DOCUMENT RESUME

ED 374 958 RC 019 821

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TITLE	Receptivity to Telecommunications among K-12 Teachers in a Rural State: Results of a Wcst Virginia Survey.
SPONS AGENCY	National Science Foundation, Washington, D.C.
PUB DATE	16 Oct 94
NOTE	31p.; Paper presented at the Annual Meeting of the National Rural Education Association (Tuscaloosa, AL, October 1994).
PUB TYPE	Reports - Research/Technical (143) -- Speeches/Conference Papers (150)
EDRS PRICE	MF01/PC02 Plus Postage.
DESCRIPTORS	*Access to Information; Computer Literacy; Distance Education; Elementary School Teachers; Elementary Secondary Education; Information Technology; *Rural Education; Secondary School Teachers; *Teacher Attitudes; *Technological Literacy; *Telecommunications
IDENTIFIERS	Internet; *West Virginia

ABSTRACT

Distance education is a way to provide needed instructional resources to rural schools, and the Internet and other telecommunications networks are the newest addition to the distance education toolkit. However, little is known about rural teachers' technological skills and attitudes in this area. A mail survey of 262 K-12 teachers in West Virginia--a predominantly rural state--examined their computer and telecommunications skills, resources available to support telecommunications networking, teacher attitudes about the utility of classroom and professional development applications of telecommunications, and background vai'ables contributing to teacher attitudes. Teachers were familiar with various computer applications, particularly instructional applications and word processing. Although much less familiar with possible applications of telecommunications, teachers were generally receptive. Few had the hardware and software necessary to use telecommunications, however. While few teachers had actually used telecommunications services, nearly 70 percent wanted access so that students could get information for class projects, and 65 percent wanted access to full-text materials for themselves. Teacher attitudes were influenced by instructional level and teaching experience, while level of technological skills was related to gender and access to technology. Despite high teacher interest, future usage patterns of rural teachers are more likely to be influenced by state concerns for control, uniformity, and "efficiency," and by the extent to which private enterprise takes over the information superhighway for profit and limits access for rural areas. (SV)

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Receptivity to Telecommunications Among K-12 Teachers in a Rural State: Results of a West Virginia Survey

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Paper Presented at the annual meeting
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Tuscaloosa, Alabama

October 16, 1994

RC 019821

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Background

Distance education has been proclaimed as a way to provide needed instructional resources to rural schools (e.g., Barker, 1992); and telecommunications technologies to access networks are the newest addition to the distance education toolkit. Commercial networks, however, are expensive. Increasingly, rural states are looking to the Internet as a less expensive and more versatile alternative to commercial telecommunications networks (CIC.NET, 1994).

As rural educators examine this option, however, they inevitably confront difficulties related to connectivity and end-user comfort. Unless teachers and other educators learn how to access the Internet with relative ease, they will make little use of the resources available.

In fact, how teachers regard this technology and its possibilities is largely unknown. The one national survey of teachers' use of the Internet and other telecommunications networks (Honey & Henríquez, 1993) investigated the activities and preferences of teachers who <u>already</u> make use of this technology. Other surveys of Internet use (e.g., Bauer, 1993) are more general still. Bauer, for instance, reported the characteristics and interests of <u>all</u> current users, the largest contingent of whom (42 percent, according to Bauer) are university students, <u>not</u> teachers in K-12 schools.

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We suspected that rural teachers in particular have experienced quite limited exposure to telecommunication technologies, though they constitute a sizable and important group of potential users. They are important because telecommunications seems to hold forth the promise of helping them overcome the impediments to schooling that rural location often entails--particularly professional and intellectual isolation, including scarcity of information resources for both teachers and students (Carlson, 1992; Miller & Hull, 1991).

However this promise works itself out in the future (cf. Cuban, 1993), the new technology will become increasingly more familiar in rural schools. Indeed, Barker and Hall (1993) report that the beginning of this trend is already evident. At the very least, all interested parties need information about these teachers' skills, attitudes, and interests with regard to networking, in order to inform efforts aimed at introducing this new instructional technology.

The purpose of this study was to assess the receptivity of teachers in a predominantly rural state (West Virginia) as part of a National Science Foundation grant. In this state 72.2 percent of the schools, and 69.8 percent of the students are located in rural areas or small towns (National Center for Education Statistics, 1993). West Virginia's schools are considered too small to be cost-effective by politicians and educational bureaucrats, who have arranged a round of

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controversial closures to increase school size (DeYoung & Howley, 1992).

