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# Correlates with Use of Telecomputing Tools: K-12 Teachers' Beliefs and Demographics

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## Abstract

*What can be determined about the demographic characteristics, beliefs about teaching, degrees of innovativeness, and world views of classroom teachers and specialists who use Internet-based telecomputing tools? This study correlated data representing a year of online use with responses to questionnaire items about teacher beliefs and demographics for 558 respondents from a sample of 1,000 randomly selected Internet account holders on TENET, the statewide K-12 educational telecomputing network in Texas. Results showed significant correlations among beliefs about teaching, personal perceptions of innovativeness, and world views; respondents who were more student-centered in their beliefs about teaching perceived themselves to be more innovative and tended to see the world in a more social constructivist way than respondents with more traditional beliefs about teaching. Yet no strong significant correlations between telecomputing activity and beliefs or demographic information were found. In the case of this study, the absence of significant relationships was even more informative than the correlations detected, and it leads us to recommend further study to see if these patterns can be confirmed, so that they can be acted upon. (Keywords: beliefs about teaching, demographics, innovativeness, Internet use, telecomputing, world views.)*

Some teachers use technology in a traditional teacher-centered model of teaching. Other teachers use technology to support different, more student-centered approaches to instruction.... The latter kinds of teachers are among the most enthusiastic technology users, since technology is particularly helpful in supporting this kind of teaching. (U.S. Congress, Office of Technology Assessment, 1995, pp. 1-2)

The connection between a student-centered, constructivist approach to teaching and use of educational technology is often stated and even more often assumed. Educational decision makers have high hopes that integrating use of computer-mediated tools into classroom contexts, for example, will catalyze and support systemic educational reform in K-12 schools, leading to more widely demonstrated authentic, problem-based teaching and learning (Means, 1994).

A growing body of literature suggests that teacher beliefs are stronger predictors of decisions and behavior than knowledge (Pajares, 1992). Currently, teachers' use of computing tools is probably more the result of an innovation decision process (Rogers, 1995) than compliance with performance expectations. Although 65% of U.S. schools and 14% of K-12 classrooms had Internet connections in late 1996,

only 20%, 16%, and 15% of U.S. teachers reported using telecommunications in their teaching, professional development, and curriculum development, respectively, at that time (Heaviside, Riggins, & Farris, 1997). A year later, 78% of U.S. schools and 27% of school-based instructional rooms had Internet access, with 95% of U.S. schools projecting connectivity by the year 2000 (Bare & Meek, 1998), but with instructional and professional development use apparently still lagging. Might the use of educational technologies—specifically, telecomputing tools—be associated with classroom teachers' beliefs about teaching, beliefs about themselves as innovators, beliefs about the nature of reality, or some combination of the three? If telecomputing technologies better support constructivist teaching and learning than more traditional instructional methods do, the more teachers use telecommunications services, the more learner-centered, innovative, and social constructivist their beliefs might be. This study tested the possibility of such correlations.

## AREAS FOR EXPLORATION

What can be determined about the demographic characteristics, professional histories, beliefs about teaching, degrees of innovativeness, and world views of classroom teachers and specialists who use Internet-based telecomputing tools? To provide an initial response to this question, we correlated data representing a year of online use with questionnaire item responses about teachers' demographic characteristics and beliefs for 1,000 randomly selected Internet account holders on TENET, the statewide K–12 educational telecomputing network in Texas.

As this was a descriptive, purely correlational study, no specific hypotheses were formed a priori. Instead, we wished to discover whether 1995–1996 TENET use data correlated significantly with any of the following user variables:

- age,
- sex,
- number of years of teaching experience,
- type of school,
- job responsibilities,
- certification(s),
- number of years of computer experience,
- number of years of telecomputing experience,
- highest degree awarded,
- beliefs about teaching, as measured by the Teacher Attitude Inventory (Whitmore, 1974),
- perceptions of degree of personal innovativeness, as measured by the Scale for the Measurement of Innovativeness (Hurt, Joseph, & Cook, 1977), or
- world view, as measured by the Attitudes About Reality Scale (Unger, Draper, & Pendergrass, 1986).

