Teachers' Beliefs About Instructional Computing: Implications for Instructional Designers

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Abstract. This article reports selected results of a study in which teachers' perceptions, opinions, and attitudes about instructional computing were examined. Implications about equitable access to computers in public schools are described. The data were gathered via a questionnaire mailed to 510 sixth-grade teachers in K–6 structured public schools. Significant findings concerning the nature of teachers' thoughts and experiences with instructional computing, and the potential effect of those factors on students' access to computers, are reported. As a needs assessment, this study provides useful information to instructional designers about how teachers perceive the computer and its use in their classrooms. Based upon the study, factors to consider when designing computer-based instruction for implementation in schools are suggested.

Computer technology is increasingly available for both home and school use, and the demands of parents, industry, and students have caused schools to purchase ever larger numbers of microcomputers (Becker, 1986a; Marrapodi, 1984). However, this rapid acquisition of new equipment has not necessarily improved education. Indeed, the novelty of the computer stands in immediate contrast to the traditional attitudes and teaching methods and the rigid bureaucracy that survived the initial computer invasion of the 1960s (Sheingold, Kane, Endreweit, & Billings, 1981). Furthermore, this immense growth in educational computing has been accompanied by inequitable practices both in the curriculum and in the students' access to the machines.

Several studies show that inequity exists in students' access to computers in schools (Anderson, Welch, & Harris, 1984; Becker, 1982, 1985, 1986b; Schubert & Bakke, 1984; Sheingold, et al., 1981) and that inequities frequently arise early in the implementation process (Enochs, 1984; Lacina, 1984). Edwards (1984) in particular distinguishes between quantitative and qualitative inequities. Quantitative inequity results from shortages of resources. Qualitative inequity involves intangible attitudes and institutional biases that pose greater long-term threats to equal access and use.

The distinction is in many ways less important when qualitative and quantitative factors combine to create inequities that cannot be corrected by addressing a single cause. Both kinds of factors lead to inequitable decision making: the school or the teacher responds by using unfair priorities that limit access. Schools often use computers selectively, scheduling access to the advantage of certain populations (i.e., boys, affluent or gifted students), over others (Becker, 1984, 1985, 1986b; Schubert & Bakke, 1984). No matter how distant, varying, or indeterminate their source, inequities converge in the classroom and are closely related to the way teachers think about and use computers.

As the most salient research confirms, the teachers' particular preconceptions are crucial to the course of innovation and change, including the process of bringing products of instructional systems design into the schools. Even though many such products are adopted by the most farsighted, enlightened school administrations, they are doomed if classroom teachers don't perceive them as meaningful within the current classroom environment (Cuban, 1986; Fullan, 1982; Weinshank, Trumbull, & Daly, 1983).

When implementing the material and procedural products of instructional systems design within the schools, it is imperative to consider the importance of both constancy and change. According to Cuban (1986), teachers work within a realm of embedded policies and work routines which must adjust to any proposed change. He points out the positive aspects of stability and craft within instruction, and notes that because "teachers are the gatekeepers for instructional technology" (p. 37), they must be consulted and involved in the introduction of any new product, including educational computing. Thus, any change in teaching practice requires the investigation and assessment of the teacher's viewpoint at the succeeding stages of planning and implementation, as well as a clear definition of what is to be implemented.

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Further, the importance of *how* a new product is implemented is much more important than *what* is implemented (Berman & McLaughlin, 1976). Accordingly, the more closely computer implementation is attuned to the existing rhythms of school life, the better the chance of meaningful computer use for all students (Cuban, 1986; Fullan, 1982). Computer-based products will not live up to their full potential in the public schools until teachers accept them as a valuable part of the school curriculum, and have enough training and equipment to properly implement them.

Purpose

The purpose of this study was to examine teacher perceptions, opinions, and attitudes about instructional computing and to draw conclusions about the quantity and quality of equitable access to computers in public elementary schools. Sixth-grade teachers were surveyed about the status of instructional computing, and their responses to instructional computing curricula were examined. Findings about selected aspects of students' access to computers and teachers' training and beliefs regarding instructional computing which may affect equity of students' computing experiences in schools are reported. Because good instructional design includes a responsibility to promote educational equity in the schools, these findings provide instructional designers with useful information.