Method

We asked the following questions to determine teachers' receptivity to telecommunications in the classroom and the school:

(1) What computer and telecommunications skills do West Virginia teachers already have?

(2) What resources are available in the homes, classrooms, and schools of West Virginia teachers to support telecommunications networking?

(3) What classroom and professional development applications of telecommunications do West Virginia teachers believe will be most useful?

(4) What background variables contribute to West Virginia teachers' receptivity to using telecommunications technologies?

Sample

We surveyed 850 randomly selected teachers among the population of 20,271 teachers employed in grades K-12 in the public schools of West Virginia. Ten days after mailing the survey, we sent a follow-up postcard to remind teachers to complete and return the survey. We received completed surveys from 262 respondents and began the data analysis. Our results need to be regarded with caution: Teachers interested in instructional technologies may have been more likely than others to respond.

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Instrumentation

We developed a survey instrument to elicit information pertinent to the questions posed. We were particularly concerned to include items that could be used to construct scales to measure factors related to teachers' technological literacy and to their receptivity to the applications of telecommunications.

Survey construction proceeded in four stages. First, we developed a draft of the instrument and mailed it to 11 reviewers (including six nationally known telecommunications experts, adept practitioners, teacher educators, and state department officials). Next, we revised the instrument, responding to reviewers' concerns, and we field-tested the instrument with a pilot group of 38 West Virginia teachers. Following the field-test, we again revised the instrument, omitting redundant items and clarifying items that confused respondents. We did not select items for the various scales during pilot testing, preferring instead to construct the scales post-hoc on the basis of the data obtained from the much larger study sample.

In the final stage, therefore, using the 262 usable responses to the survey, we constructed four scales to measure aspects of teachers' technological literacy and receptivity to telecommunications. To identify these factors, we first performed a factor analysis on all items developed to assess teachers' technological literacy and then one on all items

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developed to assess teachers' receptivity to telecommunications applications.

The factor analysis on items relating to technological literacy disclosed two distinct but moderately related factors, which we named "computer literacy" and "telecommunications literacy." The factor analysis on items relating to teachers' receptivity also revealed two factors, which we termed "receptivity to instructional applications" and "receptivity to professional development applications."

To construct each of the scales, we used the following procedure: (1) we selected items that had factor loadings of .50 and above on the relevant factor, (2) using these items, we computed alpha reliabilities for a scale of items thus selected, and (3) we removed items that contributed least to the reliability. Our goal was to develop four scales (one relating to each of the four factors), each with the same number of items, yet each maintaining a high alpha reliability. Each final scale contained seven items, with the alpha reliabilities given in Table 1.

INSERT TABLE 1 ABOUT HERE

Total scores were computed for each scale. These scores provided summative measures of respondents' computer literacy (COMPLIT), telecommunications literacy (TELELIT), receptivity to

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instructional uses of telecommunications (INSTRUCT), and receptivity to professional development uses of telecommunications (PROFDEV).

Results

We report results below as they pertain to teachers' technological skills, the computer resources available to them, and their preferences for telecommunications applications. We also present more detailed analyses that demonstrate the effects of background characteristics on teachers' skills and their receptivity to telecommunications applications.

Technological Skills

Two scales measured the self-reported technological skills of West Virginia teachers, computer literacy (COMPLIT) and telecommunications literacy (TELELIT). In each instance, respondents were asked to rate their familiarity, on a 1 (low) to 5 (high) Likert scale, with a variety of computer or telecommunications applications. Each of these two scales contained seven items, so values for both scales could vary from a minimum of 7 to a maximum of 35; actual scores reflected the full possible range.

Computer literacy. The seven items comprising the computer literacy scale asked respondents about their familiarity with (1) microcomputers, (2) modems, (3) CD-ROM, (4) wordprocessing software, (5) database management software, (6) statistical

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analysis software, and (7) desktop publishing software. The mean score was 18.9, with a standard deviation of 6.9. COMPLIT values were normally distributed.

Table 2 reports the percentages of respondents who gave ratings of 4 ("some independent use") and 5 ("frequent independent use") on these seven items.

