational software was available for microcomputers. If teachers were going to use computers in their classrooms, they usually had to write the programs themselves.

More recent research, for example that carried out as part of the 1988 National Assessment of Educational Progress, was cited by Brosnan (1990) as indicating a trend away from programming skills and more toward the use of computer applications. This reiterates the findings of the two New York surveys. Complicating this issue is the fact that several other lines of study point out the positive cognitive impact of computer programming by students at all grade levels. (For example, see Clements & Merriman, 1988; Dalbey & Linn, 1986; Fay, 1988; Mandinach & Linn, 1986, 1987.) Unfortunately, most programming in the schools is taught as a separate computer science area. Its application by students to the solution of problems specific to a given subject area is extremely limited. Preservice teachers might need some knowledge of the ways programming can be used by their students as an exploratory tool.

Brosnan's study examined the computer competency of approximately half the teachers in a sizable urban school district. She found that 72% of these teachers rated their general computer skill at the "no experience" or "low expertise" level. Seventy-nine percent said they had no experience with database software, 83% had never used a spreadsheet, and nearly 60% had not used word processors. One can come to the conclusion that although computers are in the schools, most teachers do not feel comfortable using it.

#### IMPLICATIONS FOR TEACHER EDUCATION

How can teacher training institutions respond to these needs? Many options, ranging from offering single topic workshops to letting prospective teachers learn on their own, exist. In between these extremes are technology-specific courses and the incorporation of technology topics into existing courses. A combination of the last two approaches likely will be effective.

Word processing, the most highly rated skill, should probably not be taught in a separate class. Software is becoming user-friendly enough that special workshops covering typical uses should be sufficient. Judging from interviews of the current student population at the University at Buffalo, many preservice teachers already have these skills.

For those who want additional exposure to the standard tools of word processing, spreadsheets, and databases, a course—The Computer as an Educator's Tool—could provide instruction in those areas. Faculty also

should encourage the use of productivity software by requiring multiple drafts of papers, suggesting data analyses be done with spreadsheets, and promoting the use of high quality graphics in student papers and presentations.

Curricular integration and knowledge of subject area software is somewhat more difficult to teach and will probably have to be taught as part of existing courses or in specialized classes such as Microcomputers in Science Education or Computers in Early Childhood Education.

But schools of education cannot continue to rely on a handful of courses to address the integration of computers into the classroom. Nor can we expect students to choose technology-oriented classes at the expense of their other coursework. Education faculty from all content areas must update their own skills and then incorporate technology into their courses—not as an afterthought, but woven throughout the coursework.

Providing support for such an effort will not be a trivial, inexpensive task. A recent survey (Parker, 1990) indicates that although most colleges of education currently have computer labs (94%), only rarely (11%) did their students have access to a networked lab facility. Only 19% of the colleges reported an extensive (> 500 pieces) collection of educational software. According to the survey, fewer than one quarter of American schools of education have research and development labs, despite that fact that research on technology's effects on the teacher education process is seen as a real need. (Brooks & Kopp, 1989).

#### *SUGGESTED COMPETENCIES AND EVALUATION STRATEGIES*

In response to this examination of the issues, a list of instructional technology competencies was prepared. Although some might argue that additional requirements should have been included, the list has been kept brief. These competencies represent the minimum technology knowledge that new teachers should have, based on the literature and the unpublished surveys noted earlier. As technological progress continues, new courses can be developed so that both preservice and practicing teachers can take full advantage of new capabilities.

The only specific, easily definable skill on the competency list is word processing. Since all groups selected this area as the top priority, it should be encouraged as a competency for preservice teachers. Completion of this requirement would simultaneously demonstrate a general understanding of computer operation. It could be tested in the following way:

1. Students demonstrate simple word processing (using software and hardware of the student's choice) including text modification, insertion, deletion, and the movement of words and phrases within a document.

There was also uniform agreement that curriculum integration issues were extremely important. There are many facets to this topic and it is correspondingly more difficult to evaluate competency. The literature of the educational reform movement advises that alternative forms of assessment might be worth investigating. (See, for example, Ewell, 1991.) Since this is the area that directly relates technology to the classroom, a practically-oriented evaluation method seems appropriate.

2. Students demonstrate skills in the integration of technology into the curriculum by producing a detailed lesson plan for teaching a particular topic. This lesson would incorporate technology in a mean-

ingful way, and use several pieces of software. Methods for evaluating the effectiveness of the lesson and its associated materials would also be described.

Because of the many ways technology can be used in the classroom, there will be a correspondingly large variety of ways to satisfy the second requirement. The preservice teacher could meet this criterion of competency by demonstrations of the use of spreadsheets, databases, subject-specific software, microcomputer-based labs, videodisc materials, or other possibilities offered by instructional technology. Because of the many variations possible, preservice teachers could select the type of technology they prefer.

One competency that seems to have been slighted in the surveys is recognizing and addressing the impact of technology on the social interactions and thought processes of students. This is surprising because of the widespread penetration of technology into today's classrooms. These issues are of such vital concern that confronting them should be part of every teacher's professional training. Unfortunately, assessing knowledge in this area is quite difficult. The following is a proposition for evaluation of competency in this area:

3. Students write an implementation plan discussing their intentions for using technology in the classroom. In this plan, they describe the students they will be teaching, including their social and cognitive characteristics. The plan includes a justification for the suggested uses of instructional technology in light of their students' characteristics. More general than the lesson plan, the implementation plan considers educational technology from several viewpoints, including how technology use will affect the student.

All three of these competencies could be evaluated by reviewing student portfolios containing, for example, copy of a word processed document—perhaps accompanied by several earlier drafts. Existing classes could be modified to require tasks similar to the last two competencies listed above. If a particular student had not taken a class where these skills were demonstrated, then a special examination would be justified. This test—a lesson plan and an implementation plan—could be completed by the student on a word processor.

This brief list of minimum competencies is not meant to exclude technology recommendations for content areas. Work done by Clements and Merriman (1988), Kowalski (1987), and others, has shown that programming can be used as a powerful way to integrate computers into curricular explorations. Some preservice teachers might learn to write computer programs. Elementary teachers could take advantage of the capabilities of the Logo language—estimated to be in use in more than a third of the country's elementary schools (Resnick, 1988). Secondary teachers might take a course in technology-assisted teaching in their particular subject area, programming in BASIC, or perhaps the development of multimedia instructional materials in an environment like HyperCard or ToolBook. Implementation of this recommendation should consider the surveys discussed previously that make it clear that programming coursework should stress direct application to the classroom and not be simply another computer science course.

## CONCLUSIONS

Not so long ago, teachers feared that computers would take over their jobs. Carbone (1985) worried that "...teachers could be reduced merely to technicians losing their 'professional' skills to technology as the blue collar worker did to the machine." (p. 210) Although this has not happened, teachers must be prepared to modify their role in the classroom. As computers begin to provide students with access to vast amounts of information and powerful new ways to explore it, teachers become not so much authorities as guides. Giving up the traditional role as "the fount of knowledge" might be threatening to some teachers, coupled with the fact that some students will inevitably know more about computers than their teachers.

Nonetheless, computers are now available in most schools. If the role of teacher preparation programs is to produce teachers able to use the instructional resources available to them, we must show them how to take advantage of the capabilities of educational technology, while also making them aware of its limitations.

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