Method

The data for this study were gathered through a mailed survey. Descriptive statistics were compiled from frequency distributions and measures of central tendency. Statistical analyses were conducted with contingency tables using the chi-square statistic, *t* tests, ANOVA, and correlations. The alpha level for significance was set at .05.

From a population of all sixth-grade teachers in Wisconsin, a sample of approximately one-third of the teachers was chosen. The sample included 510 teachers, all full-time, sixth-grade teachers who taught in K–6 structured public schools. Two mailings of the survey produced a response rate of 72%; 369 teachers responded. Follow-up telephone interviews with the 141 non-respondents enabled the researcher to check for variations between respondent and non-respondent groups.

Because this survey sampled all sixth-grade teachers in the selected schools regardless of their current or past contact with computers, each school contained between one and three teacher respondents. This characteristic of the sample plus the research focus on teachers made the teacher the unit of analysis for all questions except those specifically concerned with school-level data. The analyses of school data included each school only one time, regardless of the number of teacher respondents representing the school.

The survey contained both closed- and open-ended questions which specifically asked how teachers were implementing computers, considering the influence of both the number of machines and time pressures natural to the school day. Focused questions were used to discern and elaborate teachers' perceptions, opinions, and attitudes about issues in instructional computing, and to learn about patterns

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of microcomputer usage, the composition of groups receiving instruction, the various instructional applications of computing, the amount of teacher training, and the equity of access among students.

Results

The Sample

T tests and chi-square analyses on several variables revealed no statistically significant differences between the respondent and non-respondent groups except for the number of years of teaching experience at the current school; non-respondents averaged three years more teaching than respondents.

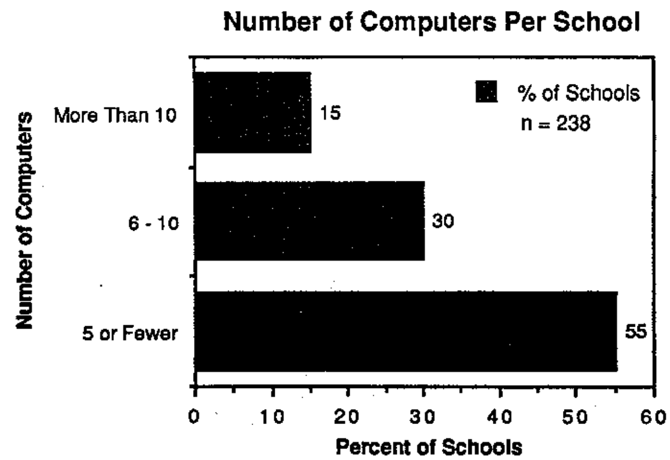

Figure 1. Number of computers per school.

Inequities in Wisconsin's Educational Computing

Material Inequities. Of the 95 school districts represented by respondents, all had at least one computer, and the majority of schools (238) within those districts had their own computers. Only 17 of the 369 teacher respondents reported no access to computers. Those 17 teachers represented 14 schools which were spread throughout several districts, cooperative educational service areas (CESAs) and counties. These results indicate that although all school districts had computers, the distribution of computing resources within districts varied.

Of the 238 schools with computers, 55% had five or fewer computers, 30% had between six and ten machines, and 15% had more than ten machines (see Figure 1). The median number of computers per school (5) and the ratio of students per computer (58:1) in Wisconsin were similar to the figures revealed by a nationwide sample (6 and 60:1, respectively), conducted by Henry Becker (1986a) during the same report period.

Spatial Inequities. Several factors—location, length of time computers could be used, how often classroom computers were used, and how many hours they were actually turned on during a day of use—highlighted inequity in access to computers among sixth-grade students. The large differences in the total time each student had access to a computer in the classroom depended upon the total amount of time allocated for specific classrooms to share the computing resources; classroom access ranged from no time to the entire school year. Furthermore, different patterns of computer access reported by teachers indicated that students' access to computers might very well depend upon the attitude of the particular classroom teacher.

