Association for Information Systems
AIS Electronic Library (AISeL)

ICIS 1992 Proceedings

International Conference on Information Systems (ICIS)

1992

MISPLACED RESOURCES? FACTORS ASSOCIATED WITH COMPUTER LITERACY AMONG END-USERS

Susan J. Winter
University of Waterloo

Barbara A. Gutek
University of Arizona

Katherine M. Chudoba
University of Arizona

MISPLACED RESOURCES? FACTORS ASSOCIATED WITH COMPUTER LITERACY AMONG END-USERS

Susan J. Winter
Department of Management and Sciences
Faculty of Engineering
University of Waterloo

Barbara A. Gutek
Katherine M. Chudoba
Department of Management Information Systems
The Karl Eller Graduate School of Management
University of Arizona

ABSTRACT

Some organizations provide a support infrastructure (e.g., information centers, on-line help) and training (e.g., vendor-supplied, one-on-one) to assist end-users and boost the computer literacy of their workforce. In this paper, we explore the efficacy of a support infrastructure, training, and various computer configurations for enhancing the computer literacy of work groups. Data come from a multi-year (1987 to 1989) study of seventy-seven computer-using work groups in the southern California area, which included two interviews with managers and two questionnaires distributed to workers. Analyses showed that none of the measures of training were associated with computer literacy. Only one kind of infrastructure support, obtaining information from a resident expert in the work group, was related to computer literacy. In contrast, many aspects of the configuration of the computer systems were associated with computer literacy. Implications of these provocative findings for the management of end-user computing are discussed.

Workers gained unprecedented access to computer resources during the 1980s as terminals, personal computers, and software application packages proliferated throughout organizations. End-users are now a large contingent in many organizations and they are assuming more and more of the responsibilities that were previously the purview of data processing experts. In today's computer intensive work environments, end-users may be in charge of selecting, implementing, using, and maintaining their own systems as well as determining which computer applications are appropriate for their work. These end-users cannot afford to be computer illiterate.

Computer literacy can be learned in school but, for the majority of Americans in the labor force, computer use is a phenomenon that postdates their educational experiences. In short, many American workers have left formal educational settings — high school or college — without becoming computer literate. Workers who are using computers must, therefore, gain computer literacy outside of the usual school setting. The computer literacy of workers in an organization may depend on the extent to which the organization facilitates or encourages high levels of computer literacy among workers. Three types of organizationally provided facilitators are the infrastructure of computer support (George, Kling and Iacono 1990), training in computer use, and the configuration of the computer system used by the workers. The ways in which organizations may facilitate computer literacy are discussed in this paper and their empirical relationships to literacy are compared.

1. BACKGROUND

1.2 What is Computer Literacy?

Computer literacy is a widely used term, but one that is not precisely defined. The Conference Board of the Mathematical Sciences (1972) defines it as an understanding of computer capabilities, applications, and algorithms. One textbook (Rochester and Rochester 1991) defined it this way: "To be literate is to be knowledgeable about something. Computer literacy is being knowledgeable about the computer and how it works in our daily lives. It also means being able to operate and use a computer, at least to perform basic tasks'' (p. 6).

Consistent with the definition proposed by Rochester and Rochester, we are focusing on functional literacy, the basic knowledge that facilitates the use of computers in performing one's work. It includes knowledge of concrete ''facts'' as well as more abstract concepts. A literate person knows enough to figure out how to solve problems and can quickly adapt to new systems and packages. Being able to do this comes from an understanding of the system well beyond just knowing the names of parts of the computer. Computer literacy can be learned through some combination of education, training, and experience.

1.2 Resources Which May Enhance Computer Literacy

1.2.1 Support Infrastructure

One resource organizations can provide to enhance the literacy of workers is a support infrastructure. A support infrastructure can include specialized assistance such as an on-call helpline, an information center, a staff of consultants to assist end-users, or a software library (Rockart and Flannery 1983; Carr 1987; Cheney, Mann and Amoroso 1986; Henderson and Treacy 1986).