## RELATED RESEARCH

It should be noted here that results from a related study (Hannafin & Freeman, 1995) of 36 teachers and 31 education interns showed no correlations among beliefs about the nature of reality and either intent to use or knowledge of ways to employ computer-based tools in instruction. Yet a recent study of technol-

ogy-using teacher educators' demographic characteristics and beliefs about teaching, learning, and the nature of reality (Harris & Robin, 1996), showed that:

- Technology-using teacher educators who held more social constructivist views of reality tended also to hold learner-centered beliefs about teaching, evidenced specifically in preferences for student-centered educational activities and importance ascribed to including and encouraging personal development as part of teacher education.
- Technology-using teacher educators preferred to learn by concrete experience rather than abstract conceptualization.
- Female technology-using teacher educators held learner-centered beliefs about teaching to a significantly greater degree than did their counterpart male respondents.

In planning the present study, we hoped that its results, given its large and randomly selected sample, along with the greater breadth and variety of correlations possible, might be able to point researchers in more productive directions for eventual generalizations about teachers' beliefs and use of educational telecomputing technologies.

## OVERVIEW

One thousand randomly selected teachers holding TENET accounts on both May 1, 1995, and April 30, 1996, received a surface mail letter in late May 1996 inviting them to complete a World Wide Web-based survey addressing the user characteristics listed under Areas for Exploration. If account holders chose to participate in the study, they went online, following the directions printed in the letter, and completed the 82-question survey. If they responded to each question, they could download a recent and lengthy directory of Internet-based resource addresses for use in K-12 classrooms.

TENET usage statistics for May 1995 through April 1996 (total number of logins and total time spent online, the only usage statistics retained by the system at that time) for the respondents were then gathered. Three successive requests to participate were made of those teachers who did not accept earlier invitations. One was sent in early July by electronic mail, and the others, which offered an option to respond to a paper version of the instrument using a postage-paid envelope, were sent by surface mail in early August and mid-October 1996. All possible correlations among demographic characteristics, subscale scores for the three types of beliefs measured, and amount of telecomputing activity in a year were calculated.

### Sample and Response Rate

The educators who comprised the sample had previously indicated that they would be willing to participate in network-related research. At the time that the sample was drawn, approximately 60,000 educators in Texas had TENET accounts. A simple random selection of 1,000 of these educators was drawn. A total of 299 (29.9%) of the educators responded to the survey using the Web interface. Another 259 (25.9%) responded on paper. In sum, 558 (55.8%)

educators responded. Account names for the participants who completed the instrument were then matched to TENET's records to obtain network usage data. These were supplied in the forms of total online time and total number of network logins for the 12-month period.

## Methods

Using survey responses and network records, we investigated statistical correlations between participant attributes and network use. In all, nine interval-level variables were included in the correlational analysis matrix. These are listed in the section titled Areas for Exploration.

Responses from various subgroups, delimited by sex, teaching experience, and professional specialty, were also examined to determine if within-group or across-group patterns existed. The three dimensions of teacher beliefs explored were measured using well-accepted, reliable, and well-validated instruments. Beliefs about teaching (represented on a continuum between traditional teacher-centered and more experimental student-centered teaching) were measured using the Teacher Attitude Inventory (Whitmore, 1974). This instrument produces a score that can range from 24 to 120, with larger numbers reflecting more pupil-centered teaching. An example statement within the instrument is "Schools are too structured these days" (Whitmore, p. 46). The scale consists of 24 statements that ask respondents to mark their levels of agreement with each item on a five-point Likert scale. Extensive testing of reliability and validity yielded, overall, a "moderately reliable" (Whitmore, p. 21) and "encouragingly" (Whitmore, p. 40) valid instrument.