Of the 352 teachers with computers in their schools, about 80% claimed that fewer than half of the students used computers on a regular, weekly basis. The major reasons teachers gave for "less than weekly use" (see Figure 2) were divided among problems concerning remote location of computers (61%), time constraints of the main curriculum (59%), and lack of teacher training (58%). Following in order of importance were lack of computers (19%), funding restrictions to specific student groups (12%), lack of necessary software (10%), undeveloped program of study (7%), funding limitations to specific curricular areas (6%), and lack of student interest (3%).

What Teachers Think

The Benefits of Instructional Computing. The teachers' attitudes and opinions about the value of educational comput-

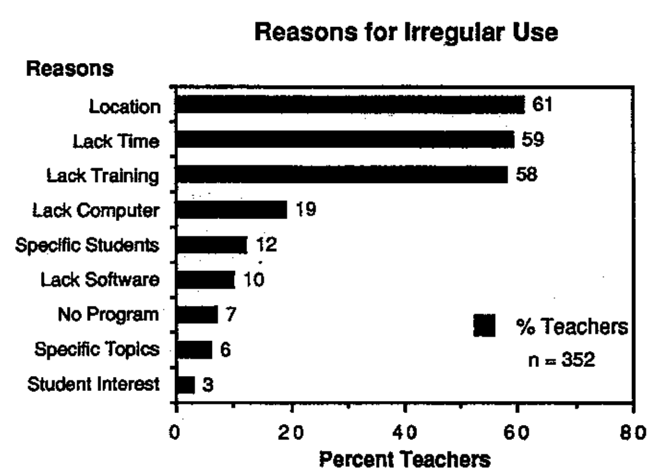

Figure 2. Reasons for irregular use of computers.

ing in their schools varied widely, and reflected a general confusion about the purposes of instructional computing. Most teachers believed that instructional computing had some benefit, but they were divided about what those benefits were and how they applied to the purposes of education.

When asked to list one or two most important benefits of instructional computing, 40% of the teachers claimed that student motivation was the predominant benefit of instructional computing (see Figure 3). They specifically commented that instructional computing added interest, posed a challenge, could be used as a reward, and offered variety in the school day. Other benefits attributed to computer use included: preparation for survival in the computer age and for life in general (19%), increased learning (11%), preparation for the job market of the future (10%), teaching higher-order thinking or problem-solving skills (6%), and variety in classroom activities (5%). Approximately 7% of the teachers claimed that there was absolutely nothing good about instructional computing.

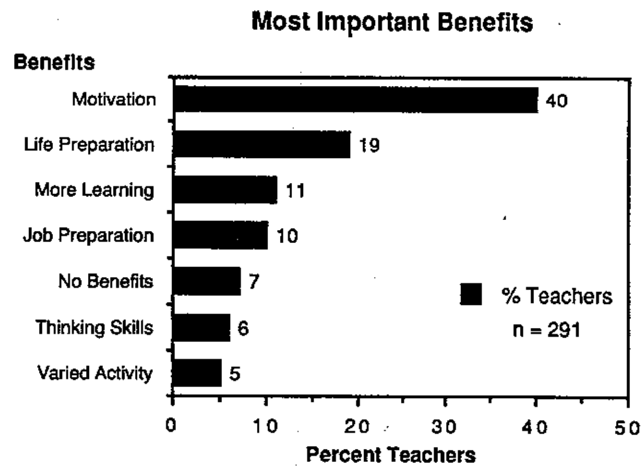

Figure 3. Most important benefits of computer use.

Worst Aspects and Major Problems. The teacher's complaints about the worst aspects of instructional computing focused on material, managerial, and training problems (see Figure 4). Heading the list was the shortage of computers and/or software (36%). Within this category, some teachers mentioned that lack of space prevented any increase in inventory. Similar comments referred to both the unjustifiable expense of computers relative to other important curricular priorities and the poor quality of software (10.9% each). Teachers were concerned that commercially available software did not match their curricular requirements for skill level and content.