An additional type of support is the availability of a coworker with computer expertise who can answer questions on an ad hoc basis: a local resident expert. The local resident expert may work outside the organization's formal support infrastructure. Research has shown that end-users prefer to ask a local expert if one is available (Bikson and Gutek 1983; Clement 1990). Computer users frequently rely on themselves and each other rather than taking advantage of the formal training and support infrastructure provided by organizations (Lee 1986; George, Kling, and Iacono 1990).

1.2.2 Training

Organizations may provide training to enhance workers' computer literacy, although the sophistication of the training can vary widely. Some employers provide computer equipment and software and assume that workers will be able to learn on their own. Previous studies showed that ''learning on their own'' was the most common mode of computer knowledge acquisition in work groups that were early adopters of computer technology (Bikson and Gutek 1983) and for middle and upper level managers (Nelson and Cheney 1987). This may work well among professionals who learned basic computing skills in college (e.g., engineers and scientists), but it may not be sufficient for people with little or no previous computer experience. Thus, many organizations are now providing a second kind of resource to boost workers' computer literacy: general and specific training to use the computer systems available in the workplace.

Research specifically focused on end-user computing has identified education and training as critical to its success (Rockart and Flannery 1983; Henderson and Treacy 1986; Cheney, Mann and Amoroso 1986). A recent survey found that IS and end-user personnel believed end-users needed to improve their general information systems knowledge as well as gain additional technical and product-related skills (Nelson 1991). These skills can be provided by classes developed by vendors or by data processing staff within the organization. Classes can be geared to the specifics of particular application programs at an elementary or advanced level, or they can be general courses in computer literacy which focus on how computers work and what can be done with them.

1.2.3 Computer Configuration

The nature of the computer system itself may enhance computer literacy. Mainframe and mini computers are generally maintained and run by computer specialists. Their use by end-users may require less knowledge than does the use of microcomputers, and so workers who make extensive use of micros may demonstrate relatively high computer literacy. In addition, levels of literacy may be affected by access to equipment and specific types of software. If a worker is able to use multiple computer platforms — mainframes and micros, Macintosh and DOS interfaces — and is proficient with a variety of software packages such as spreadsheets, graphics, and database, the worker may be more computer literate than a person who uses a simpler computer configuration. Prior research has demonstrated a positive relationship between access or availability and the use of computers (DeLone 1988; Mutschler and Hoefer 1990). A similar positive relationship may exist between availability and computer literacy.

1.2.4 Summary

Organizations can provide formal and informal support, training, hardware, and software — all in an attempt to boost the computer knowledge of their workers. We have relatively little information, however, on the efficacy of these attempts to develop a computer literate workforce. For example, the effect of training on workers is rarely evaluated (Bikson and Gutek 1983). It is not clear if training is associated with greater computer literacy among workers or if organizations that provide a learning center or computer consultants have more knowledgeable workers than other organizations.

This paper will illuminate the relationship between these three practices and computer literacy. Our research question is: Are work groups which have these computing resources available to them (support, training, and particular computer configurations) more computer literate than work groups lacking them?

2. METHOD

Data for our analyses come from a study of computer-using white collar work groups. Consistent with previous research (Bikson, Gutek and Mankin 1987; Gutek, Bikson and Mankin 1984), we defined a work group as four or more people engaged in some common information-related process or product, including at least one level of supervision.

Work groups were eligible for the present study under the following conditions:

1. At least four people in the group.

2. Computers have been used for at least one year.

3. Computers were necessary for the work of the group (rather than for the work of one or two individual employees), but not all people in the group need personally use a computer.

Groups that were diverse in size, product, computer implementation, and use, as well as in computer equipment configuration, were sought. Questionnaires evaluating the use of computers in organizations were handed out to all members of the work groups and an interview with the supervisor of each group was conducted in summer, 1988. A second questionnaire which evaluated levels of computer literacy was completed by workers eighteen months after the first. This paper presents analyses based on the responses of 168 respondents in seventy-seven work groups who answered both questionnaires and the interviews with their managers. The demographic characteristics of our sample are described in Table 1.

