WEB-BASED SURVEYS: ARE SCHOOLS AND EDUCATORS READY FOR NEXT-GENERATION RESEARCH METHODS?

Jonathan D. Becker
Research Director
Interactive, Inc.[1]

and

Kara Sweeney[2]
Research Associate
Interactive, Inc.

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[1] Jonathan Becker is also a doctoral candidate in the program in Politics and Education at Teachers College, Columbia University.

[2] Kara Sweeney is also in the Masters of Arts in Teaching program at the State University of New York – Stony Brook.

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Back in March of 1998, Don Dillman made a bold prediction. "It is that self-administered surveys, which leave interviewers out of the data collection process entirely, will become the dominant method of surveying early in the 21st century." By "self-administered," Dillman was referring to methods such as touch-tone data entry, electronic mail and Web surveys.

Given the pervasiveness of the Internet and other digital technologies today, Dillman's prediction does not seem so radical. However, the prediction was made more than three years ago, when the Internet and other digital technologies were really still in the formative stages. Consider that in December 1998 (already 9 months after Dillman's prediction), 43.9% of households in the United States contained at least one computer, and 26.6% of households had a computer with Internet access. By November 2002, it is projected that 68.2% of American households will have a computer and 66.9% of households will have a computer with Internet access (U.S. Department of Commerce, 2001).

That growth is even more dramatic in U.S. public schools. In 1994, 35% of public schools had Internet access, compared to 99% this year (NCES, 2001). Further, in 1998, just over half of all instructional rooms in U.S. public schools had access to the Internet. Today, almost 80% of all such rooms are Internet-ready (NCES, 2001).

Therefore, while it is unclear if Dillman's prediction has or will come true any time soon, the explosion of digital technologies and the Internet is quite clear. What is also clear is that the so-called "information age" has arrived. With the growth of the Internet necessarily comes a tremendous growth in the amount of data and/or information that is and can be collected. At the back-end of the Internet infrastructure lives complex, comprehensive database technologies. And while web-based service providers are still trying to figure out what to do with all of the data that is captured automatically, the possibilities of collecting other data through online forms or surveys increases dramatically too. The

Internet is not only a source of information; it is also an information gathering device.

Yet, out of the hundreds of sessions at the 2001 annual meeting of the American Educational Research Association, there existed one single symposium on Web-based survey research. Does that fact say something of the constituents of AERA? Or, does it say something about the field that is the subject of the work of the constituents of AERA?

Leaving it to others to speak about the AERA constituency, this paper reports on the latter issue: Are schools, teachers, and students ready for what Dillman refers to as self-administered surveys? Does the Internet and other means of electronic communication eliminate the need for educational researchers to arrive at schools with thousands of pencils and sheets of paper?

The data necessary to answer these questions surfaced, essentially by chance, through an evaluation of a statewide technology initiative funded by the Pennsylvania Department of Education. The evaluation, currently being conducted by a research team led by the two authors of this paper, includes the use of Web-based surveys as one of the main data collection methods. The first round of surveys of teachers and administrators began in the Spring of 2001. Despite the fact that there is Internet access in every school involved in the study and that the grant itself is fundamentally technology-based, a significant number of teachers and building administrators filled out paper forms of the survey that had been printed, copied and distributed for completion. As hundreds of surveys were returned with the data needing to be manually entered into the database, the questions became: “What is it about these districts, schools and/or educators that prevented them from completing a survey online rather than on paper?” “Are schools and educators simply not ready for the next generation of data collection methodologies?”

Although outside the scope of work for the statewide evaluation, the data necessary to answer these questions exist, and they are the subject of the analyses reported in this paper.

This paper is organized into three parts. Part I tracks the development of survey research methods, from personal interviews to telephone surveys to the current- and next-generation of survey methodologies. Using Dillman's four forces of change (societal organization and culture; technology; costs and efficiency; and error considerations) as a theoretical framework, Part 1 of the paper looks at why survey research methodologies have changed and how they will continue to change.

Part II, which serves as the bulk of the paper, contains an analysis of the teacher survey data with a focus on the differences between those respondents who completed surveys online and those who submitted a "paper-pencil" version. A series of analytic tests of differences will be conducted to discover what actual disparities exist across those two groups of educators.

Finally, Part III of this paper will contain a set of conclusions and recommendations based on the early experiences of the authors with web-based surveying. Some of the conclusions and recommendations will be based on the information gleaned from the actual data analysis, while others will be more procedural in nature. Tying back into Part I and Dillman's forces of change, Part III will be particularly informative and illuminating for anyone looking to advance to the next generation of survey research methodologies.

PART 1:BACKGROUND AND THEORETICAL FRAMEWORK: Dillman's Four Forces of Change

Survey research methodologies have evolved significantly in the last half-century. It was only about twenty years ago that the most popular and efficient means of survey research was in-person interviews. However, although initially seen as an extremely radical idea, by the end of the twentieth century, surveying by telephone had become widely accepted and practiced. As Dillman (1998) asserted, "[there] can be little doubt that the nation's dominant survey method in the late 1990's is telephone interviewing" (p. 2).

In large part, the shift away from in-person interviewing was driven by the increasing practicality of phone surveys. However, there were other forces at work. In fact, Dillman (1998) suggests that changes in institutionalized methods such as the conduct of surveys happen slowly and usually occur as the result of "the coalescence of factors in the survey environment that encourage the use of one method over another (p. 5)." These forces can be summarized as: (1) changes in social organization and culture; (2) available technology; (3) sources of cost and efficiency; and, (4) consideration of contributors of survey error (Dillman, 1998).