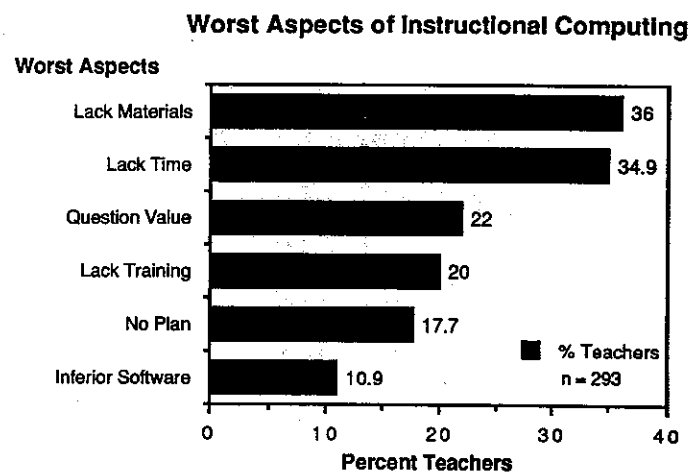

Figure 4. Worst aspects of instructional computing.

Major managerial concerns included time constraints of the daily curriculum (25.3%) and time limitations in teachers' schedules (9.6%). Together, these two categories comprise a larger category of general time constraints, becoming the most predominant single problem, even greater than lack of program direction or teacher training. Time limitations in the teachers' schedules precluded planning for instructional computing, reviewing software, and both long-range and immediate implementation of instructional computing into the existing curriculum.

About 20% of the teachers believed that inadequate teacher training was the worst aspect of instructional computing, and another 17.7% faulted the lack of any program direction. Approximately 22% of the teachers questioned the value of educational computing. They were aware that their fellow teachers did not care about or were afraid of instructional computing, or believed that the computing objectives were unrealistic. Questionable educational value was mentioned both by those who had and who had not used instructional computing.

When asked to list one or two major problems, 275 teachers who had computers in their schools blamed lack of time (48%), lack of computers (37%), and lack of teacher training (33%) (see Figure 5). These responses are consistent with the top three worst aspects reported earlier. The emphasis on such management issues as supervision and grading procedures (24%) suggests the extent to which teachers who use computers are still struggling to fit them into their normal routines. Lack of program objectives (23%) and poor-quality software (19%) also were frequently indicated. Smaller percentages of teachers who had computers in their schools believed that remote location of computers (8%), low teacher interest (6%), and poor administrative support (5%) were major problems.

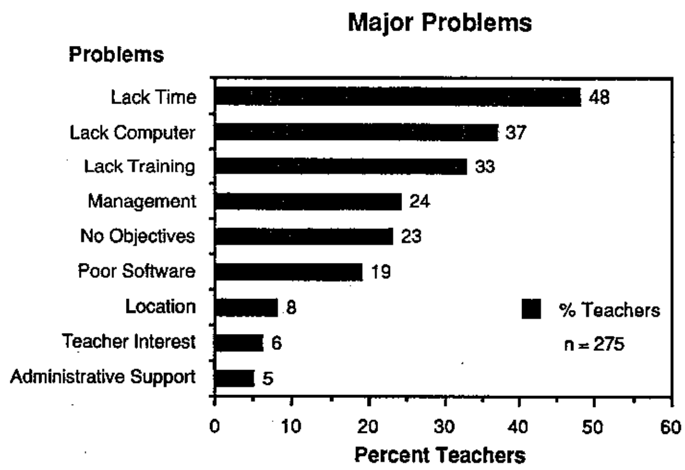

Figure 5. Major problems with instructional computing.

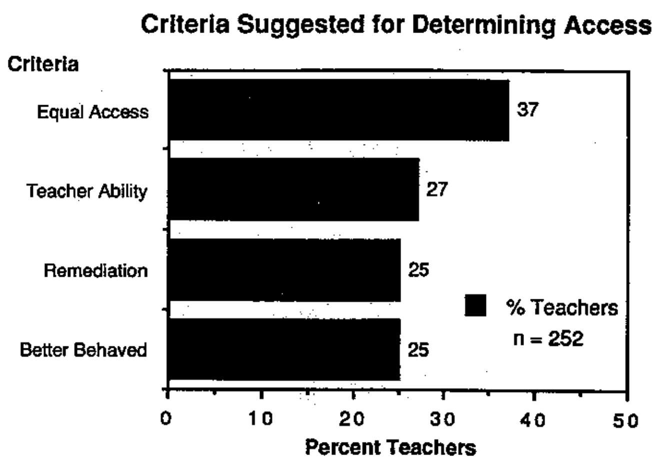

Figure 6. Criteria suggested for determining access to computers.