2.1 Measures

Functional computer literacy: Functional computer literacy was assessed with a 23-item measure described in detail elsewhere (Gutek and Winter 1992) and summarized in Table 2. The measure included seven questions assessing self-reports of computer knowledge (from floppy disk to baud rate in Table 2), nine multiple-choice items (recognition of information), three fill-in items (recall of information), and four experience items (performance of computer-related tasks). In general, questions cut across computer hardware and software applications and tapped both abstract and concrete knowledge. The instructions for each type of question and a sample question are given below.

1. Self Report Knowledge
   Following are a set of computer terms. Please circle the appropriate number where 1 = I know nothing about this and 5 = I know a lot about this.
   baud rate

2. Multiple Choice
   Here are a few more general questions about computers. Please circle only one answer for each question.

The "brain" of a computer is:
the operating system
the CPU (CORRECT ANSWER)
the printer
the mouse
I don't know

3. Recall of Information
   Here are some computer acronyms. For as many as you know, please write in what the letters stand for. Skip the ones you do not know.

   DOS (CORRECT ANSWER: disk operating system)

4. Experience Items

Have you ever modified a computer program? (yes or no)
If yes, in which programming language?

A principal components factor analysis indicated that a one factor solution was probably most interpretable (Gorsuch 1983). The 23-item scale showed good internal consistency (coefficient alpha = .93) as well as discriminant and convergent validity. For this study, each item was standardized and then the average of all members in a work group was calculated to yield an estimate of the average level of functional computer literacy of the work group (Mean = 0.002, s.d. = 0.61; see Table 2).

Organizational support: During interviews, supervisors were asked about formal organizational support for computer use and about the training provided workers. Supervisors indicated whether or not the work group members had access to an information center, computer consultants, help with systems maintenance, or computer programmers who could write programs for the work group or help workers.

Supervisors also indicated where workers found the experts who helped them with computing questions: within the work group, outside the work group but inside the company, or outside the company. In addition, workers were asked in the computer use questionnaire about the frequency with which they received answers to their questions from someone in their work group or from someone outside of their work group. Responses were coded 1 = never; 2 = occasionally; 3 = usually; 4 = always and then they were aggregated to the group level. The mean for receiving answers from within the group was 2.79 (s.d. = 0.44), and the mean for receiving answers from outside the group was 3.11 (s.d. = 0.48).

Organizational training: In the interview, supervisors also indicated whether or not new and continuing employees received computer training, whether training was done at a terminal, whether the training emphasized specific, concrete

Table 1. Demographic Description of Sample

Description	Percent
Work group Classification	
- Managerial or Administrative (N=17)	22
- Text-oriented Professional (N=21)	27
- Data-oriented Professional (N=20)	26
- Clerical (N=19)	25
Gender in Average Group	
- Women	61
- Men	39
Work group Functions	
- Line	51
- Staff	49
Work group Size	
- 4 to 39 members; Mean=10.1	
Salary of Sample	
- < $10,000	6
- $10,001 - $15,000	5
- $15,001 - $25,000	26
- $25,001 - $35,000	22
- $35,001 - $50,000	23
- $50,001 - $75,000	15
- > $75,000	3
Education of Sample	
- Completed High School	11
- Attended Vocational School	6
- Some College	35
- Bachelor's Degree	17
- Master's Degree	27
- Ph.D.	4
Age of Sample	
- Under 25 years old	11
- 26-35	34
- 36-45	31
- 46-55	18
- Over 55	6
Company Classification for 77 Work groups	
- Manufacturing	25
- Provide Services	75
- Public Sector	45
- Private Sector	55

steps involved in performing one's job, and whether it included broad generic principles of how computers work. Also, supervisors indicated in broad categories the proportion of people in the work group who joined the group already knowing how to use a computer system, and supervisors described the nature of the training available to workers (learn on their own, trained individually, trained in a group, etc.).