For sure, these forces help explain the tremendous growth that has occurred in the use of the Internet for survey research. The Internet, as in virtually every aspect of society, has had a tremendous impact on the field of survey research. Ranging from early disk-by-mail electronic surveys to comprehensive web-based survey systems, electronically-administered surveys as a form of what Dillman calls "self-administered surveys" have proliferated in the last few years. In 1999, in an informal survey search of Yahoo, Kaye and Johnson identified over 2,000 Web-based surveys in 59 areas.

A. Cost And Efficiency

Of Dillman's four forces of methodological change, the one that is most often cited as an explanation for the increasing use of electronically-administered surveys is cost and efficiency. As reported in previous studies, the most apparent benefits of using electronically-administered surveys over telephone

and mail surveys are reductions in time and cost, and a cutback in the often error prone and time-intensive data management and data entry (Medin, Roy and Ann, 1999). Web-based and email surveys eliminate the need for mail out/mail back surveys, and they improve response time. These methods also allow for larger quantities of surveys to be administered at any given time. In addition, the data collected from web-based surveys can be easily accessed and converted into a database for analysis. Overall, electronically-administered surveys are significantly more cost-effective than any other survey research method, particularly the traditional paper-pencil version and telephone interviews.

B. Contributors Of Survey Error

In addition to cost-efficiency, increased understanding of the contributors of survey error has aided the growth of electronic surveying. In fact, much of the most current research on electronically-administered surveys has shown that many of the same survey design considerations and principles that influence responses to mail and telephone surveys also apply to self-administered surveys such as the Web-survey (Cook, Heath & Thompson, 2000; Dillman, 2000; Dillman & Bowker, 2000). For example, we now know that in e-mail surveys, just as in more traditional survey methods, it is necessary to contact respondents more than once (Couper, Blair, & Triplett, 1997; Schaeffer & Dillman, 1998). Although access and coverage bias are the biggest concerns when using Web-based surveys, it is also important to consider the impact of survey design. As Dillman, et al. (2001) concluded, surveys that are simple and load quickly got the most responses. The research literature also suggests that respondents are most likely to stop completing the survey when asked personal questions (Solomon, 2001; Jeavons, 1998).

C. Changes In Social Organization And Culture

Changes in social organization and culture, or the changes in levels of living, help to make one method of surveying desirable over another. For example, the increase in the number of households that had a telephone made it possible for interviewers to call larger populations of people (Dillman, 1998).

Today, communication that was once normally conducted over the phone is now shifting to electronic mail. Electronic mail, just like the telephone, is becoming a cultural norm for interaction. This shift in cultural and societal norms has opened a door to the Web-based survey and other electronically administered survey methods.

D. Technological Advances

During the 1960s, when operator assistance was needed to make long distance calls, telephone surveys were not an efficient methodology; in-person interviews were preferable. With the convenience of making long distance calls as well as the development of, for example, automatic dialing, call scheduling, and data reporting software, phone interviews became more widely used. Mail surveying also benefited from technology advances. With the use of word processing programs, it became easier to print questionnaires, send correspondence, and keep track of records. During the 1980s, telephone interview surveyors were assisted by mainframe computers, which were extremely slow and had little memory. However, with the advances in technology and the increased use of microcomputers, computer-assisted telephone surveys became an extremely efficient method of surveying respondents (Dillman, 1998).

Similarly, advances in computer programming, specifically the development of Hypertext Markup Language (HTML) forms, have made web-surveys inherently advantageous. "These forms streamline the data collection process formatting and entering responses directly into a database for analysis…The formatting capabilities of HTML allow the creation of easy-to-read and attractive forms that may improve response rates" (Solomon, 2001, p. 2). HTML can be coded directly into forms, or one could use one of the many HTML editors that are now available and increasingly easy to use. Also, there are a growing number of pre-packaged survey development systems through which web-based surveys can be designed and administered. In conjunction with advances in hardware and connectivity, these programming developments make web-based surveys an increasingly realistic and feasible option.

Thus, it is quite clear that Dillman's four forces are working furiously in the direction of increased use of self-administered, electronically-administered surveys such as Web-based or Internet surveys. These new forms of surveys dramatically reduce response time and overall costs, and there is an increasing knowledge base on how to increase response rates and cut down on survey error when using them. Further, as technology continues to advance and the Internet becomes an increasingly pervasive aspect of society, electronic, Web-based survey methods will take hold and proliferate.

While growth in the use of electronically administered surveys is unquestioned herein, one question that does remain is whether or not Dillman's forces are equally applicable to all domains of society. The schooling realm is of particular interest to the authors and to all educational researchers. For sure, the cost and efficiency benefits, and the understanding necessary to reduce survey error still apply when electronically-administered surveys are conducted in schools. However, what about technology and the changes in social and organizational culture in schools? Schools are notably resistant to change, and while computer-related technology is increasingly present in schools, there are still plenty of questions about teachers' ability and/or willingness to utilize the computers (see e.g. Cuban, 2002). Are schools and educators ready for next-generation survey methods?