Teacher innovation and willingness to take risks were represented using the Scale for the Measurement of Innovativeness, developed by Hurt, Joseph, and Cook (1977), which is based upon diffusion of innovations research results. This instrument consists of 20 statements related to a person's innovativeness, such as "I enjoy trying out new ideas" (Hurt, Joseph, & Cook, p. 61). Respondents indicate their levels of agreement or disagreement on a seven-point Likert scale, to produce scores ranging from 20 to 140, with higher scores representing more innovativeness, and by implication, tendencies toward earlier adoption of new ideas and new tools. Internal reliability for this instrument is "excellent" (Nunnally's  $r = .89$ ) (Hurt, Joseph, & Cook, p. 61). "Substantial predictive validity" (Hurt, Joseph, & Cook, p. 62), face validity, and construct validity were also documented first by the instruments developers, and later by the other users of the tool.

The third teacher belief instrument included in the survey was the Attitudes About Reality Scale (Unger, Draper, & Pendergrass, 1986). This short form of a longer instrument consists of 28 items that ask respondents to represent the extent of their agreement with statements such as, "People who achieve success usually deserve it" (Unger, Draper, & Pendergrass, p. 78), on a seven-point Likert scale. Statements are designed to measure personal philosophy, with total scores ranging from a belief in logical positivism:

Reality is stable, irreversible, and deterministic. Power and status are individualistic (Draper, p. 71).

to social constructivism:

Reality is changeable and largely a matter of social, cultural and historical definition. Power and status are socially determined (Unger, Draper, & Pendergrass, p. 71).

The instrument produces a score ranging from 28 to 196, with higher scores representing tendencies toward logical positivistic world views. Test-retest reliability over a three-month period was measured at .73, and the internal consistency of the instrument (coefficient alpha) was calculated to be .72. Construct validity was demonstrated for the scale as a whole, but not for four component factors that emerged during one phase of instrument testing (Unger, Draper, & Pendergrass). Harrison and Atherton (1992) suggest that the scale measures a respondents "self in relation to society rather than his or her epistemological assumptions about reality in general" (Harrison & Atherton, p. 338). For the purposes of this study, either definition is serviceable.

## RESULTS

Statistical correlations and descriptive statistics were examined for all 558 of the educators completing the survey. To ensure that the method of participant response (using the World Wide Web form or the paper instrument) was considered in the interpretation of results, each of these two subgroups was also examined in a separate correlational matrix and analysis. Of the 558 respondents, 299 chose to complete the survey using the Web form (54% of the respondent group), and 259 (46%) chose to respond on paper.

### Sample Characteristics

For the total sample of 558 participants, network use was found to be relatively high, with a mean of 216 logins for the one year period (average of ~4 per week), and a mean online time of 3,924 minutes (65.4 hours, or 1.26 hours per week, on average). The variance within each category was large as well, with a standard deviation of 290 for network logins, and 10,537 minutes for online time. Descriptive statistics for each of the nine variables considered in the correlational matrices are presented in Table 1.

**Table 1. Descriptive Statistics**

Variable	M	SD	Minimum	Maximum	n
Years Telecomputing	3.9	4.1	1.0	27.0	558
Years Using Computers	10.6	6.2	1.0	32.0	558
Years in Education	15.5	8.2	1.0	45.0	558
Age	43.6	8.8	21.0	67.0	558
Teacher Attitude Inventory	89.6	11.8	47.0	119.0	558
Attitudes About Reality Scale	105.2	15.1	59.0	147.0	558
Innovativeness Scale	113.9	13.4	62.0	140.0	558
Total Network Logins	216.5	290.3	1.0	3,028.0	558
Total Online Time	3,924.7	10,537.6	11.0	166,111.0	558

