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No Access, No Use, No Impact: Snapshot Surveys of Educational Technology In K-12

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Abstract

There is general agreement that computing technologies have not had a significant impact on teaching and learning in K-12 in the U.S even though billions of dollars have been spent in purchasing, equipping, and supporting the technology. Some critics of school technology use this situation to push their position that technology is not appropriate for children. Others put the failure on the backs of classroom teachers. However, based on the data we collected administering the Snapshot Survey in districts, large and small, around the country, to approximately 4,000 K-12 classroom teachers, the reason there has not been an impact of technology is that students have actually, for all intents and purposes, not used the technology. And, the reason for this non-use lies not at the feet of the teachers, but rather in the very real lack of access to the technology, e.g., having one computer in the classroom is *not* access nor will it lead to significant student use. Frankly, there can't be an impact of technology if children have not add the opportunity to access and use the technology.

1. Introduction

Contrary to some highly vocal naysayers (e.g., Stoll, 1995, Healy, 1998, Oppenheimer, 1997, Cordes & Miller, 1999), computing technology can, under the right conditions, have a positive impact on learning and teaching in the primary and secondary grades (Honey, 2001, Norris, Smolka, & Soloway, 2000). In fact there is a range of impacts, e.g., increased time on task, higher test scores, lower cost, and increased motivation.

But, while the literature points to the potential for impact, the reality is sobering: to a first order approximation, the impact of computing technology over the past 25 years on primary and

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secondary education has been essentially zero (e.g., Oppenheimer, 1998, Cuban, 2001). While specific classrooms or even schools can be identified where computing technologies have had an impact, overall, looking across the landscape of schools in the U.S, there are precious few lasting footprints left by the technology. By and large classrooms and schools go about their daily business ignorant of the profound changes caused by computing technologies in many other areas of everyday life, from new manufacturing practices to new science research methods, from new business practices to new methods for creating art and music. Why aren't our children and their teachers benefiting from technology?

One possible source for resolving this discrepancy may be found in teachers' responses to the "Snapshot Surveys," which we have been conducting throughout the U.S. since 1997. Consisting of approximately four dozen questions, the Snapshot Survey[2] is a multidimensional survey of demographics, educator attitudes, classroom practices, and technology access. In an attempt to systematically identify the factors that most strongly influence the curricular use of computer technology and Internet resources in K-12 classrooms, the present study analyses responses from 4,000 teachers throughout the U.S. surveyed during the school year 2000-2001.[3] This paper presents the results of four distinct but interrelated analyses:

- First, we summarize our findings on the ***use*** of technology in K-12 schools.
- Next, we summarize our findings on the ***access*** to computing technology by students and teachers in U.S. schools, in both individual classrooms and shared computer laboratories.
- Third, we identify the variables that most accurately predict teachers' ***use*** of technology for instructional purposes.
- Finally, we identify some specific relationships between the ***access*** to technology and its ***use*** by the teachers and students.

Overall, we found a significant and substantive correlation between technology access and use; almost without exception, the strongest predictors of teachers' technology use were measures of technology access. Convsersely, and contrary to conventional wisdom, teacher characteristics and demographics (e.g., time on the job, subject matter, gender) were of relatively little consequence in predicting technology use.

2. Sources of Data for the Survey

The data analyzed for the present study consists of the pooled responses from 3,665 teachers surveyed in late 2000 and early 2001. The sample was geographically diverse, representing four U.S. states (California, Florida, Nebraska, and New York), with a mixture of rural and urban respondents. Originally, 4,043 teacher responses were obtained during these four administrations, but 67 of these responses (1.7% of the total) were excluded due to internal inconsistencies in respondents' answers. Additionally, teachers whose primary assignment involves teaching technology-related courses (311 respondents in all) were deliberately excluded from analysis. Because these teachers teach technology-related subjects, their use of classroom

[2] See for example, http://snapshotsurvey.org

[3] We continue to carry out Snapshot Surveys. For example, a Survey was conducted in the late spring of 2002 in a school district in the southwest. The data from that study are essentially identical to the data reported in the body of this paper.

technology is, by definition, nondiscretionary, whereas the focus of the present study is discretionary technology use among K-12 teachers.