E. The Data Source: The Fortuitous Experiment

The data necessary to begin to formulate an answer to that very question surfaced somewhat by chance. The authors are in the midst of conducting an evaluation of a statewide learning technology initiative being implemented in schools across the Commonwealth of Pennsylvania. Given the technology-based nature of the initiative, a decision was made to use Web-based surveys as the major data collection method. Teachers, school-building administrators and even students would complete Web-based surveys at multiple points in time over the course of the longitudinal study. Among others, the teacher surveys included items and factors measuring the following constructs:

- Technology access

- Technology literacy/proficiency
- Teaching experience

These constructs were included because one of the goals of the statewide initiative was to improve technological sophistication and comfort levels with technology for all teachers and administrators across the state.

Shortly after funds from the statewide initiative were dispersed to successful grant applicants, the surveys were administered to teachers and building administrators across the state as a baseline measure in the Spring of 2001. A grant administrator from each of the 122 grantees was contacted and asked to forward the survey information (the purpose, the URL, etc.) and instructions to all teachers and building administrators who would be involved in implementing the "learning solutions" that would be obtained from the state funds.

Well, a funny (and perhaps fortuitous, from the perspective of researchers with an interest in research methodology) thing happened…A number of the grant administrators or teachers decided, for any number of reasons, that negotiating the administration of Web-based surveys would not be feasible. Despite the fact that there is Internet access in every school involved in the study and that the grant itself is fundamentally technology-based, a significant number of teachers and building administrators filled out paper forms of the survey that had been printed, copied and distributed for completion.

As hundreds of surveys were returned with the data needing to be manually entered into the database, the question became: "What is it about these districts and/or schools and/or educators that prevented them from completing a survey online rather than on paper?" "Are schools and educators simply not ready for the next generation of data collection methodologies?"

Although outside the scope of work for the statewide evaluation, the data necessary to answer these questions exist, and they are the subject of the analyses reported in this paper.

In Part II, we investigate the differences between the teachers (and their schools) that completed the Web-based survey online as expected, and those

that completed a printed form of the survey. Our goal in Part II is not to determine “causes” or exact reasons why certain teachers did not complete the survey online. We simply conduct tests of associations and differences between the two groups of teachers to both satisfy our curiosity and to see if there are any systematic variations between the two groups that would help us and other educational researchers begin to understand whether or not schools and educators are ready for next-generation survey research methods.

PART 2: WEB-SURVEYS AND THE PENNSYLVANIA STUDENTS ACHIEVING STANDARDS GRANT PROGRAM EVALUATION

A. Description Of The Sample

In total, surveys were completed by 1,300 teachers across the Commonwealth of Pennsylvania. These teachers come from 234 schools in 80 school districts.[3] Ninety-six percent of the teachers classify themselves as regular, full-time teachers. The other four percent are either part-time teachers or long-term substitutes.

For reporting purposes, those teachers who completed the survey online as expected are identified as the "Web" group. The teachers who completed a survey that was printed from the Internet and sent it to us for manual data entry are identified as the "Paper" group. Our first step was to compare the two groups of teachers demographically. As depicted in table 1 below, there are essentially no true differences between the two groups. Arguably, the web group is slightly more educated, but those differences are small and likely inconsequential.

[3] Per the research design, our goal was to survey all teachers who would be using the computer-based "learning solution" purchased with funds from the grant that was the subject of the evaluation. Since this first survey was intended to capture baseline information, and since most of the grantee districts had not fully identified all of the teachers who would be using the "learning solutions," we never had a complete sense of the size of the population of teachers to be surveyed. However, we believe that nearly all the teachers involved completed surveys. Further, we are confident that with nearly 1,300 surveys completed, we have, at the very least, a large-enough and representative sample for the purposes of the evaluation.

Table 1. Sample Description

	Paper (n=373-378)	**Web** (n=899-918)
SEX		
Male	80	20
Female	79	21
RACE		
Caucasian / White	91	93
Of African Descent	2	0.3
Indigenous or Native American	0	0.4
Asian / Pacific Islander	0	0.2
Latina/o	0.8	0.3
Multiracial	0.3	0.3
Rather not say	7	6
TEACHING EXPERIENCE		
First year teacher	3	3
1-3 years	12	13
4-7 years	14	14
8-10 years	12	7
10 or more years	60	63
HIGHEST DEGREE OBTAINED		
BA	28	23
BA+	23	21
MA	38	35
MA+	10	16
Ed.D. / Ph.D.	0.5	2
Other	1	3

B. The Predictors Of Online Survey Completion

Thus, we have two groups of teachers that are demographically identical. Yet, one group of teachers could not, or simply did not complete the web-based survey online. So, what is it about these teachers or the schools wherein they work that prevented them from doing so?

Our first step was to conduct a logistic regression analysis with a binary outcome (0=paper, 1=Web). We included a number of variables and factors as potential predictors of Web-based survey completion. No matter how many variables or factors we included, the two that repeatedly surfaced as significant predictors were a variable considered a proxy for computer access and a technology proficiency scale.

Therefore, we posited two hypotheses. First, perhaps it was simply a matter of access to a computer or an Internet-connected computer. Maybe it was too difficult for some teachers to get to an Internet-connected computer to complete the survey, so either the grant administrator for that district or one teacher in the school printed up copies and distributed them to all the teachers in the school. Our second hypothesis relates to the technological proficiency of the teachers themselves. Maybe some teachers were simply not comfortable enough with computers or web-savvy enough to complete the survey, so they asked someone to print up the survey so that they might complete it "the old-fashioned way."

In the next two sections, we examine those two hypotheses.

1. Access to Computers in Schools

The survey included a number of items intended to measure both the extent to which teachers have access to computers and the extent to which they utilize them. For this paper, we focus on the latter because our first hypothesis is that whether or not a teacher completed the survey online may be a function of basic access to a computer.