A summary of the demographic information from the survey indicated that the respondents were strongly representative of the public school sector, with 94% indicating that they worked in public rather than private institutions. The grade-level breakdown was fairly uniform, with 31% of the respondents identifying themselves as teaching at the elementary level, 21% at the middle school level, and 38% at the high school level. The remaining 10% of the respondents considered themselves to be administrators or specialists who worked across grade levels. Highest degrees held by individual participants were a bachelor's degree for 47% of the respondents, a master's degree for 51%, and a doctorate for 2%. The sex breakdown of the sample was more representative of females, accounting for 71% of the respondents, with males comprising 29%. This is not reflective of the sex distribution of TENET users overall. Women held approximately 53% of the accounts on the statewide system at the time that the sample was drawn (Anderson & Harris, 1997).

**Correlations**

We investigated statistical correlations between network use and participant attribute variables using a 9 × 9 variable matrix of correlation coefficients (Pearson's Product Moment Correlation). This matrix consisted of pairwise correlations for all nine interval-level variables, including two usage variables (total logins and online time); three teacher-belief variables represented as scores on the Teacher Attitude Inventory, Attitudes About Reality Scale, and Innovativeness Scale; and four experience-related variables: years telecomputing, years using a computer, years in education, and age. Pairwise correlations emerging during data analysis that were considered significant at the  $p < .05$  level are represented graphically in Figure 1.

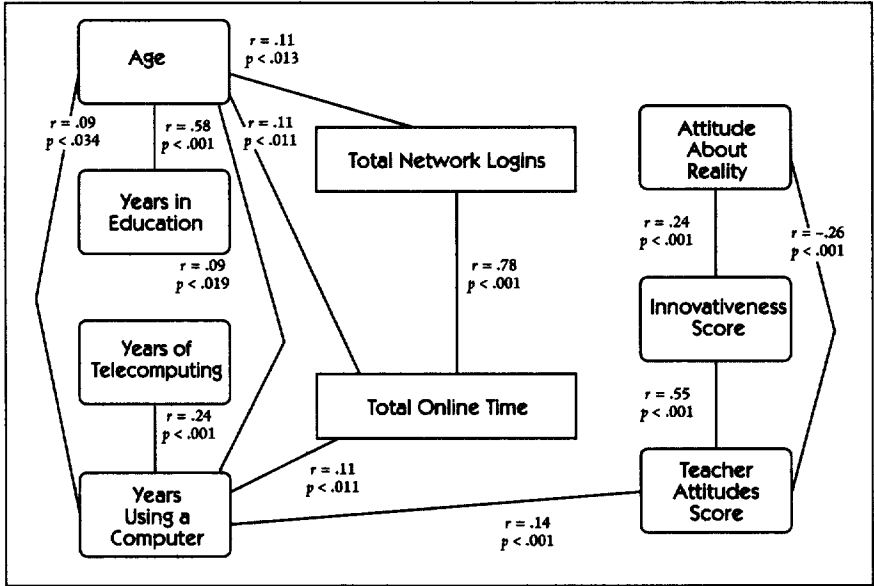


Figure 1. Relationships among variables (data for n = 558)

### *Full Sample*

As indicated in Figure 1, scores on the three belief instruments indicated that none of these variables was significantly related to either total network logins or total online time. Significant correlations did exist, however, among all belief measures. These moderately strong relationships included Attitude About Reality scores correlating with Teacher Attitude scores,  $r = -.26, p < .001$ , and with Innovativeness scores,  $r = -.24, p < .001$ . In addition, the Innovativeness and Teacher Attitude scores were correlated relatively strongly,  $r = .55, p < .001$ . Follow-up partial correlation calculations indicated the independence of these three variables.