3. Analyses of Snapshot Survey Data

3.1 Curricular Use of Computers and the Internet

Please indicate the number of typical or average minutes PER WEEK that:	
A typical student would use a computer (but not the Internet) for curricular purposes in YOUR class: 1. None 2. < 15 minutes 3. 15-45 minutes 4. 46-90 minutes 5. > 90 minutes	A typical student would use the Internet for curricular purposes in YOUR class: 1. None 2. <15 minutes 3. 15-45 minutes 4. 46-90 minutes 5. > 90 minutes

Figure 1. Snapshot Survey Questions Regarding Instructional Technology Use.

As shown in Figure 1, the Snapshot Survey contains two questions regarding technology use. One question focuses on the use of computer technology exclusive of Internet use, while the second specifically focuses on curricular use of the Internet. Table 1 summarizes respondents' curricular use of non-Internet computer technologies, and Table 2 summarizes respondents' curricular use of the Internet.

Curricular Computer Use	Number of Responses	Percent	Cumulative Percent
None	523	14.4	14.4
< 15 minutes	1099	30.3	44.7
14 - 45 minutes	1364	37.6	82.4
46 - 90 minutes	427	11.8	94.2
> 90 minutes	212	5.8	100.0
Total	3625		

Table 1. Curricular Use of non-Internet Computer Technology

Curricular Internet Use	Number of Responses	Percent	Cumulative Percent
None	920	25.6	25.6
< 15 minutes	1493	41.5	67.0
14 - 45 minutes	959	26.6	93.7
46 - 90 minutes	177	4.9	98.6
> 90 minutes	51	1.4	100.0
Total	3600		

Table 2. Curricular Use of the Internet

These results paint an alarming picture: despite the expenditure of literally billions of dollars in classroom technology, fully 14% of U.S. K-12 teachers make no use whatsoever of computers for instructional purposes, and nearly half (45%) use it with their students less than 15 minutes per week—*equivalent to just 3 minutes per day*!. At the opposite end of the spectrum, only 18% of respondents report using computers for instructional purposes more than 45 minutes per week.

Table 2 indicates that Internet use is even less pervasive, lagging well behind non-Internet technology use. Only a tiny fraction of respondents (1.4% of the total) makes extensive use the Internet for instructional purposes, and over a quarter report making no use of the Internet whatsoever. *Fully two-thirds of respondents make minimal or no use (<15 mins/week) of Internet technologies with their students.*

3.2 Access to Computers and the Internet

The Snapshot Survey contains two questions regarding access to computer technology, reproduced in Figure 2. One question focuses on the access to Internet-connected computers in respondents' classrooms, while the second focuses on the access to Internet-connected computers in shared computer laboratories. Table 3 summarizes the results for classroom access to Internet-connected computers, while Table 4 summarizes the results for questions regarding access to Internet-connected computers in shared computer labs.

What is the availability of Internet-connected computers for your STUDENTS in your classroom?	What is the availability of an Internet-connected computer lab for your students?
1. 0 Internet-connected computers 2. 1 Internet-connected computers 3. 2-5 Internet-connected computers 4. 6-10 Internet-connected computers 5. >10 Internet-connected computers	1. Never 2. Seldom 3. 1 time/week 4. 2 times/week 5. 3 or more times/week

Figure 2. Snapshot Survey Questions Regarding Technology Availability

Number of Classroom Computers	Number of Responses	Percent	cumulative percent
None	574	15.8	15.8
1	1724	47.4	63.2
2 – 5	1036	28.5	97.1
6 – 10	140	3.8	95.5
>10	163	4.5	100.0
Total	3637		

Table 3. Summary of Classroom Computer Access

Frequency of Lab Access	Number of Responses	Percent	cumulative percent
Never	560	15.8	15.8
Seldom	809	22.8	38.6
1 time/week	994	28.0	66.5

2 times/week	513	14.4	81.0
> 2 times/week	675	19.0	100.0
Total	3551		

Table 4. Summary of Lab Access

These statistics are also alarming. One teacher in six had no computers in his or her classroom, and nearly two-thirds of respondents had no more than one computer to be shared among their entire classroom.[4] Furthermore, less than 5% of respondents had more than 5 classroom computers available for use. In other words, teachers with no more than one classroom computer outnumbered teachers with 6 or more computers by a factor of 7-to-1.