Providing Student Access to Computers. Confusion of attitudes and opinions about the goals, value, and general validity of educational computing was particularly apparent when the teachers were asked to devise criteria for access to a limited number of computers. This question was directed to all teachers, regardless of whether or not their schools currently had computers. Although "equal access" was the first choice of the largest number (37%) of teachers who responded to this question (see Figure 6), this criterion co-existed with views that hardly promote equal access, even in a rationing situation. For instance, the second most preferred criterion (27%) for determining students' access was the ability of teachers to use computers. This criterion clearly would prevent some students from having access to a computer at all, especially those whose teachers believed that computers had no place in the schools.

Two other criteria, each mentioned by about 25% of the teachers, stressed the motivational or remedial purposes of computing. "Motivation" meant that the computer should be used to encourage good behavior. Better-behaved students would have a better chance of getting to the machine. This underscores the incoherence of instructional computing objectives, especially in the minds of those teachers who might conscientiously condemn inequity in theory but enforce it in practice. Teachers do not view the computer as a valuable component of a standard curriculum that should be made accessible to all students at some level.

At least the criterion of remedial instruction (i.e., drill and practice for students who needed to improve basic skills) has some educational validity. The danger here is more likely to lie in a steady diet of drill-and-practice programs which rarely direct the student's curiosity about the computer to further development of higher-order skills.

Teachers' Training for Instructional Computing

Teachers frequently reported inadequate training and deferred computer access to their more competent colleagues. Training requirements for teachers existed in only 14% of the schools and were not consistent within districts. The median amount of inservice training time received by all teachers surveyed was three hours. The median amount of college or university credits, vocational school classes, community education, or training from other sources in computer use was zero. A few teachers (1%) had many hours of inservice training, but the large majority had none at all. The teachers who had participated in formal classes generally reported one university-level course in educational computing.

To determine whether teachers' age or years of teaching experience were correlated with amount of computer training, analysis of variance tests were performed on four training categories: inservice hours, college computer credits, semesters of technical school, and hours of local private training. The analyses of variance by both age and years of experience showed significant differences only for the number of college computer credits earned. Scheffe multiple-range post hoc tests of each category revealed a significant difference between the youngest and oldest age groups (groups one and four in Table 1), and between the least experienced and most experienced teachers (groups one and four in Table 2). Younger teachers had a mean of 1.74 computer credits while older teachers had a mean of .48 credits. The least experienced teachers had a mean of 2.11 credits, while the most experienced teachers had a mean of .31 credits.

The variables of age and years of teaching experience may exhibit parallel patterns because, in the majority of cases, the number of years of teaching experience increases with age. The larger number of college computer credits shown for the younger and least experienced teachers may be due to more interest in computers, more willingness to accept innovations, or new requirements for instructional computer credits in teacher preparation programs. This study did not pinpoint the source, however. *T* tests performed on the variance categories of training to determine any differences in training by gender of the respondents showed no significant differences.

TABLE 1
ANOVA for Training by Age

COLLEGE COMPUTER CREDITS

Source	*df*	*Sum of Squares*	*Mean Squares*	*F Ratio*	*F Prob*
Between Groups	3	37.27	12.42	3.59	.01
Within Groups	364	1258.53	3.46		
Total	367	1295.80			

Scheffe Multiple Range Posthoc Analysis = Significant Difference Between Group 1 and Group 4 at the .05 level

Group	*Age*	*N*	*Mean*	*SD*
1	30 or younger	27	1.74	3.22
2	31–40	149	1.11	1.90
3	41–50	130	.80	1.70
4	51 or older	62	.48	1.18

TABLE 2
ANOVA for Training by Years of Teaching Experience

COLLEGE COMPUTER CREDITS

Source	*df*	*Sum of Squares*	*Mean Squares*	*F Ratio*	*F Prob*
Between Groups	3	51.40	17.13	5.01	.002
Within Groups	364	1244.40	3.42		
Total	367	1295.80			