As might be expected, total network logins and total network online time were strongly related to each other,  $r = .78, p < .001$ . The general experience level of the full sample of respondents was relatively high, with a mean age of 43.6 years for the group, and means of more than 15 years of experience in education and more than 10 years of experience using a computer. In addition, the full sample of respondents had an average of almost four years of telecomputing experience (3.9 years). However, when considering relationships between these experience variables and network use, age and years using a computer were the only variables to be correlated with amount of network use. Age was slightly correlated with both network logins,  $r = .11, p < .013$ , and total online time,  $r = .11, p < .011$ . Years using a computer was slightly correlated with total online time,  $r = .11, p < .011$ . As might be expected, a relatively strong pairwise correlation was also found between the demographic variables of age and years in education,  $r = .58, p < .001$ . Several other positive correlations were also present among the experience-related variables themselves. For example, years of telecomputing was statistically related to years using a computer,  $r = .24, p < .001$ . Please note, though, that any relationships detected between demographic characteristics and telecomputing activity, other than those that would be logically assumed (e.g., between age and years of teaching experience), were relatively weak.

### *Partial Samples*

When considering the subgroup of data generated by participants who responded using the Web page,  $n = 299$ , a similar overall correlational pattern emerged, but with less significant correlations observed among the experience-related variables themselves. Similar to the patterns emerging from the full respondent data set, none of the three belief instrument scores had a significant correlation with total network logins or total online time. The logically expected relationship between the two network usage variables themselves, logins and online time, remained strong,  $r = .79, p < .001$ . Interestingly though, in this Web-based response subgroup, the age variable was less influential in the correlational matrix, with no significant relationships found with either of the network variables. Age was related only to number of years in education,  $r = .50, p < .001$ . Years using a computer continued to be related to both online time  $r = .12, p < .031$ , and years of telecomputing,  $r = .27, p < .001$ .

Subgroup analyses for respondents who completed a paper version of the survey,  $n = 259$ , also showed no significant relationships between teacher belief variables and network use levels. The expected relationship between total logins and total



online time was actually strongest for this subgroup,  $r = .83, p < .001$ . In contrast to the analysis results for the Web response subgroup, some descriptive and experience-related variables for participants using paper instruments were significantly correlated with network use. Specifically, total number of logins was related to age of respondent,  $r = .14, p < .001$ , and years using a computer,  $r = .13, p < .034$ , and total online time was significantly correlated with age,  $r = .15, p < .001$ ; years using a computer,  $r = .12, p < .049$ ; and years of telecomputing experience,  $r = .20, p < .001$ . In addition, several of the experience-related variables were related to each other. Particularly, age was related to years in education  $r = .68, p < .001$ , and to years using a computer,  $r = .14, p < .022$ . Years using a computer was related to years in education,  $r = .24, p < .001$ , and years of telecomputing experience,  $r = .24, p < .001$ .

An interesting contrast was also noted between the two different response instrument subgroups of respondents, relating to their overall network use, as represented by both total logins and total online time variable values. Using an independent *t*-test, group means for both network use variables were compared for respondents in the two subgroups. Respondents who completed the survey using the Web form were found to have a significantly higher mean for network use. Specifically, Web respondents' login mean of 259 was significantly higher than the paper respondents' mean of 167 logins,  $t = 3.76, p < .001$ . This contrast was also apparent for total online time. Web respondents used 4,871 minutes of online time during the year on average, but paper respondents used only 2,871 minutes,  $t = 2.21, p < .001$ . Standard deviations for each group indicated that the Web respondents were considerably more variable in their scores. The *t*-test comparison of these two groups is presented in Table 2. Group differences for these two variables were unique, with no other significant differences noted for any of the other seven variables matched with correlational analyses.

**Table 2. Comparison Between Web and Paper Respondents**

	<i>M</i>	<i>SD</i>	<i>t</i> value	<i>p</i>
<b>Total Network Logins</b>				
Web Respondents ( <i>n</i> = 299)	259.0	343.7	3.76	.001
Paper Respondents ( <i>n</i> = 259)	167.4	202.6		
<b>Total Online Time</b>				
Web Respondents ( <i>n</i> = 299)	4,837.1	13,790.2	2.21	.028
Paper Respondents ( <i>n</i> = 259)	2,871.2	4,242.0		

Additional subgroup analyses relating to nominal subject attribute variables, such as teaching level and sex, were completed to further examine possible trends within data sets. No correlations inconsistent with earlier full group analyses were detected.