Computer configuration: Supervisors described the computer configurations available to workers during interviews. The average group began using computers for their work late in 1980 (s.d. = 5.28 years). The rate at which the group's computer system was being upgraded was assessed with two questions. Managers described system expansion during the last two years (1 = none, 2 = some expansion, 3 = extensive expansion, 4 = whole new system), and the

Table 2. Scale Characteristics for Computer Literacy Instrument

Item	Item-Total Correlation	Factor Loadings
Self-Report Knowledge		
floppy disk	.64	.69
software	.71	.75
directory	.71	.76
modem	.71	.75
bit	.73	.77
mainframe	.66	.71
baud rate	.70	.74
Multiple Choice		
cursor	.32	.35
printer	.25	.27
back up	.58	.57
utility	.58	.60
brain	.53	.55
BASIC	.60	.62
RAM	.60	.62
ideal use	.36	.41
microprocessor	.45	.47
Recall/Fill-In		
CPU	.62	.65
DOS	.61	.64
IC	.49	.53
Experience		
ever saved a program	.56	.59
ever copied a program	.60	.64
ever written a program	.60	.64
ever modified a program	.58	.66

alpha = .93 Mean = 0.002 Std. Dev. = 0.61 N = 520

Table 3. Computer Functions and Applications, and Their Use in Work Groups

Computer Function	Groups with Function Available to Them
Word processing	91%
Database management	83%
Retrieve information (external or internal databases)	78%
Electronic filing system	74%
Spreadsheet	73%
Customized computer function	71%
Graphics	66%
Statistics	65%
Communicate outside work group	51%
Communicate within work group	40%
Calendar	31%
Decision support system	17%

expansion planned during the next two years (1 = none, 2 = some, 3 = a lot).

In addition, three questions were asked about the types of computers available to members of the work group. Microcomputers were the most plentiful with 92% of groups reporting access to at least one. Most groups (56%) had one or more mainframe computers available to their members and less than half (44%) had access to one or more minicomputers. An objective measure of computer intensiveness (the ratio of full-time equivalent employees to terminals of any kind) was included in the interview. This ratio varied from more than four terminals per person to an outlier of twelve people per terminal. When this outlier was recoded to the next largest number (four people per terminal), the ratio averaged a little over one person per terminal (mean = 1.35; median = 1.08; s.d. = 0.81).

An objective measure of each computer system's degree of specialization was also assessed during interviews. Each supervisor was presented with a list of computer applications (e.g., word processing, creating spreadsheets, communications, etc.) and asked to identify the ones his or her system could perform. In addition, managers were asked the number of special applications (not mentioned in the list provided to them) available on the system. On average, the groups' systems could perform a little more than eight functions (mean = 8.42; s.d. = 3.50). A list of these functions and their frequency in work groups are presented in Table 3.

A subjective rating of system specialization was also obtained from the supervisors by asking the number of different tasks or functions for which the computer system was actually used by workers in the group (both were coded 1 = only one or several; 2 = many or an unlimited number). The mean was 1.55 with a standard deviation of 0.50.

Supervisors also rated their system's user friendliness (1 = not at all or not very; 2 = somewhat; 3 = very friendly) with a mean of 1.94 and a standard deviation of 0.75.

3. RESULTS

We will explore some relationships among work group functional computer literacy, organizational support and training, and computer configuration. Since the outcome of interest (computer literacy) was continuous, analyses will differ due to the nature of the predictors. Continuous predictors (i.e., full-time equivalent workers per terminal, year of computer adoption, number of functions) will be correlated with literacy. ANOVA's or *t*-tests will be performed for categorical predictors. A score above 0.002 means the group is more computer literate than average and a negative score indicates lower than average computer literacy.

Table 4. Computer Support and Functional Computer Literacy: Means, Standard Deviations and t-test Results

Computer Support		Mean	St. Dev.	N	$t_{(75)}$-Value
Information Center	Yes	.002	.43	27	0.25 n.s.
	No	.027	.39	50	
Consultants	Yes	.102	.36	17	-.98 n.s.
	No	-.006	.41	60	
Systems Maintenance Help	Yes	-.001	.40	67	1.09 n.s.
	No	.147	.41	10	
Programmers to Write Programs	Yes	-.053	.40	31	1.28 n.s.
	No	.066	.40	46	
Programmers to Help Users	yes	-.019	.41	29	0.62 n.s
	no	.040	.40	48	
Help Found Within Group	yes	.059	.42	61	-2.19 *[a]
	no	-.138	.29	16	
Help Out of Group (In Company)	yes	.005	.37	50	0.38 n.s.
	no	.042	.46	27	
Help Found Outside Company	yes	-.004	.38	39	0.49 n.s.
	no	.041	.43	38	