Independent confirmation of these statistics is available from the Statistical Abstract of the United States (U.S. Department of Commerce, 2000; Becker, 2000). While confirming the oft-quoted, if superficial, statistic that 95% of U.S. K-12 schools had access to the Internet in 1999, the Statistical Abstract also confirms that the average number of students-per-computer, across a wide range of demographic, geographic, and socioeconomic groups, is a remarkably constant (but instructionally inadequate) ratio of 5-to-1 (Cattagni, Farris & Westat, 2001). Still further, a recent Corporation for Public Broadcasting report suggests that, while there has been significiant growth in Internet connectivity in the home, "With state and local governments facing crisis-level budget shortfalls, schools may find it difficult to dedicate the expenditures necessary to build out [school] systems." (Corporation for Public Broadcasting, 2003)

As shown in Table 4, lab access in U.S. K-12 schools is a little better. Overall, there are three roughly equal-sized groups. About one-third of respondents report having access to Internet-connected computers in a shared computer lab at least 2 times per week. However, 28% have lab access only once a week, and fully 39% have either no lab access or only sporadic, occasional access to a computer lab.

By combining the results of the two technology access questions (number of classroom computers and frequency of lab access) it becomes apparent that K-12 classrooms are actually a very long way from being "wired." Table 5 summarizes the combined access to technology, in both classroom and shared laboratories, among survey respondents. While it's true that only a tiny fraction (less than 2%) of respondents have no technology access at all, it is equally true that 26% of teachers responding (925 total) work in what can only be described as technology-poor environments (no more than 1 classroom computer and no better than sporadic lab access). Conversely, only 21% (747 respondents) teach in technology-rich environments (more than 10 classroom computers *or* regular lab access more than twice a week).

Number of Classroom CPUs	Frequency of Lab Access					
	Never	Seldom	1/week	2/week	>2/week	Total

[4] Mississippi's Governor proudly declared that Mississippi was the first state in the Union to put one Internet-connected computer into each and every classroom in the state (Volz, 2003). While clearly a significant milestone, our data suggest that practically speaking, this achievement may do little for students' education.

None	57	281	192	22	6	558
1	184	403	186	17	15	805
2-5	144	493	300	27	22	986
6-10	81	236	151	14	28	510
>10	97	255	180	53	86	671
Total	563	1668	1009	133	157	3530

Table 5. Crosstabulation Summary of Technology Access for K-12 Teachers

Clearly, teachers cannot employ educational technology to which they have minimal or no access, let alone integrate that technology seamlessly into curricular activities. *When two-thirds of teachers report having no more than one computer for an entire classroom of students, it is unsurprising to discover than 44% of respondents report that they use computers in curricular activities less than 15 minutes per week.*

3.3 Predicting Technology Use

Of course, merely noting the apparently strong similarities between limited technology access and similarly limited technology use does not provide a clear and definitive link between technology access and instructional use. It is entirely possible, for instance, that both technology access and educator attitudes play a significant role in the use of technology for curricular purposes.

The next set of analyses attempted to identify predictor variables that were most strongly correlated to use of classroom technology. Such predictions are typically undertaken via regression analysis, sometimes referred to as ordinary least squares (OLS). OLS is the familiar linear modeling procedure in which one or more predictor variables are examined to identify the variable(s) that most strongly influence or correlate to a dependent variable of interest.

However, in predicting teachers' use of technology, there are literally dozens of candidate predictor variables from which to choose, and no clear rationale for preferring one variable, or one set of variables, over another. Further complicating analysis, correlations are possible, even likely, among many of the candidate predictors. For example, it's reasonable to expect that a teacher who believes that students exhibit higher levels of learning when using technology probably also believes that time spent searching the Internet is well spent, or that the positive elements of technology use outweigh the negative. All three questions are on the Snapshot Survey, and correlational analysis shows that there is indeed a substantive and statistically significant relationship among all three of these variables. Correlations among predictors (commonly referred to as *multicolinearity* or simply *colinearity*) are known to profoundly distort attempts to identify the most robust predictor variables via traditional regression analysis.