## DISCUSSION

In a study such as this, the composition of the sample itself is interesting. TE-NET is used voluntarily by teachers in Texas. The educators comprising the

sample have, to some degree, self-selected themselves for study, first by using Internet-based resources through TENET, and then by agreeing during online registration procedures to later consider participation in research efforts. Thus, in this case, all educators sampled could be considered to have at least a basic level of computer competence and at least some experiential familiarity with telecomputing.

### Network Use

In general, we found relatively high overall use of the TENET network among respondents, which may be encouraging news for educational telecomputing advocates. For this sample, mean network use averaged more than 10 logins and almost 5.5 hours (327 minutes) per month. Such a large number of logins and lengthy on-line time totals generated from nearly 60% of a random sample of 1,000 users would suggest that the network was indeed being used extensively.

Of the two usage measurements, the login variable would seem to be the more important to consider when interpreting network use in this setting. This is due to some of the participants having "direct connect" (e.g., T1, T3, or 56 kbps) network hookups, as contrasted with much slower modem hookups. When connected through a high-speed network, some respondents might have stayed online longer than their modem-using sample partners, without actively using the network during all, or even most, of their logged online time. Thus, the online time variable may have been artificially inflated by the work habits of users with direct connections.

### Innovativeness

The teachers in the sample also viewed themselves to be comparatively innovative in nature, as represented by a skewed distribution on the Measurement of Innovativeness instrument, and as can be seen in Figure 2. All other variables in

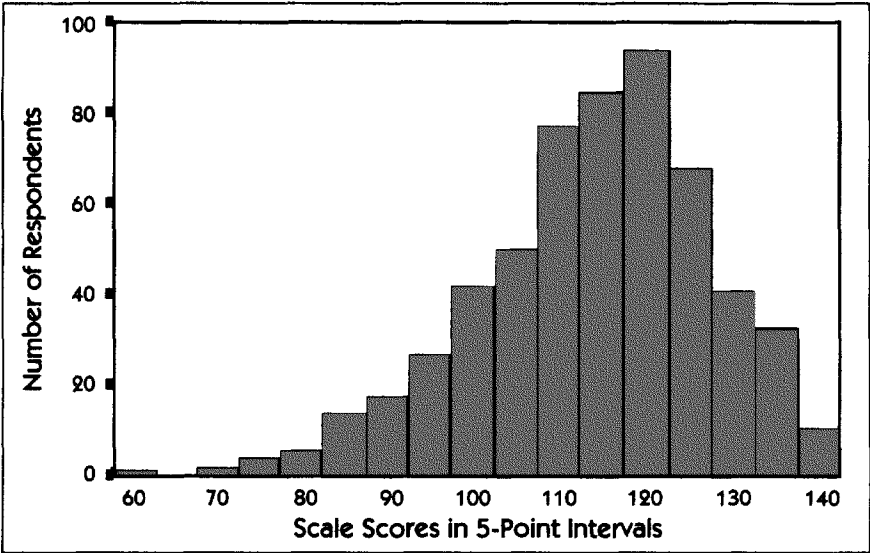


Figure 2. Measure of innovativeness distribution

the study, including those measured by the other two belief instruments, but with the exception of sex, were fairly normal in distribution across participants. Thus, the sample may indeed represent a rather unique set of educators, as defined by both their participation in an educational telecomputing network and their self-perceptions of innovativeness. Such a sample is interesting to study in this context and probably represents a group of innovators and early adopters (Rogers, 1995) in the use of networked technologies in teaching and learning. In the present study, 558 respondents represent approximately 7% of the total number of TENET account holders at the time that data were generated for this study. Rogers's (1986, 1995) work, the results for which were substantiated by many other researchers, called the first 2%–3% of any social system to adopt a new idea or tool *innovators* and the next 13%–14% *early adopters*. Several other recent studies of telecomputing educators (Anderson & Harris, 1997; Boulware, 1994; Hamilton & Thompson, 1992) similarly describe respondents as displaying characteristics reflective of innovator or early adopter status.