The first question we asked of teachers was where students in their class used computers. The response set included four options[4] (classroom, computer lab, media center/library, and other) and teachers were asked to select all that applied. As seen in table 2 below, it appears that students in the classes of those teachers who completed the survey online use computers in more locations than students in the classes of the teachers in the Paper group. Whereas over 80% of the teachers in either group have students working on computers in the classroom, many more students of teachers in the Web group use computers in locations additional to the classroom (i.e. a computer lab and/or the media center / library).

[4] Approximately 10% of the teachers marked "other." The survey included a text box where teachers could specify their response. The vast majority of those who marked "other" specified that students also used computers at home for their class. Because that information is irrelevant for these analyses, we have excluded it.

Table 2. Where do students in your class use computers? (select all that apply)

	CLASSROOM	COMPUTER LAB	MEDIA CENTER / LIBRARY
PAPER	83.3	63.0	26.2
WEB	87.3	80.0	49.0

Given these first pieces of data, we set out to create a crude measure of access to computers within the schools. We created a scale that ranged from no access to computers (scale score = 0) to access in all three potential locations (scale score = 3). Those teachers who had students access computers in only one location (either the classroom or a lab or the library) were given a scale score of one. Teachers who indicated that their students accessed computers in two of the three locations were given a scale score of two, etc.. The score frequencies of the two groups of teachers are displayed in table 3 below. It became quite clear that the teachers who completed the survey online had their students accessing computers in more locations. The bottom line of the table shows that more than one-third (37%) of the teachers in the Web group have students accessing computers in three different locations, compared to only 17.7% of the teachers in the Paper group.

Table 3. Computer Access (percent reporting)

	PAPER (n=378)	WEB (n=918)
No Access (0)	9.0	1.1
Classroom Only or Lab only or Library Only (1)	27.2	18.2
(Classroom + Either Lab or Library) or (Lab + Library) (2)	46.0	43.5
Classroom + Lab + Library (3)	17.7	37.3

Under the assumption that the computer access scale is an ordinal, categorical variable, we ran a chi-square test of association (a 2x4 contingency table). As shown in the next two tables, there is, in fact, a significant relationship between computer access and whether or not the surveys were completed online. Of the teachers whose students access computers in all three possible locations, 84% completed the survey online.

Table 4a. Computer Access by Group (Paper vs. Web)

		Computer Access Scale				
		0	**1**	**2**	**3**	**Total**
PAPER	**Count**	34	103	174	67	378
	% within column	77.3	38.1	30.4	16.4	29.2
WEB	**Count**	10	167	399	342	918
	% within column	22.7	61.9	69.6	83.6	70.8
Column Totals		44	270	573	409	1296

Table 4b. Chi-Square Tests Of Association, Computer Access by Group

	Value	**df**	**Asymp. Sig. (2-sided)**
Pearson Chi-Square	92.589	3	.000
Likelihood Ratio	90.127	3	.000
Linear-by-Linear Assocation	80.126	1	.000

Because the computer access scale is also fairly normally distributed, we also ran an independent samples t-test on the computer access scale and found, again, that the differences between the two groups are statistically significant. On average, the teachers who completed the surveys online have their students access computers in 2.17 of the 3 possible locations, compared to 1.72 locations for the teachers in the Paper group.

Table 5. T-Test, Computer Access by Group

	N	MEAN	STD. DEV.	STD. ERROR MEAN
PAPER	378	1.72	.858	.044
WEB	918	2.17	.755	.025

	Levene's Test for Equality of Variances		t-test for Equality of Means						
	F	Sig.	t	df	Sig. (2-tailed)	Mean Diff.	Std. Error Diff.	95% Conf. Int. of Diff.	
								Lower	Upper
Equal variance assumed	9.86	.002	-9.24	1294	.000	-.444	.048	-.538	-.350
Equal variance not assumed			-8.76	629.6	.000	-.444	.050	-.543	-.344

We recognize the crudeness of our access scale, and accept its limitations. In particular, just because a teacher has her/his students access computers in only one or two locations does not mean that computers were not available to that teacher in more locations to complete the survey online. However, we believe the scale is a decent proxy for access to computers within the school. Further, using that proxy scale, we can say with good confidence that access to computers played a significant role in whether or not the teachers completed the surveys online. That is to say, access to computers has a significant and negative relationship to the probability that the survey was completed online.

2. Technological Proficiency

In addition to the hypothesis that access correlated with online completion, we also conjectured that there is a relationship between the technological proficiency of the teachers and the probability that the survey was completed online.

To measure technological proficiency, the survey contained what we call a "mastery scale" comprised of eight items. In each item, the teachers are presented with a particular computer skill or application and asked to rate

themselves on a scale of 0=no mastery to 4=complete mastery. Table 6 below shows the mean scores for each of the eight individual items of the scale, and the mean score on the full scale (15.41). These data reveal a number of important conclusions. For one, overall, teachers rate themselves as most masterful on the computer skills or applications normally deemed "basic" (e.g. word processing and Internet browsing). Second, there is a great deal of variation in technological proficiency across the teachers. Essentially, on a scale that ranges from zero to 32, the mean score across 1,300 teachers is 15.4.