In order to arrive at a correct and clear picture of the factors that most influence computer and Internet use, it is important to minimize the effects of colinearity among the various predictor variables. One technique suitable for disentangling the effects of colinearity among predictors is two-stage least squares (2SLS) analysis (Berry, 1984). Commonly used in structural equation modeling, 2SLS is able to replace "problematic" (autocorrelated or colinear) predictor variables with computationally derived substitutes that are minimally correlated among themselves. Once the effects of colinearity have been thus mitigated, 2SLS performs a standard OLS regression analysis.

Because it is based on OLS regression, the output from a 2SLS analysis is a familiar set of standardized regression coefficients or beta weights. Larger values for beta weights indicate a greater impact on the dependent variable, while values close to zero indicate no predictive power. As with OLS regression, the statistical significance of individual beta weights is measurable via t-test.

A 2SLS analysis was undertaken in which all of the demographic, attitudinal, and infrastructure variables available from the Snapshot Survey (some 44 variables in all) were specified as both potential predictors and potentially "problematic" variables, while instructional use of non-Internet computer technology was specified as the dependent variable. By folding all 44 predictors into a single 2SLS analysis, the most influential predictors of curricular technology use can be determined by directly examining the beta weights output by 2SLS. Table 6 shows the significant predictors of technology use identified by the 2SLS procedure.

	Beta	T	*P*
Number of classoom computers	0.17	3.67	<0.001
When my students use the Internet for course assignments, they create products that show higher levels of learning.	0.15	2.71	<0.01
What best decribes your teaching assignment?	-0.14	-2.84	<0.01
Indicate the number of typical minutes PER WEEK that you use the Internet at school.	0.11	2.36	0.02
I need more curricular-based software.	0.12	2.33	0.02
I need more technical support to keep computers working.	0.12	2.31	0.02

Table 6. Significant Predictors of Educational Technology Use

Of the 6 significant predictors identified in this analysis, one is demographic, and only one is attitudinal. The demographic variable, type of school assignment, supports the conclusion that teachers in upper grade levels (middle school and high school) are more likely to employ computer technology for curricular purposes than teachers in lower grade levels (elementary schools). The sole attitudinal variable correlated to technology use is a belief that students exhibit a higher level of learning when using instructional technology. It is important to note, however, that a plausible (though necessarily tentative) inference can be made that this belief is, by definition, outcome-based, and is more likely to be a result of, rather than a predictor of, technology use. In other words, teachers whose opportunity to integrate computer technology into curricular activities is constrained by a lack of access to that technology have no basis for forming any belief (whether positive or negative) regarding the impact of that technology on student learning.

All four of the remaining significant predictors are directly related to access and technology infrastructure. By far, the single most significant predictor of technology use is the number of classroom computers. Also significant, but less markedly so, are teachers' use of the Internet at school, the availability of curricular software, and the availability of adequate technical support to maintain operational status of computers and networks.

A second 2SLS analysis was undertaken in an attempt to identify significant predictors of educator use of the Internet and related technologies for curricular purposes. Results of this analysis are summarized in Table 7.

	Beta	T	*P*
I need more access to the Internet for my students.	0.20	3.00	<0.001
Number of classoom computers	0.17	3.65	<0.005
Indicate the number of typical minutes PER WEEK that you use the Internet at home.	0.16	2.83	<0.005
Indicate the number of typical minutes PER WEEK that you use the Internet at school.	0.14	2.91	<0.01
What is the availability of an Internet-connected computer lab for your students?	0.13	2.69	<0.01
What best decribes your teaching assignment?	-0.12	-2.33	0.02
When my students use the Internet for course assignments, plagiarism becomes more of a problem.	-0.10	-1.96	0.05

Table 7. Significant Predictors of Educational Use of the Internet

Once again, the results are dominated by predictor variables that relate to technology access. Only one attitudinal variable was found to be significantly correlated to Internet use: respondents' belief that increased Internet use correlates to a greater likelihood of student plagiarism. Whether such a belief represents the result of experience using the Internet, or an attitudinal obstacle to such use, remains unclear.