Scheffe Multiple Range Posthoc Analysis = Significant Difference Between Group 1 and Group 4 at the .05 level

Group	*Years Experience*	*N*	*Mean*	*SD*
1	1– 5	18	2.11	2.25
2	6–15	141	1.13	2.20
3	16–25	160	.84	1.63
4	26 or more	49	.31	1.10

Training in Rural versus Urban Communities. Analysis of variance tests performed on each of the three main sources of teacher training (inservice hours, college computer credits, and semesters of technical school) between five community sizes (urban, suburban, medium city, small city, and rural) revealed a significant difference in hours of inservice training. A Scheffe post hoc analysis further identified a significant difference between urban and rural communities (see Table 3). The mean number of inservice training hours for urban communities was twice that of the rural communities.

The Relationship Between Attitudes and Training

When asked if they had enough skill to feel comfortable teaching various computer activities, teachers generally expressed either low levels of agreement or disagreement, based upon a Likert-type unipolar scale of 1 to 5 where 1 = strongly disagree and 5 = strongly agree. In descending order of strength of agreement, the teachers agreed most strongly that they were comfortable using computer software (M = 3.32). Teachers were uncertain about their comfort with teaching the rudimentary logic about how computers work (M = 3.03), teaching introductory BASIC programming (M = 2.88), and using Logo (M = 2.27). Teachers were uncomfortable teaching about advanced BASIC programming (M = 1.86), telecommunications (1.70), robotics (1.67), Pascal programming (1.64), data bases (1.58), and spreadsheets (1.53).

Although some teachers may be very comfortable with their training and current skill level, inadequate training surfaced throughout the questionnaire responses as a major problem. Teachers' responses concerning criteria for determining access, major problems, worst aspects, and reasons for nonuse were used to evaluate their beliefs about the adequacy of training. Teachers repeatedly complained of inadequate training throughout those four areas. About one-third (33%) of the teachers believed that inadequate training was a major problem, more

TABLE 3
ANOVA for Teacher Training by Community Size

HOURS OF INSERVICE					
Source	*df*	*Sum of Squares*	*Mean Squares*	*F Ratio*	*F Prob*
Between Groups	4	1135.19	283.80	3.25	.01
Within Groups	362	31598.97	87.29		
Total	366	32734.16			

Scheffe Multiple Range Posthoc Analysis = Significant Difference Between Group 1 and Group 5 at the .05 level

Group	*Population*	*N*	*Mean*	*SD*	*Max*
1–Urban	50,000 or More	64	10.59	12.11	48
2–Suburban	Adjacent to Urban	58	6.93	10.03	60
3–Medium City	15,000–49,999	95	6.42	9.32	40
4–Small City	3,000–14,999	80	6.02	7.01	30
5–Rural	Less than 3,000	70	5.30	8.13	40

TABLE 4
***t* Tests on Training Between Teachers Who Do and Do Not Use Computers**

Variables	*N*	*M*	*SD*	*df*	*t*	*P*
INSERVICE HOURS						
Nonuser	142	4.75	6.73			
User	226	8.39	10.67	365.99	−4.02	.000
COLLEGE COMPUTER CREDIT						
Nonuser	142	.52	1.33			
User	226	1.20	2.12	366.00	−3.83	.000
SEMESTERS TECHNICAL SCHOOL						
Nonuser	142	.01	.12			
User	226	.10	.42	279.58	−2.99	.003

than a quarter (27%) indicated that those who had more training should have first access rights to computers, and one-fifth (21%) believed that inadequate teacher training was the worst aspect of instructional computing. Sixty-four percent of the teachers who had not used instructional computing indicated lack of training as the reason. Several teachers inserted unsolicited complaints about their administration's willingness to "jump on the bandwagon" and spend large sums of money on computing equipment and yet be unsupportive of teachers' training needs.

Training might boost a teacher's confidence and skill level, leading one to expect that better trained teachers would be more involved with instructional computing and have more positive attitudes about computers. *T* tests performed on the variable of training between teachers who used computers and those who did not showed significant differences in the amounts of inservice training, college computer credits, and semesters of technical school (see Table 4). For all types of training, higher means (more training) were apparent for the teachers who used microcomputers.