Table 6. Technological Proficiency Scale, Descriptive Statistics and Factor Analysis Statistics

COMPUTER SKILL / APPLICATION	MEAN	STD. DEV.	FACTOR LOADING
Word Processing	2.62	1.17	.762
Spreadsheets	1.34	1.25	.744
Presentation Software	1.27	1.21	.750
Desktop Publishing	1.61	1.27	.764
Internet Browsing	2.55	1.16	.781
Using Internet Search Engines	2.47	1.25	.814
Copying / Moving Files	1.97	1.37	.863
Installing Software	1.59	1.38	.806
	MEAN	**STD. DEV.**	**ALPHA**
TECH. PROFICIENCY SCALE	15.41	7.92	.911

We performed a confirmatory factor analysis on the technological proficiency scale to make sure that we did, in fact, have a reliable measure. Using principal components factor analysis extracting eigenvalues over one, only one component was extracted. Further, reliability analysis generated an alpha of .911. Factor loadings for each of the individual items of the scale are included in table 6 above.

To see if there were any differences in technological proficiency between our two groups of teachers, we ran an independent samples t-test on the scale. As shown in the following two tables, there is a statistically significant difference in technological proficiency between the two groups. The average proficiency score for the teachers in the Paper group is 13.7 compared to 16.1 for the Web

group. That difference is practically significant as well, since the Paper group is below the overall average and the Web group is above the overall average.

Table 7. T-Test, Technological Proficiency by Group

	N	MEAN	STD. DEV.	STD. ERROR MEAN
PAPER	357	13.74	7.75	0.41
WEB	872	16.09	7.89	0.27

	Levene's Test for Equality of Variances		t-test for Equality of Means						
	F	Sig.	t	df	Sig. (2-tailed)	Mean Diff.	Std. Error Diff.	95% Conf. Int. of Diff.	
								Lower	Upper
Equal variance assumed	9.41	.332	-4.76	1227	.000	-2.35	.493	-3.32	-1.38
Equal variance not assumed			-4.80	672.4	.000	-2.35	.490	-3.31	-1.39

C. The Correlates of Access to Computers and Technological Proficiency

Thus, we know that the teachers who completed a survey, but did not do so online, had less access to computers and/or lower levels of technological proficiency. Accordingly, our next step was to inquire into potential correlates of computer access and technological proficiency. That is, if access or proficiency limitations are negatively related to the probability of teachers completing a survey online, what factors might be related to access or technological proficiency? As in the last set of analyses, we looked at school- or district-level contextual factors and teacher factors. The three factors that show up as consistently and significantly correlated to computer access and proficiency are: urbanicity, the socioeconomics of the school, and teaching experience.

We tested each of those three factors against the computer access scale and the technological proficiency scale. For the computer access scale, we ran chi-square tests of association between the access scale and each of the three categorical factors. This is the equivalence of running a 4 x Z contingency table, where Z equals the number of categories in the factor. For the technological

proficiency scale, we ran a oneway analysis of variance (ANOVA) to see if there were differences in proficiency across the Z groups in each of the three factors.

1. Correlates Of Access

(a) Access x Urbanicity

As it turns out, computer access within schools in Pennsylvania is significantly associated with both the geographical location of the school (urbanicity) and the socioeconomic status of the student body. Teachers in schools coded as suburban and rural have significantly greater access than teachers in urban schools. Of those teachers with access in all three locations, only 15.3% are in urban schools, while the other 85% is almost evenly divided between suburban (40.6%) and rural (44.1%) teachers. Further, 31% of teachers in urban schools have either no access or a single access point for computers, compared to only 22% for rural teachers and 13% of suburban teachers. The chi-square test of association shows that those group differences are statistically significant.

Table 8a. Computer Access by Urbanicity

		Computer Access Scale				
		0	**1**	**2**	**3**	**Total**
URBAN	**Count**	14	122	166	62	364
	% within column	31.8	47.5	29.3	15.3	28.6
SUBURBAN	**Count**	6	42	152	165	365
	% within column	13.6	16.3	26.9	40.6	28.7
RURAL	**Count**	24	93	248	179	544
	% within column	54.5	36.2	43.8	44.1	42.7
Column Totals		44	257	566	406	1273

Table 8b. Chi-square Tests of Association, Computer Access by Urbanicity

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	99.871	6	.000
Likelihood Ratio	100.759	6	.000
Linear-by-Linear Assocation	23.749	1	.000

(b) Access x SES[5]

Additionally, teachers in schools that serve higher socioeconomic communities tend to have greater access to computers in schools. Of those teachers with access in all three locations, 45.1% are in high SES schools, while the other 55% is almost evenly divided between teachers in mid SES (28.3%) and low SES (26.6%) schools. Similarly, of the three groups of teachers, the high SES group is the only group within which accessing computers in three locations is the modal circumstance.

Table 9a. Computer Access by SES

		Computer Access Scale				
		0	**1**	**2**	**3**	**Total**
HIGH SES	**Count**	24	36	149	183	392
	% within column	54.5	14.0	26.3	45.1	30.8
MID SES	**Count**	5	83	189	115	392
	% within column	11.4	32.3	33.4	28.3	30.8
LOW SES	**Count**	15	138	228	108	489
	% within column	34.1	53.7	40.3	26.6	38.4
Column Totals		44	257	566	406	1273

[5] Our proxy measure for SES is "state aid ratio," a statistic provided by the Pennsylvania Department of Education for the percentage of students who qualify for free or reduced-price lunch. Based on that statistic, schools were placed into one of the three categories used in these analyses.