### Beliefs

It was also interesting to note that for this sample, teacher beliefs, as represented by scores for the three instruments mentioned above, appeared to have no direct relationships to network use. In other words, no significant correlations were found between teachers' beliefs and network use. The absence of these relationships could be considered good news for network training specialists. Perhaps we need not be concerned about educators' beliefs when providing initial training and encouraging network use. Yet this possible implication should be considered with caution. This study did not differentiate between curriculum-based telecomputing with students and teacher-only telecommunications. Relationships among teachers' beliefs, classroom practices, and uses of computer technology are being explored in a three-year, large-scale study led by professors Henry Becker of the University of California–Irvine and Ronald Anderson of the University of Minnesota (Center for Research on Information Technology and Organizations, 1998). This comprehensive study of 3,100 teachers from 900 nationally representative schools should provide definitive answers about any extant relationships among teachers' beliefs and instructional computer uses, along with other important and helpful information.

The observed relationships among the belief variables themselves were remarkable. The strongest relationship was between the Measurement of Innovativeness and Teacher Attitude Scales, with a significant positive correlation,  $r = .55, p < .001$ , indicating that educators who perceived themselves to be more innovative also perceived themselves to be more student-centered in nature. Such a relationship might be expected in today's schools, where leaders often encourage the use of student-centered activities in the learning process. Weaker but significant relationships were also noted among the other belief variables. The correlation between the Attitudes About Reality Scale and Teacher Attitude Scale scores implies that the more social constructivist an educator's world view was, the more student-centered his or her beliefs about teaching were. A similar relationship was noted for the Attitudes About Reality and the Measurement of Innovation instruments, where higher levels of social

constructivism were positively related to higher levels of perceived innovativeness. These relationships among beliefs probably imply that both social constructivism and student-centered teaching styles are generally considered to be innovative perspectives and practices. We can begin to suspect that actions reflective of certain belief systems—perhaps those that are student-centered and constructivist—are more strongly supported in our nation's schools, or at least in schools in Texas, because (a) the correlational and partial correlational patterns found within the study demonstrated that these belief constructs are independent of each other and (b) many educational leaders encourage use of innovative approaches to teaching and learning. Yet it does not appear that use of telecomputing tools by teachers is in any way related to the holding of these beliefs. Perhaps telecomputing tools are flexible enough to be used in a broad variety of ways. Rogers's (1986) work would support this assertion.

### Participant Age and Experience

The only other study variable that was found to be related to the belief variables examined in the study was years of computer use. There was a weak but significant relationship between number of years of computer experience and the Teacher Attitude instrument. Teachers who used computers longer had more teacher-centered beliefs about teaching. This would seem to challenge the common assumption that helping educators learn about computers may be a way to also help them become more student-centered in their pedagogic practices. For this large and randomly generated sample, more years of computer use was not related to more student-centered beliefs. Follow-up partial correlations to examine this relationship in more detail, controlling for age, years of education, and years of telecomputing, were all consistent with the independence and consistency of this relationship.

Teacher experience variables (age, years in education, years telecomputing, and years using a computer) did have some relationships to network use, but overall, these relationships were not strong. For example, there was a weak statistical correlation between years using a computer and total online time, but this relationship accounted for only a very small amount of variance in the sample,  $r = .11$ ,  $p < .011$ . Thus, experience level correlations overall, although significant, were not strongly related to general network use. Among the experience variables themselves, age played more of a consistent role, by being positively related to both years in education and years using a computer. Considering that finding, it was interesting that age was not directly related to the telecomputing experience of teachers, suggesting that perhaps telecomputing still is a rather new activity in K-12 settings.