These results clearly indicate that teachers' use of technology is severely constrained by the extremely limited access to that technology in K-12 schools and classrooms. To the extent that teachers' use of computers and the Internet is disappointingly spare, it must simultaneously be noted that technology access in most U.S. schools is similarly spare.

It is equally important to note that educator demographic and attitudinal variables were, comparatively speaking, of no statistical value in predicting technology use for curricular purposes. The image of a wizened Luddite, fearful of innovation and stubbornly resistant to adoption of classroom technologies, is wholly unsupported by these results. The relative impact of the individual/attitudinal variables most commonly raised in informal conversation as possible predictors (such as years on the job, age, hours of professional development, or gender) range from the insignificant (gender: t=1.218, p=0.22) to the infinitesimal (years of experience: t=0.05, p=0.96).

3.4 Specific Relationships between Access and Use

In order to probe more deeply into the specifics of the relationship between access and use, a series of correspondence analyses (Clausen, 1998) was carried out. Correspondence analysis is a nonparametric descriptive/exploratory technique that can be applied to any crosstab or contingency table. Correspondence analysis allows detailed examination of interdependence among categories of the variables being analyzed. A derivative visualization technique, known as correspondence mapping, supports the creation of a spatial/geometrical representation that allows both rows and columns from the table to be displayed simultaneously in a common space. The resulting output charts (sometimes called correspondence maps) bear a superficial resemblance to traditional scatterplots. However, on a correspondence map, association among categories is represented by proximity among their respective points. Thus, the closer two points are on a correspondence map, the stronger the relationship between the corresponding categories.

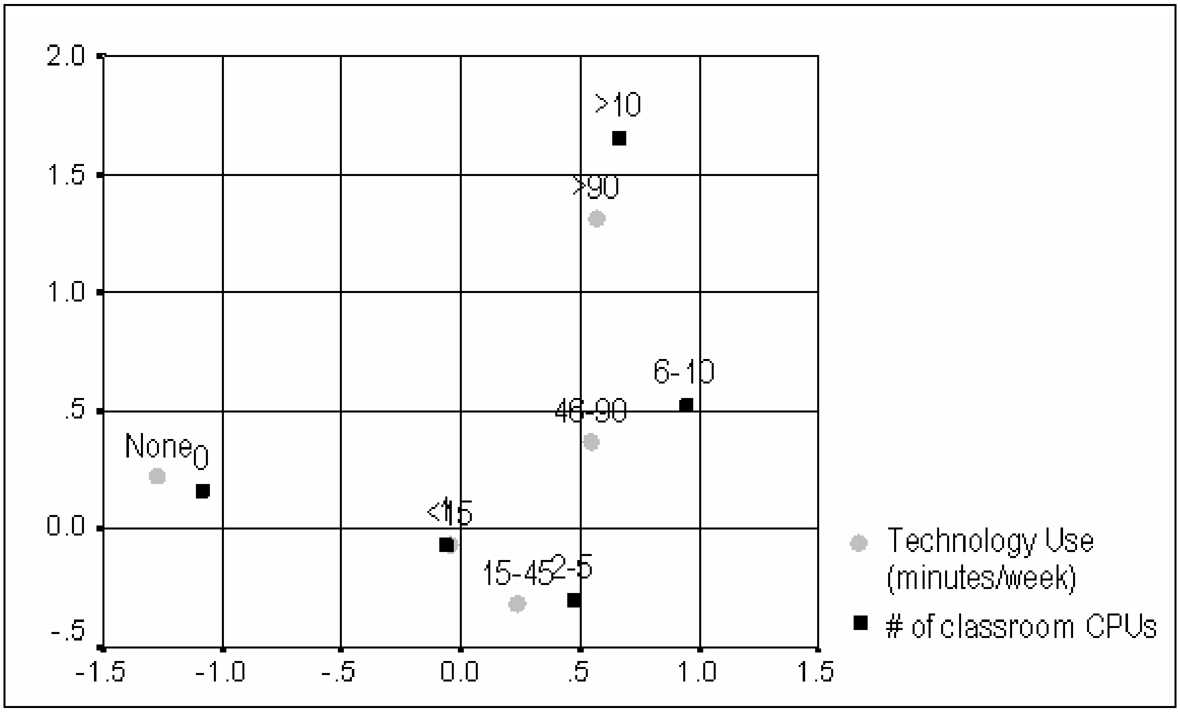

Figure 3. Correspondence Map of Technology Use and Number of Classroom Computers

The correspondence map between technology use and the number of classroom computers is shown in Figure 3. The visual clearly shows a distinct and unambiguous relationship between the number of classroom computers and various levels of instructional technology use. Indeed, two of the points (1 classroom computer and <15 minutes/week of use) are so closely positioned as to literally occlude one another. The correspondence map strongly suggests that more-than-sporadic technology use seems to require the availability of at least 6 computers per classroom.