Pearson correlations were performed to investigate the relationship between the amount of training and attendance at computer planning sessions, both prior to computer purchase and for the school year studied. These correlations used the three most common sources of training; inservice hours, college credits, and semesters of technical school. All correlations were weak, but the correlation between inservice training and attendance at planning meetings during the current school year (.36) was more than twice as strong as the other variables measured.

Pearson correlations were also performed to investigate the relationship between the amount of training and favorable or unfavorable attitudes about computers (see Table 5). Two separate sets of variables measured the favorable and unfavorable attitudes. A Likert-type scale of 1–5 used to measure attitude indicated more intensely favorable and more intensely unfavorable attitudes, shown by higher numbers. The positive correlations between favorable attitude and the amount of training indicate that teachers with more training had more favorable attitudes toward computers. Negative correlations between the amount of training and unfavorable attitude indicate that teachers with the most unfavorable attitudes had the least amount of training.

Conclusions

Instructional designers can use the information revealed from this study to improve the state of instructional computing by directly responding to teachers' needs. Because teachers will mold any instructional design effort to their immediate classroom requirements (Shrock & Byrd, 1987), it is es-

TABLE 5
Correlation Table for Attitude and Training

Correlations	*R*	*R^2*	*N*	*SIG**
FAVORABLE ATTITUDE with:				
Inservice Hours	.1598	.0255	368	.002
College Credits	.1436	.0206	368	.006
Semesters Technical	.1279	.0163	368	.014
UNFAVORABLE ATTITUDE with:				
College Credits	−.1128	.0127	368	.030
Semesters Technical	−.1093	.0119	368	.036

*One-tailed

sential that developers uncover the teachers' beliefs and incorporate such findings into design strategies.

Results of this survey highlight the importance of developing three distinct instructional computing efforts: computer-based instructional programs, user guides to accompany the programs, and teacher training for computer-based instruction. Although this conclusion is hardly surprising, instructional designers have yet to accept its emphasis on an integrated approach, as evinced by the fact that computer-based instructional programs are often produced without the crucial user guides and training to support them. Recommendations for instructional designers will center around these three areas of development.

Development of Computer-Based Instructional Programs

Although the market boasts an abundance of computer-based instructional programs, there is a need for programs that closely match standard curricula and therefore help teachers view computers as useful tools relevant to their educational objectives. Currently, many teachers confine computer access to certain students; notwithstanding the method's purpose or the perceived need of its target group, this practice is clearly inequitable and nonsupportive of the curricula. Given the demands placed on teachers to provide instruction in particular curricular areas, it is obvious that computers will remain underutilized if they remain outside of the curriculum.

In addition to matching the subject matter of the curriculum, developers should design programs which complement commonly used curricular materials and which fit the usage patterns imposed by equipment shortages, space limitations, and time constraints within schools. This type of program could accommodate the rationing of computer time among students and teachers as well as the restrictive patterns of a segmented school day by emphasizing either group activities at the computer or a combination of computing and non-computing activities. Such mixed learning activities might shorten the individual student's computing time by requiring that most of an assignment be completed without the computer.

Programs that offer fuller flexibility for curricular needs require some modification. Teachers want programs which include management capabilities and which allow simple modifications to provide a better curricular match. By developing programs that coincide with commonly used curricular materials, designers will facilitate on-site modifications that can help simplify and fine tune skills management. Further, designers should be aware that the increased popularity of "networkable" software stems from not only the ease of disk management but also from the enhanced capability for prescribing tasks and tracking student progress.

Development of User Guides

Teachers' demanding schedules and daily curricular requirements impose time constraints that limit the opportunity to locate, review, and plan for implementation of particular programs. User guides with good, complete documentation that follows a standard format would help relieve this situation. The guides should include a brief introductory section listing objectives, an overview of how the software works, implementation suggestions, and accompanying non-computer exercises that link the computer exercises to curricular topics. Although documentation should be complete, teachers need guides with a brief introductory section because they do not

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have the time to read extensive instructions.