INSERT TABLE 2 ABOUT HERE

Telecommunications literacy. Two items among those related to teachers technological skills loaded heavily on both the computer and telecommunications literacy scales and were retained in each in accord with the procedure described above. Those two items were familiarity with (1) modems and (2) statistical analysis software (see Table 2).

The other items on the telecommunications scale (TELELIT) assessed respondents' familiarity with (1) accounting software, (2) computer-assisted design, (3) the Internet, (4) commercial telecommunications networks, and (5) independent bulletin board services. We interpret the deployment of items among the two scales as indicating that a degree of computer literacy serves as a threshold for telecommunications literacy. This interpretation accords with data reported by Honey and Henríquez (1993) and makes sense logically.

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The mean value on TELELIT was 12.7 and the standard deviation was 5.5; the distribution showed strong positive skewness (many more low than high scores), lending further support for the possibility that telecommunications literacy is a form of high-level of computer literacy. The median score was 11.0.

Table 3 reports, for all seven items contributing to the TELELIT score, the percentages of respondents who rated each item 4 ("some independent use") or 5 ("frequent independent use").

INSERT TABLE 3 ABOUT HERE

Resource Availability

The researchers posed a series of 13 items to elicit information about teachers' access to computer resources at home and at school. For these items, respondents were asked to place a check-mark in boxes if they had access and to leave the item blank if they did not.

For home resources, respondents were asked to check three items: (1) computer with floppy drives only, (2) computer with hard drive, and (3) modem. Cross-tabulated responses indicate that 58 percent of the respondents with valid information (150 of 258) have a computer at home, and of these, 69 percent (103

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teachers, or 40 percent of valid cases) have computers with hard-disk drives at home. Finally, 17 percent of teachers (43) report having a modem at home, most configured with a machine with a hard disk drive.

For classroom resources, respondents were asked to check five items; the three above were repeated for the classroom context and two others were added: the presence of a phone jack and accessibility within the classroom to a local area network. For the sake of comparability, only information on the first three items will be provided. Cross-tabulation results indicate that 69 percent of the respondents (179 of 258) have a computer in the classroom, of whom 51 percent (91 teachers, or 35 percent of the full sample) have access in the classroom to computers with hard-disk drives. Twenty-three teachers (or 9 percent of the full sample) have access to a modem in their classroom; for all but one of these teachers the modem is configured with a hard-disk machine. Table 6 summarizes these results.

Resource availability by level. Two dichotomous variables were created from data gathered about resource availability, HOMERES and CLASSRES. If a respondent indicated no access to a computer or access only to a computer with floppy drives (and no hard drive), then the respondent was classified as a "low-resource user." Use of a computer with hard-disk drive or a modem was warrant to classify the respondent as a "high-resource user."

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Chi-square analysis was done to determine if the number of high-resource versus low-resource users varied from expectancy by level. With respect to HOMERES, there were more low-resource users in grades K-4 and fewer high-resource users than might be expected on the basis of chance ($p < .05$). The opposite was true of teachers in grades 5-12. The differences in CLASSRES were nonsignificant.

Receptivity to Telecommunications Applications

The two scales used to measure respondents' receptivity to telecommunications applications (INSTRUCT and PROFDEV) each contained seven items, as noted above. In this case no items loaded heavily on both factors used to construct the scales. Possible (and actual) values of INSTRUCT ranged from 7 to 35, with a mean of 26.2 and a standard deviation of 5.6; and the distribution was near normal. Possible (and actual) scores on PROFDEV ranged from 7 to 35, with a mean of 25.7 and a standard deviation of 5.8. The distribution exhibited minimum skewness.

Interest in specific instructional applications. The seven items on the INSTRUCT scale concerned the desirability of using telecommunications to help students (1) conduct collaborative projects with distant peers, (2) obtain information for class projects, (3) access remote computers for analysis and simulation, (4) establish relationships with expert mentors, (5) participate in electronic discussion groups, (6) publish their work, and (7) articulate positions on matters of public

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interest. These specific applications, together with the percentage of the sample giving ratings of 4 ("desirable") or 5 ("very desirable") are provided in Table 4.