Table 9b. Chi-square Tests of Association, Computer Access by SES

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	100.865	6	.000
Likelihood Ratio	103.969	6	.000
Linear-by-Linear Assocation	46.639	1	.000

2. Correlates Of Technological Proficiency

Whereas access to computers in schools in Pennsylvania is a function of geography (urbanicity) and socio-economics of the community, there are differences in technological proficiency of teachers according to geography, SES, and teaching experience. That is, teachers in suburban schools, high SES schools, and/or those teachers with fewer than ten years experience have the highest levels of technological proficiency.

(a) Technological Proficiency x Urbanicity

A oneway ANOVA reveals that the mean proficiency score for suburban teachers (16.8), is significantly higher than rural teachers (14.99) and urban teachers (14.5). Post hoc tests (Tukey HSD) clarify that the mean score for the suburban teachers is higher than either of the other two groups, whereas there is no difference between the urban and rural teachers.

Table 10. Oneway ANOVA, Technological Proficiency by Urbanicity

	N	MEAN	STD. DEV.	STD. ERROR
Urban	343	14.53	8.12	.439
Suburban	344	16.80	7.18	.387
Rural	519	14.99	8.15	.358

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1021.77	2	510.88	8.23	.000
Within Groups	74640.58	1203	62.05		
Total	75662.34	1205			

(b) Technological Proficiency x SES

A similar result arises for the analysis of variance between teachers in the three socioeconomic groups. The mean technological proficiency score for teachers in high SES schools (16.8), is significantly higher than the mean scores

for teachers in the other two groups. Again, post hoc tests (Tukey HSD) clarify that the mean score for the teachers in high SES schools is higher than either of the other two groups.

Table 11. Oneway ANOVA, Technological Proficiency by SES

	N	MEAN	STD. DEV.	STD. ERROR
High SES	369	17.10	7.60	.40
Mid SES	373	14.87	7.99	.41
Low SES	464	14.41	7.91	.37

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1622.18	2	811.09	13.18	.000
Within Groups	74040.16	1203	61.55		
Total	75662.34	1205			

(c) Technological Proficiency x Teaching Experience

Finally, we found that teachers who had more than ten years of teaching experience self-report lower overall levels of technological proficiency. A oneway ANOVA followed by post hoc tests show that the group of teachers with more than ten years of experience report significantly lower technological proficiency levels than any of the other groups of teachers with less teaching experience.

Table 12. Oneway ANOVA, Technological Proficiency by Teaching Experience

	N	MEAN	STD. DEV.	STD. ERROR
First Year	34	19.74	5.95	1.02
1-3 Years	150	18.93	6.04	.49
4-7 Years	163	18.45	7.11	.57
8-10 Years	103	16.95	7.77	.77
10+ Years	737	13.50	7.95	.29

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	6929.01	4	1732.25	30.35	.000
Within Groups	67454.12	1182	57.07		
Total	74383.13	1186			

PART 3: CONCLUSIONS AND IMPLICATIONS

A. Summary Of The Findings

In sum, in the language of Dillman's four forces of change, we already knew of and assumed the decreases in cost and increases in efficiency from electronically-administered surveys. Further, we knew of the growing research and literature into the contributors to survey error that might arise when using electronically-administered surveys. Finally, we knew that the necessary technology advances were being made such that our society was generally becoming increasingly organized around electronic communications. Therefore, generally speaking, we expected that the forces were moving decisively in the direction of newer, more modern survey research methods. In other words, Dillman's prediction that self-administered surveys would become the dominant method of surveying early in the 21st century would very likely come true.

However, given our all too keen understanding of the eternally adversarial relationship between schools and change, we were not convinced that the latter two of Dillman's four forces were equally as applicable to schools as other areas of our society. Information and statistics from multiple sources suggest that schools are ahead of society generally with respect to technology penetration. Whereas almost 70% of homes have at least one Internet-connected computer, there is at least one Internet-ready computer in 98% of all schools. Yet, we were also aware that the simple fact that computers and the Internet were available to be used in schools did not necessarily mean that the organizational culture had changed enough to support the use of advanced survey research methods such as web-based surveys. That is to say, we were not sure that schools and educators were ready for next-generation survey methods.

Through a bit of good fortune, we came into possession of the data necessary to begin to formulate an answer to that question. Conducting tests of difference and association on a group of teachers in Pennsylvania who completed a Web-based survey and a group that chose to complete the same survey by filling out a printed copy, we discovered two predictors of online survey

completion. The first and perhaps obvious finding is that teachers with more access to computers in schools were more likely to complete the survey online. Second, teachers with greater computer-related technological proficiency were more likely to complete the survey online.

Given those findings, we set out to find the correlates of computer access and technological proficiency. Ultimately, we found that those factors were related to the geographical location (or urbanicity) of the school and the socioeconomics of the population of the students in the school. Teachers in urban schools had significantly less access to computers in schools, and teachers in suburban schools self-reported higher levels of technological proficiency. Additionally, teachers in schools serving more affluent communities had both more access to computers and higher levels of technological proficiency. Finally, teachers with more than ten years of teaching experience self-report significantly lower levels of technological proficiency than their counterparts with less experience.

B. Extrapolating the Findings

We have not modeled the data simultaneously in any way that allows us to definitively conclude that the probability of Web-completion is directly related to the demographics of the school population and the experience level of the teacher. All we can say is that from these analyses is that access to computers and technological proficiency are positively and significantly related to the likelihood that teachers in Pennsylvania completed a web-based survey online or on a printed copy. Further, across the Commonwealth of Pennsylvania, there are variations in access and proficiency by the demographics of the school population and the experience level of the teachers.