* = $p < .05$; ** = $p < .01$

[a] Separate variance estimate - 33.8 degrees of freedom

Organizational support: Means, standard deviations, and results of t-tests comparing the average functional computer literacy of groups that have access to various types of organizational support are shown in Table 4. Information about the average amount of support workers report receiving inside and outside of their groups is also shown in Table 4. The only significant difference in computer literacy related to the type of support provided is for two questions on the availability of help within one's group. Whether assessed by the supervisor or as an average of workers' perceptions, those groups who ask someone within their group for help with their computers show higher levels of functional computer literacy.

Training: Shown in Table 5 are means, standard deviations, and results of t-tests comparing average functional computer literacy of groups that provided training to new and continuing employees. Table 6 shows means, standard deviations, and results of oneway ANOVA's comparing the average functional computer literacy of groups with different types of training and computer configurations. The first compares groups where everyone, over half, and less than half of the employees enter the work group knowing how to use their computer system. The second compares groups where no training is done, where there is individual training (by someone inside or outside the group) or group training by the vendor, and where there is group training by the organization or in a classroom setting. No differences in functional computer literacy were found among groups with different types of training.

Computer configuration: The third and fourth ANOVA's, presented in Table 6, show the average functional computer literacy of groups whose systems differ in user friendliness and degree of specialization. Table 7 shows correlations between literacy and the year in which the group first started using computers, the objective number of functions available to the group, and the number of full-time equivalent employees per terminal of any kind. Table 8 shows means, standard deviations, and results of t-tests comparing groups with access to computers and eleven common computer functions.

Table 5. Training and Functional Computer Literacy: Means, Standard Deviations and t-test Results

Training		Mean	St. Dev.	N	$t_{(75)}$-Value
New User Training Available	yes	-.006	.39	52	-.077 n.s.
	no	.069	.44	25	
Continuing Training Available	yes	.039	.37	41	-0.48 n.s.
	no	-.006	.44	36	
Terminal Avail. for Training	yes	-.001	.40	73	1.81 n.s.
	no	.370	.35	4	
Training in Specific System Use	yes	.019	.39	67	0.07 n.s.
	no	.029	.54	9	
Training in General Concepts	yes	.026	.43	28	-0.07 n.s.
	no	.019	.40	46	

* = $p < .05$

Table 6. Training and System Configuration, and Functional Computer Literacy: Means, Standard Deviations and ANOVA Results

	Groups	Means	St. Dev.	N	F-Value
% of New Workers in Group Needing Training	Nobody	-.062	.33	30	2.27 n.s.
	Some of Group	.000	.43	30	
	Over Half	.191	.44	17	
Type of Continuing Training Available	None	.031	.43	25	2.05 n.s.
	Ind/Vendor Grp	-.091	.42	28	
	Org Grp/Class	.132	.33	24	
User Friendly System	Not Very	-.047	.49	24	1.83 n.s.
	Somewhat	.115	.36	34	
	Very	-.074	.32	19	
Rated System Specialized in Actual Use	One Function	-.188	.30	4	3.57 *
	Several	-.064	.39	44	
	Many Functions	.137	.37	27	
	Unlimited	.620	.54	2	

* = $p < .05$

Table 7. Group Level Correlations between Predictors Measured Continuously and Functional Computer Literacy

Predictor	Mean (Standard Dev)	Simple r
Questions Answered Within Group	2.79 (0.44)	.248 *
Questions Answered Outside Group	3.11 (0.48)	.135 n.s.
Yr. Computers Adopted	1980.62 (5.28)	-.108 n.s.
Number of Functions Available	7.51 (2.98)	.390 **
FTE per Terminal	1.35 (0.81)	-.228 *

* = p < .05; ** = p < .01

Several characteristics of computer configuration were related to literacy. System specialization was positively related regardless of whether it was rated subjectively (four categories) or objectively (continuous). Having access to microcomputer(s), word processing, database management, spreadsheet, graphics, communication (inside or outside of group), and calendaring functions were all positively related to literacy as were the number of functions available. The number of full-time equivalent employees per terminal was negatively related to literacy.