INSERT TABLE 4 ABOUT HERE

Interest in professional development applications. Seven items also comprised the scale related to the factor the researchers called "receptivity to professional development applications" (PROFDEV), as follows: (1) electronic mail, (2) consultation with experts and scholars, (3) electronic discussions, (4) electronic access to journals, (5) access to electronic full-text materials, (6) access to software and other nonprint media, (7) participation in electronic conferences. These items, together with the percentage of the sample giving ratings of 4 ("desirable") or 5 ("very desirable") are provided in Table 5.

INSERT TABLE 5 ABOUT HERE

Low-rated application items. It is also useful to know which application items were rated low by teachers. Six of these items--three pertaining to instruction and three pertaining to professional development--were rated as 1 "not

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acceptable" or 2 "not desirable" by at least 10 percent of respondents. On items relating to instructional applications, 12.2 percent of teachers rated collaborative projects as a "1" or "2". Eleven percent gave low ratings to student access to mentors, and 10.1 percent gave low rating to electronic pen-pals. On items relating to professional development, 11.8 percent of respondents gave low ratings ("1" or "2") to electronic mail, 10.5 percent to electronic discussion groups, and 10.5 percent to electronic journals.

<u>Differences in interest by instructional level</u>. Oneway analyses of variance were conducted (following tests for homogeneity of variance) on the means of all items related to applications, whether for instructional or professional development purposes. Several statistically significant differences were discovered:

- o Teachers in grades K-4 viewed student participation in electronic discussion groups as less desirable than teachers in grades 5-12 (means of 3.5 versus 3.8, $p < .01$).
- o Teachers in grades 9-12 viewed the use of telecommunications to establish pen-pal relationships as less desirable than teachers in grades K-8 (means of 3.3 versus 3.7, $p < .01$).
- o Teachers in grades 9-12 viewed the use of telecommunications to publish student work as less desirable than teachers in grades K-8 (means of 3.4 versus 3.8, $p < .01$).
- o Teachers in grades 9-12 viewed the use of telecommunications to allow students to articulate positions on matters of public interest as less desirable than teachers in grades K-8 (means of 3.6 versus 3.9, $p < .05$).

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- Teachers in grades K-4 viewed use of electronic journals for professional development as less desirable than teachers in grades 5-12 (means of 3.4 versus 3.7, $p < .01$)
- Teachers in grades K-4 viewed participation in electronic conferences (of a professional nature) as less desirable than teachers in grades 5-12 (means of 3.5 versus 3.8, $p < .05$)

Predictor Variables

A review of related literature suggested that teachers' receptivity to computer-based technologies can be associated with their computer literacy (e.g., Hunt & Bohlin, 1992), their years of teaching (Fulton, 1989; Lawson, 1988; Novak, 1991; Sheingold & Hadley, 1990), and the availability of appropriate resources (Austin, 1988). Moreover, numerous studies have demonstrated that computer literacy varies according to gender (e.g., Cardinale, 1992; Mathews & Winkle, 1982) and access (e.g., Martinez & Mead, 1988; Zammit, 1992). To test whether or not such associations held true for our sample of West Virginia teachers, we constructed four regression equations. First, we looked at the variables that might explain variations in levels of computer literacy (COMPLIT) and telecommunications literacy (TELELIT). Then we examined the effects of technological skill and other background variables on teachers' receptivity to telecommunications for instruction (INSTRUC) and for professional development (PROFDEV).

Predictors of literacy. Two associations, identified in other studies, also obtained among this West Virginia sample. Access to computer resources (PERS_RES), defined here as access

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either at home or in the classroom, accounted for a significant ($p < .01$) amount of the variation in both computer literacy (COMPLIT) and telecommunications literacy (TELELIT). Respondents who had access to computer equipment at home or in their classrooms were more skilled in using computers and telecommunications technologies than were teachers who did not have similar access.

Gender also had a significant effect ($p < .01$). With regard to both computer and telecommunications literacy, males reported greater levels of skill than females.

Noting the strong association between computer literacy and telecommunications literacy ($r=.87$), we omitted this variable from the regression analyses. Obviously, facility in using computers is a prerequisite for competence with telecommunications technologies.

Table 6 reports multiple regression results with both computer literacy and telecommunications literacy as our outcome measures.