User guides can also contain suggestions about managing limited resources. Instructional designers can provide guidance for integrating computers into both the curriculum and the classroom routine, for utilizing computers as basic educational tools, and for assuring equitable access to them. Instructional designers are in a particularly influential position as sources of information on how the teachers' decisions about managing computer time affect classroom equity and distribution of limited resources. For example, they can warn teachers that the common policy of "first come, first served" in effect favors access for fast-working students at the expense of slower ones. The user guides can tackle other management issues, too. For instance, Dalton and Hannafin (1986) found that a steady diet of drill-and-practice activities for remedial students had deleterious effects: students became bored and regarded the computer activities as a punishment for being less intelligent than other students.

User guides can also be helpful to teachers by providing suggestions for integrating computers into their daily routine. Teachers need assistance in using computers for grading and managing instruction, as well as in curricular integration and lesson planning. Clearly written guides can help teachers by reducing the effort it takes to accomplish routine tasks.

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Development of Teacher Training

Successful implementation requires that teachers understand both the innovation and their role in using the innovation within the classroom setting (Fullan, 1982). Therefore, teachers need adequate training, resources, and time for implementation (Weinshank et al., 1983). Instructional designers can help teachers by developing training that fosters meaningful computer implementation.

Teachers in this study were unsure about the objectives of instructional computing, and the majority named motivation as its primary benefit. Motivation precedes learning (Keller, 1987) but does not guarantee it. Teachers need training which addresses motivation and then goes beyond to the primary objectives and methods of instructional computing. Such training could suggest methods for linking computer activities to topics of study, for grouping students for cooperative work across ability levels, and for sharing resources among students so that all students gain meaningful, productive access to the machines. If all students were required to use the computer as a tool to complete significant class projects, then teachers could hardly continue the practice of requiring that "regular" class work be finished prior to using the machine.

Useful training also requires instructional designers to anticipate their audience. Generic training might be appropriate for preservice teachers, but meaningful inservice training must be tailored to the audience. Different training should be afforded to specific groups of teachers according to subject, grade level, and the teacher's skill level with computers. Further, because more experienced teachers might be more resistant to change (Cuban, 1986; Sarason, 1982), the age of the audience must be considered. Instructional designers must be aware of the possible reasons for resistance (e.g., job burnout, adherence to set routines, or status anxiety) and find a way to overcome them through training. Some training sessions might be appropriate for mixed audiences, but others may best address teachers' needs in separate groups. Whatever the case, staff development is one of the most influential forces affecting teachers' behavior (Shrock & Byrd, 1987). Instructional designers can influence teachers by informing them about the elements of an instructional design that implements computers in a strategic, systematic way that is meaningful to both students and teachers.

Training must be expanded into rural and underserved areas, perhaps through telecommunications or with the aid of the school library's media center (Schiffman, 1987). The media center could be responsible for organizing and administering training sessions, maintaining software collections, and consulting with teachers and students.

In addition to the obvious need for incorporating computer training requirements into preservice teacher training programs, school administrators must recognize the importance of inservice support for teachers during the implementation process. After all, the administrators are in the most influential position to help teachers (Weinshank et al. 1983). Implementation is an ongoing effort that goes well beyond the initial placement of computer hardware in the schools, so continuous training, instructional support, and good management are all vital to its success. Developers can work with administrators to suggest systematic strategies for providing ongoing support and incentives for teachers to attend inservice training. Components of such an approach could include plans for regular equipment maintenance and upgrades, software support, teacher training, and a method for evaluating implementation progress and adjusting the implementation plan accordingly.

In summary, instructional designers

must realize that currently the implementation effort often ends with the placement of equipment in the schools, even though acquisition is just one of the first steps of successful implementation (Fullan, 1982). The same holds true for the products of instructional design—computer-based instructional programs, user guides, and teacher training all should be thoroughly tested prior to implementation, and most important, the effort to improve them should not simply end with their adoption by teachers or schools.

Computer-based instruction offers instructional designers a means of implementing instructional design principles, products, and procedures into the schools, but to take advantage of this opportunity, instructional designers must be aware of teachers' attitudes and concerns. To ensure successful implementation of instructional design products, developers must design instructional programs, support materials, user guides, and teacher training that are appropriate to the teachers' current needs.

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