Therefore, before discussing the implications of these findings, we take a look at whether these "digital inequities"[6] exist outside of Pennsylvania.

[6] Digital equity in education is defined herein as a statistical condition whereby advanced learning technologies are, at the very least, randomly distributed by according to, for example, sex, race, SES, and geography.

First, with respect to access to Internet-connected computers, table 13 below shows that not only are 98% of our nation's schools now equipped with at least one Internet-ready computer, but 77% of all instructional rooms are now so equipped.

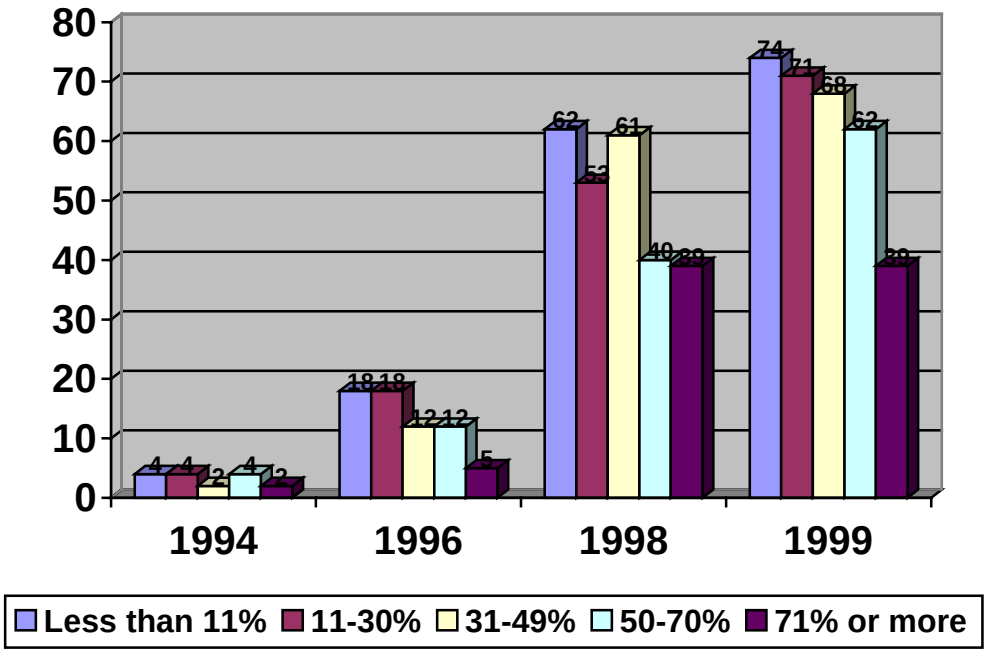
Table 13. Technology Penetration in U.S. Public Schools, 1995, 1998-2000

	1995		1998	1999	2000
Percent of Schools Having Access to the Internet	50		89	95	98
Percent of Instructional Rooms with Access to the Internet	8		51	63	77
Percent of Instructional Computers with Access to the Internet	8		50	62	77
Mean Number of Instructional Computers per School	72		90	100	110

SOURCE: U.S. Department of Education, National Center for Education Statistics, Internet Access in U.S. Public Schools and Classrooms: 1994-2000.

However, as shown in Figure 1 below, we know that the same inequities that showed up in Pennsylvania repeat themselves elsewhere across the nation. Seventy-four percent of the instructional rooms in schools where fewer than 11% of the students qualify for free or reduced-price lunches have Internet access, compared to just 38% of the classrooms in schools where 71% or more of the students qualify. That is, figure 1 depicts the relationship that exists between the socioeconomics of the population a school serves and the access to computers that exists within the schools. The more low-income children a school serves, the fewer the instructional rooms with Internet access the school has.

Figure 1. Percent of Instructional Rooms with Internet Access in Public Schools by Percent of Students Eligible for Free or Reduced-Price School Lunch



SOURCE: U.S. Department of Education, National Center for Education Statistics, Advanced Telecommunications in U.S. Public Schools Surveys, 1994-99.

Further to the same point, table 14 below shows that schools in urban areas (or even on the urban fringe) have a lower percentage of instructional rooms with Internet access than schools in other areas. Also, there is a negative relationship between access to instructional rooms with Internet access and the percentage of minority students enrolled in the school.

Table 14. Percent of Instructional Rooms with Internet Access in Public Schools, by School Characteristics, 1994-2000

	1994	1995	1996	1997	1998	1999	2000
Metropolitan Status							
City	4	6	12	20	47	52	66
Urban Fringe	4	8	16	29	50	67	78
Town	3	8	14	34	55	72	87
Rural	3	8	14	30	57	71	85
Percent Minority Enrollment							
Less than 6%	4	9	18	37	57	74	85
6-20%	4	10	18	35	59	78	83
21-49%	2	9	12	22	52	64	79
50% or more	2	3	5	13	37	43	64
Percent of Students Eligible for Free or Reduced-Price Lunch							
Less than 35%	3	9	17	33	57	73	82
35-49%	2	6	12	33	60	69	81
50-74%	4	6	11	20	41	61	77
75% or more	2	3	5	14	38	38	60

SOURCE: U.S. Department of Education, National Center for Education Statistics, Internet Access in U.S. Public Schools and Classrooms: 1994-2000.