It was also interesting that age played slightly less of a role in the correlational patterns observed for the subgroups of respondents who completed the survey on the Web rather than on paper. In actuality, these two subgroups were only slightly different from each other in their overall correlational patterns among investigated variables. Such an overall similarity between groups that might have had very different types and extents of access to telecomputing facilities is encouraging for researchers considering collecting much of the data in studies like this using interactive, Web-based instruments rather than paper surveys. The only notable variation between the two respondent subgroups in this study was

represented by significantly higher means for total logins and online time for Web respondents, which probably reflected differences between groups in convenience and types of Internet access.

### **Other Participant Demographics**

It was also interesting to note that many demographic variables not related to experience played negligible roles in establishing statistical correlations. For example, no relationships were found for sex; no differences were observed between males and females for any of the other demographics or beliefs measured. In addition, there were no differences in telecomputing activity noted for variables such as level of schooling (e.g., bachelor's versus master's degrees), or teaching level (elementary, middle, or secondary). In contrast, Lowther & Sullivan's (1994) study of K-12 teachers', university faculty members', and graduate students' educational-technology-related and general pedagogical beliefs showed an overall preference in all groups for cooperative learning and learner control, but to a significantly greater extent among elementary- and middle-level teachers than among secondary and postsecondary educators. The absences found in the present study for many of these more familiar demographic variables should also be good news for professional development planners, as demographic variables in general appear to be less influential in Internet use and, therefore, less of a concern in preparing individuals to use networked technologies effectively.

### **Possibilities for Future Research**

It is important to repeat that this sample was somewhat unique in that it was comprised of individuals already using a well-established telecomputing network—respondents had been doing so for at least a year—and that, overall, these educators perceived themselves to be innovative. Our respondents were relatively experienced computer users, very experienced educators, and innovators. The sample's homogeneity in these areas might explain, for example, the lack of significant difference between paper- and Web-based instrument subgroups or, more importantly, the lack of correlation between beliefs and amount of telecomputing activity. It would be interesting to contrast this group with other samples of educators who are more mixed in computer experience and possibly less innovative. Might there be relationships for less-experienced computer users or less-innovative educators among network use and beliefs about themselves, about teaching, about the world in general, or some combination thereof? If not, then perhaps we need to rethink and amend our assumptions about classroom use of educational computing tools and learner-centered beliefs and practices. Mere use of telecomputing tools (and, perhaps, computers in general) may not necessarily encourage, predict, or support more innovative educational practices. How these powerful tools are used might be the discerning factor. Unfortunately, independently verifiable information about the particular ways in which our respondents used telecomputing tools, which would have helped us to address this important issue, was not available when the data were generated, in accordance with network policy concerning privacy. We feel that to some extent this limits the educational implications of our results.

If future research determines that teachers' beliefs about themselves and their work are, over time and across groups, statistically related to their use of educational technologies, a set of important practical and ethical decisions must be made. Answers to questions such as the following then assume positions of critical importance to educational researchers and providers of professional development.

- How can beliefs, attitudes, and values be encouraged to change?
- Is it advisable, ethical, or possible to attempt to do this?
- Should this be part of inservice or preservice teacher education (or both)?

Considering the virtual explosion of networking technologies in school settings (Bare & Meek, 1998), it is important to understand more fully how such environments will both influence and be influenced by the beliefs of those who co-create them. Such networked spaces are substantially different from the self-contained classrooms of the past, as communities of minds come together in distributed formations, engaged in the common task of learning. We may well expand our comprehension of the learning process itself or, at the very least, the roles of telecollaboration and teleresearch in the improvement of teaching and learning by better understanding the reasons behind the ways we use these evolving networks. ■

### Contributors

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