4. DISCUSSION

Although a support infrastructure and training may be important for an organization's implementation and use of computers, neither appears to have much effect on the computer knowledge or literacy of workers, with one exception. The presence of a local resident expert, a person who is knowledgeable and can help others, was associated with higher levels of computer literacy for the group. Other forms of support such as the presence of an information center, the availability of consultants, and the like were not related to the computer literacy of the work group.

In general, the findings suggest that it was factors within the work group itself, notably the configuration of computer equipment and the presence of one or more local resident experts, that were associated with higher computer literacy. Some configurations of hardware and software seemed to demand more knowledge from users than others. Specifically, an abundance of equipment, especially microcomputers, having many different functions was associated with above average computer literacy.

It is worth noting that the dependent variable, computer literacy, was assessed with a questionnaire distributed to workers in the groups; most of the independent variables were assessed in two separate interviews with managers of the groups. Thus, our findings were not inflated by common method variance. A large number of tests of significance were performed increasing the overall likelihood of Type I error; however, this is a risk worth taking in exploratory research.

It is also important to note that causality cannot be firmly inferred from our findings, even though most of the independent variables were measured earlier in time than was the dependent variable, computer literacy. For example, the type of training available in spring of 1988 or summer of 1989 was not associated with the computer literacy of workers as measured in winter 1989-1990. Nevertheless, it is possible that a support infrastructure and training may boost the computer literacy of a work group if the groups having these available were especially low in computer literacy to begin with. As another example, work groups having access to microcomputer technology in 1988 were more computer literate in winter 1989-1990 than other work groups. Since levels of computer literacy before exposure to the organization's support infrastructure or training were not measured, it may be the case that only the more literate work groups acquired microcomputers.

Though training and support infrastructure may have improved literacy, it is clear that they have not made workers highly computer literate. Perhaps the training and on-line help available are at a fairly low level (or remedial) and more advanced assistance would help. It is also possible that the formal support may make it easier for end-

Table 8. Computer Configuration and Functional Computer Literacy: Means, Standard Deviations, and t-test Results

Configuration		Mean	St. Dev.	N	$t_{(75)}$-Value
Micro Computer Available	yes	.054	.39	71	2.85 **
	no	-.412	.36	6	
Mainframe Available	yes	.054	.41	43	0.89 n.s.
	no	-.028	.39	34	
Mini Computer Available	yes	.027	.42	34	0.17 n.s.
	no	.011	.39	43	
Word Processing Function	yes	.077	.37	70	4.54 ***
	no	-.568	.20	7	
Database Management Function	yes	.057	.39	64	1.91 *
	no	-.173	.41	13	
Information Retrieval Function	yes	.026	.39	60	0.34 n.s.
	no	-.011	.45	17	
Spreadsheet Function	yes	.118	.37	56	3.89 ***
	no	-.249	.36	21	
Electronic Filing	yes	.053	.41	57	1.27 n.s.
	no	-.080	.36	20	
Graphics Function	yes	.141	.36	51	4.12 ***
	no	-.222	.37	26	
Statistics Function	yes	.064	.42	50	1.36 n.s,
	no	-.066	.37	27	
Communicate Outside Grp	yes	.142	.37	38	2.87 **
	no	-.109	.40	39	
Communicate in Group	yes	.157	.36	31	2.59 **
	no	-.076	.40	46	
Calendaring Function	yes	.239	.32	24	3.47 ***
	no	-.082	.40	53	
Decision Support System	yes	.065	.43	13	0.46 n.s.
	no	.008	.40	64	

* = $p < .05$; ** = $p < .01$ *** = $p < .001$

users to perform their jobs with only cursory knowledge and does not promote (or actually inhibits) an in-depth understanding of computing (Guimaraes and Gupta 1987).

It is also possible that providing more advanced training would not be the most appropriate way to increase levels of computer literacy. Instead, providing computer systems which require that users acquire a certain level of knowledge, coupled with a local resident expert to help them, may be more effective than providing advanced training or an information center. Our findings suggest that distributing knowledge among users is associated with greater computer literacy. A centralized approach such as an online help service or an information system may be less effective in creating computer knowledgeable workers than a decentralized approach of making microcomputer equipment available and infiltrating each work group with an enthusiastic computer expert.