Thus, across the nation, as in Pennsylvania, there are inequities with respect to access to Internet-ready computers. Additionally, if we accept teacher preparedness to use computers and the Internet as a proxy for technological proficiency, similar inequities persist with respect to technological proficiency of teachers. Thirty-seven percent of teachers in schools with the fewest low-income students report feeling well prepared to use computers and the Internet, compared to 32% of teachers in schools serving the highest percentage of low-income students. Most glaringly, teachers with the most experience report feeling least prepared to use computers and the Internet.

Table 15. Percentage distribution of teachers with access to computers or the Internet at school according to the level of preparedness they feel to use computers and the Internet by school and teacher characteristics: 1999

	Not at all prepared	Somewhat prepared	Well prepared	Very well prepared
All public school teachers with access to computers or the Internet at school	13	53	23	10
School Instructional Level				
Elementary School	12	55	23	10
Secondary School	15	50	23	12
Teaching Experience				
3 or Fewer Years	10	46	31	13
4-9 Years	10	49	28	13
10-19 Years	14	55	21	10
20 or more years	16	58	19	8
Hours of Professional Development				
0 hours	32	46	15	6
1-8 hours	19	55	20	6
9-32 hours	4	61	25	10
More than 32 hours	1	32	37	29
Percent of Students in School Eligible for Free or Reduced-price Lunch				
Less than 11%	10	53	25	12
11-30%	13	52	25	10
31-49%	14	51	24	10
50-70%	16	58	16	10
71% or more	13	55	22	10

SOURCE: U.S. Department of Education, National Center for Education Statistics, Fast Survey Response System, "Public School Teachers Use of Computers and the Internet," FRSS 70, 1999.

C. Implications and Recommendations

So, are schools and educators ready for next-generation survey research methods? With full recognition of the limitations of our work (particularly the simplicity of the statistical analyses)[7], our answer to that question is, "almost." Of

[7] For example, we make no pretense that our findings rise to the level of causality; only that we discovered some relationships between factors that might describe teachers and whether or not they completed a survey online. We are fully aware that there are other factors that explain why certain teachers completed the survey in paper form rather than online. However, our whole goal was simply to try to begin to understand why some teachers did not complete a web-based survey online. We think we have accomplished our goal.

the almost 1,300 electronically administered (web-based) surveys that were completed by teachers as part of an evaluation in Pennsylvania, 71% were actually completed online. So, perhaps if we had to give schools and educators a "readiness for electronically-administered surveys" grade, the grade would be a 71% (C-). Further, that the other 29% of teachers bothered to send back a printed survey they had completed makes it difficult to suggest that educational researchers should hesitate in using electronically-administered surveys (and probably raises the grade). However, there is at least one clear implication and a few recommendations that emanate from the findings reported herein.

While the statewide evaluation that produced the data for these analyses was not so much concerned with sampling error[8], there are clear survey coverage implications to be drawn from the findings.

The social sciences and educational research field have accepted the use of web-based surveys, because it offers many advantages over traditional survey methods. "Computer methods make it possible to combine methods into one survey and blend the results" (Dillman, 1998). At this time there are a variety of software programs available to create web-based surveys more efficiently and easily. The formatting capabilities of the software programs allow for many possibilities when creating a survey. Also, web-based surveys offer the researcher a more efficient means of creating and modifying the survey, as well as reaching the respondents, and in turn increasing response rates.

However, web-based surveys require that respondents have minimal technological skills and access to the Internet. These factors may limit the population that may complete such a survey. Researchers need to be aware of the coverage bias of this method. Care should be taken when a survey is intended to reach a large number of respondents who may choose not to use or who may not have access to the Internet. Over time, access and availability will

[8] The research methods mutually agreed upon by Interactive, Inc. and the Pennsylvania Department of Education included surveying of the entire population of teachers and administrators in districts awarded grants. There is some sampling involved in other parts of the evaluation, but not with respect to the web-based teacher surveys.

no longer be an issue as increasing numbers of people use the Internet more frequently. At least for now, when using this method, the surveyor must compensate for those respondents that don't have access or do not feel comfortable completing web-based survey.

As per our study reported herein, if web-based surveys are used in educational research that intends to utilize a random sample of schools and/or teachers, our findings suggest that the respondent group will likely not be representative of the overall population of teachers and/or schools. Very possibly, teachers in schools serving traditionally disadvantaged students and teachers with the most teaching experience will be underrepresented. In other words, the digital inequities in education that exist and that are documented above create a likely coverage bias in the use of web-based surveys in educational research.

One recommendation to remedy likely coverage bias is to over-sample from those groups of schools and teachers who we found less likely to complete a survey online. Those groups include urban schools, schools that serve low-income children, and teachers with ten or more years of experience.

A second recommendation for those educational researchers considering the use of web-based surveys would be to offer the print option and budget for the time and costs associated with manual entry of those data. For certain, we were very pleased to have the data from the close to 400 teachers who did not complete the survey online. As in all survey research, the more data, the merrier. However, there are very definite costs associated with manual data entry, and it takes a lot of time.

Finally, there are lots of other issues that need to be addressed with web-based surveys including, but not limited to, privacy concerns, coding of incomplete surveys, etc. Those issues are not addressed herein, but, like the gaps in computer access and teacher technological proficiency that exist in Pennsylvania and beyond, they are problems or issues that are not insurmountable. Thus, our last recommendation is to push forward and stretch the survey methods envelope. Arnold Bennett once said that, "any change, even

a change for the better, is always accompanied by drawbacks and discomforts." The Internet is different things to different people. To educational researchers, it is, at the very least, a highly efficient medium for data collection. That is, in our opinion, there may still be drawbacks and discomforts, but web-based surveying is definitely a change for the better.

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