INSERT TABLE 6 ABOUT HERE

<u>Predictors of receptivity</u>. Our regression equation to explain variation in receptivity to instructional applications included only one significant variable, years teaching ($p < .01$), and explained just a small amount of variation (7%). This

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finding indicated that teachers with fewer years teaching experience were more receptive than more experienced teachers to using telecommunications in the classroom to support instruction. Contrary to Sheingold and Hadley's findings, our results did not single out beginning teachers as less receptive than their more experienced counterparts. This effect may, however, be an artifact of the high average experience level (approximately 18 years) of the teachers in our West Virginia sample.

Years of teaching also had a significant negative effect on receptivity to professional development applications, again with younger teachers indicating higher levels of receptivity. And access to resources at home or in the classroom had a positive effect ($p < .01$). This variable approached but did not reach significance when receptivity to instructional applications was the outcome. These teachers saw lack of ready access to equipment as a greater impediment to their use of telecommunications for professional development than for instruction. A possible explanation for this difference is that resources available in the school building, but not in the classroom (e.g., computer labs), provide sufficient access to support instruction. For professional development, which is usually conducted outside of the regular work day, more proximate resources appear necessary.

Table 7 reports the multiple regression results for the equations using as outcome measures receptivity to instructional

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applications and receptivity to professional development applications.

INSERT TABLE 7 ABOUT HERE

INTERPRETATION

This study found that West Virginia teachers are familiar with a variety of computer applications, particularly instructional applications and wordprocessing. Although much less familiar with the possible applications of telecommunications, teachers are generally receptive. They do not yet have the hardware and software necessary to make use of telecommunications, however. Approximately 40 percent have access to computers with hard drives, and though 17 percent report that they have modems at home, only 9 percent report access to modems in their classrooms.

Few teachers in this sample have actually used telecommunications services (i.e., Internet, commercial networks, or bulletin board services). Nonetheless, many recognize the worth of information potentially available to them through emerging networks. Nearly 70 percent of these teachers want access so that students can get information for class projects; 65 percent want access to full-text materials for themselves. Lacking much experience in the use of telecommunications (fewer than 4 percent report actual use),

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these teachers' receptivity to instructional and professional development applications is not clouded by the frustrations inherent in navigating wide-area networks. Nor is it inspired by encounters with the electronic cornucopia. We do not therefore believe that it is possible to infer eventual usage patterns from receptivity data.

Moreover, usage patterns are more likely to be influenced by what happens next with regard to the expansion and exploitation of telecommunications networks rather than by teachers' needs and interests. And this eventuality ought to be of special concern to rural educators. For telecommunications to be of real value in rural schools, it must be a resource over which teachers have control. Yet both the difficulties in using public-access telecommunications networks and the potential profitability of a private-enterprise "information superhighway" militate against such empowerment of rural teachers.

In West Virginia, a recent mandate to implement computer-assisted instruction is illustrative. This mandate, accompanied by state-wide in-service training, required teachers to learn and make use of two specific commercially packaged software systems. It did not cultivate teachers' facility in making wise use of technology, nor did it encourage them to integrate a range of resources into instructional sequences of their own design. In short, it nurtured teachers' dependence rather than their autonomy. The one-best system works this way.

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At the moment, telecommunications offers and, in fact, requires teachers to make autonomous judgments. We say "at the moment," because this circumstance--the necessary exercise of teachers' professional judgment--may elicit a variety of responses, which we conceive, for the sake of simplicity, as two alternatives.

The more appropriate response, in our estimation, is one indicated by the teachers themselves in open-ended comments on the survey, namely a massive staff development effort. Teachers in this sample are clearly eager to engage the telecommunications effort, especially for the benefit of their students. Again and again they stressed to us the importance of providing training and technical assistance. Indeed, one of their complaints about the large-scale computer initiatives they had endured was lack of responsive staff development.

The other alternative would follow tradition, circumscribing teachers' choices in the service of uniformity, efficiency, and accountability. To become a dedicated user of the Internet, for instance, is akin to becoming a devoted browser of a library. Uniformity and efficiency are difficult to impose as matters stand, which is perhaps why the most proficient users among teachers connect to networks and explore from their homes, and not from school (Honey & Henríquez, 1993). Nurturing this sort of activity, which requires a great deal of time, in schools is liable to be deemed inefficient, too expensive, and ultimately a threat to accountability. The

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alternative therefore would constitute measures to teacher-proof the telecommunications environment.