5. ACKNOWLEDGMENTS

This research was partially supported by the National Science Foundation, grant # IRI-87-14768 to Barbara A. Gutek.

6. REFERENCES

Bikson, T. K., and Gutek, B. A. "Training in Automated Offices: An Empirical Study of Design and Methods." In J. Rijinsforp (Editor), *Training for Tomorrow*. Amsterdam: Elsevier, 1983, pp. 129-145.

Bikson, T. K.; Gutek, B. A.; and Mankin, D. A. *Implementing Computerized Procedures in Office Settings: Influences and Outcomes*. The RAND Corporation, R-3077, 1987.

Carr, H. H. "Information Centers: The IBM Model Versus Practice," *MIS Quarterly*, Volume 11, Number 3, 1987, pp. 325-338.

Cheney, P. H.; Mann, R. I.; and Amoroso, D. L. "Organizational Factors Affecting the Success of End-User Computing," *Journal of Management Information Systems*, Volume 3, Number 1, 1986, pp. 65-80.

Clement, A. "Cooperative Support for Computer Work: A Social Perspective on the Empowering of End Users." In D. Tatar (Editor), *Proceedings of the Conference on Computer-Supported Cooperative Work*. New York: The Association for Computing Machinery, 1990, pp. 223-236.

Conference Board of the Mathematical Sciences. *Recommendations Regarding Computers in High School Education*. Washington, DC: Conference Board on the Mathematical Sciences, 1972.

DeLone, W. H. "Determinants of Success for Computer Usage in Small Business," *MIS Quarterly*, Volume 12, Number 1, 1988, pp. 50-61.

George, J. F.; Kling, R.; and Iacono, S. "The Role of Training and Support in Desktop Computing." In K. M. Kaiser and H. J. Oppelland (Editors), *Desktop Information Technology*. Amsterdam: Elsevier Science Publishers B.V., 1990, pp. 237-252.

Gorsuch, R. L. *Factor Analysis*, Second Edition. Hillsdale, New Jersey: Lawrence Erlbaum Associates, 1983.

Guimaraes, T., and Gupta, Y. P. "Personal Computing and Support Services," *OMEGA International Journal of Management Sciences*, Volume 15, Number 6, 1987, pp. 467-475.

Gutek, B. A.; Bikson, T. K.; and Mankin, D. A. "Individual and Organizational Consequences of Computer-Based Office Information Technology." In S. Oskamp (Editor), *Applied Social Psychology Annual*, Volume 5. Beverly Hills, California: Sage, 1984, pp. 231-254.

Gutek, B. A., and Winter, S. J. "Measures of Computer Literacy in Work Groups: Development and Initial Validation," University of Arizona Working Paper Series, 1992.

Henderson, J. C., and Treacy, M. E. "Managing End-User Computing for Competitive Advantage," *Sloan Management Review*, Winter, 1986, pp. 3-14.

Lee, D. M. S. "Usage Pattern and Sources of Assistance for Personal Computer Users," *MIS Quarterly*, Volume 10, Number 4, 1986, pp. 313-325.

Mutschler, E., and Hoefer, R. "Factors Affecting the Use of Computer Technology in Human Service Organizations," *Administration in Social Work*, Volume 14, Number 1, 1990, pp. 87-101.

Nelson, R. R. "Educational Needs as Perceived by IS and End-User Personnel: A Survey of Knowledge and Skill Requirements," *MIS Quarterly*, Volume 15, Number 4, 1991, pp. 503-521.

Nelson, R. R., and Cheney, P. H. "Training End-Users: An Exploratory Study," *MIS Quarterly*, Volume 11, Number 4, 1987, pp. 546-559.

Rochester, J., and Rochester, J. *Computers for People: Concepts and Applications*. Homewood, Illinois: Irwin, 1991.

Rockart, J. F., and Flannery, L. S. "The Management of End-User Computing," *Communications of the ACM*, Volume 26, Number 10, 1983, pp. 776-784.