As telephone companies and media conglomerates move to establish dominion over the new "information vectors" in order to offer on-demand services, we could find that information access is determined by profitability. The value of actual libraries--as compared to virtual ones--is that they have always intended to meet low-volume needs. Browsers are welcome, encouraged, and intrinsically rewarded. By comparison, network television, which serves a high-volume market--provides a uniform product, with little opportunity for browsing. We note, however, that commercial television does little to serve the needs, represent the interests, uphold the traditions, or honor the dignity of rural communities. For rural communities to preserve their characteristic identities, in fact, they require services that meet low-volume needs.

These are simplified extremes; reality may mediate between them, but we worry that the median may lie nearer to the second extreme (teacher-proofing). This possibility has particular dangers for rural schools, which continue to chafe under the yoke of centralized financial, personnel, curricular, and instructional practices. A privately controlled "information superhighway" is not likely to take much account of local circumstance, not in the modes of access, the variety of services offered, nor the type of information ultimately accessible.

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The involvement of teachers in telecommunications networks is important now, in order that a knowledgeable--and diverse--public voice its needs. Among society's various constituencies, teachers have an arguably strong stake, perhaps the strongest, in expanding access to the intellectual resources on which learning and thinking depend. The voices of rural teachers are among the most important in this endeavor.

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Table 1

Alpha Reliabilities for Technological Literacy and Receptivity Scales

Scale	Alpha
computer literacy	.87
telecommunications literacy	.88
instructional applications	.93
professional development applications	.92

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Table 2

Computer Literacy
Percentage of Respondents Providing Ratings of 4 or 5 on Each Item

Item	percentage
wordprocessing	62.2
microcomputers	44.3
desktop publishing	29.0
database management	28.5
CD-ROM	28.1
modems	17.0
statistical analysis	14.1

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Table 3

Telecommunications Literacy
Percentage of Respondents Providing Ratings of 4 or 5 on Each Item

Item	percentage
modems	17.0
statistical analysis	14.1
accounting	14.1
computer-assisted design	10.2
bulletin board services	7.4
commercial networks	5.8
Internet	4.3

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Table 4

Preferences for Classroom Applications of Telecommunications
Percentage of Respondents Providing Ratings of 4 or 5 on
Each Item

application	percentages
information	69.5
voice on public issues	60.2
mentors	58.8
electronic discussions	56.0
publication	55.2
collaborative projects	52.4
remote computers	52.0

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Table 5

Preferences for Professional Development Applications of Telecommunications: Percentage of Respondents Providing Ratings of 4 or 5 on Each Item

application	percentages
full-text materials	64.6
nonprint materials	58.6
consultation with experts	55.3
electronic conferences	53.9
electronic journals	52.1
electronic mail	46.3
electronic discussions	45.3

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Table 6

Regression Coefficients: Computer Literacy and Telecommunications Literacy as Outcomes

Computer Literacy as Outcome

Variable	B	Beta	Sig T
School Resources	.654164	.135258	.0179
Years Teaching	-.021850	-.022714	.6840
Sex	3.874885	.250864	.0000
Personal Resources	1.562510	.416501	.0000

Adjusted R Squared = 24%
N = 262
F = 20.78, p < .0000

Telecommunications Literacy as Outcome

Variable	B	Beta	Sig T
School Resources	.439504	.111700	.0563
Years Teaching	.026340	.033885	.5529
Sex	3.884803	.311699	.0000
Personal Resources	1.030592	.331607	.0000

Adjusted R Squared = 20%
N = 262
F = 16.51, p < .0000

Table 7

Regression Coefficients: Receptivity to Instructional and Professional Development Applications of Telecommunications as Outcomes

Receptivity to Instructional Applications as Outcome

Variable	B	Beta	Sig T
Years Teaching	-.182366	-.228492	.0003
School Resources	.188980	.047555	.4617
Sex	-.190993	-.015075	.8175
Personal Resources	.376348	.123260	.0806
Computer Literacy	.050274	.061716	.3929

Adjusted R Squared = 7%
N = 262
F = 4.51, $p < .001$

Receptivity to Professional Development Applications as Outcome

Variable	B	Beta	Sig T
Years Teaching	-.131347	-.167187	.0067
School Resources	.072594	.018369	.7706
Sex	.279370	.022135	.7294
Personal Resources	.577653	.187953	.0070
Computer Literacy	.110601	.135432	.0568

Adjusted R Squared = 10%
N = 262
F = 6.14, $p < .0000$