The correspondence map between technology use and lab access (Figure 4) suggests a somewhat different relationship. Sporadic or minimal lab access is seen to have no positive impact on technology use. There is some indication, however, that regular and frequent lab access may be related to increased technology use. Specifically, there is at least a preliminary visual indication that lab access must be at least regular and predictable, 2 or more times/week, before it has a measurable effect on curricular integration of technology.

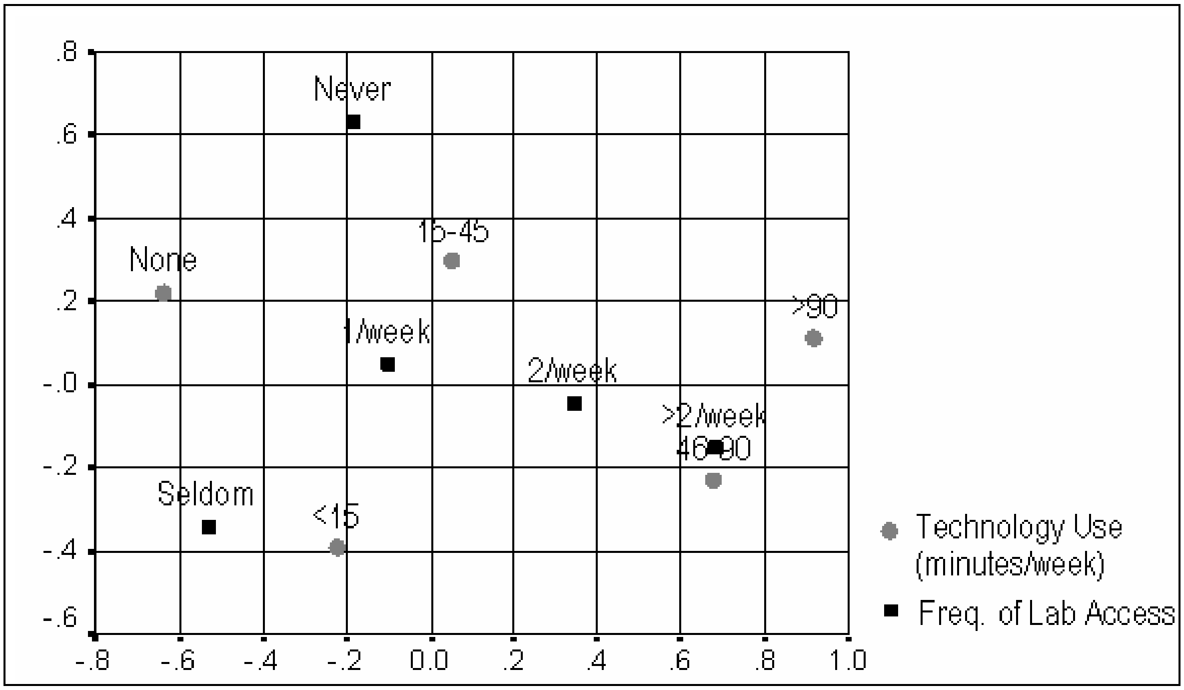

Figure 4. Correspondence Map of Technology Use and Frequency of Computer Lab Access

The correspondence map between Internet use and the number of classroom computers is shown in Figure 5. There is at least a visual suggestion that the relationship between classroom computer availability and instructional use of Internet technologies may be inherently complex and multidimensional. Specifically, there is an obvious, almost unidimensional relationship between limited availability of classroom computers and limited Internet use. However, the point corresponding to more than 90 minutes per week of Internet use is not only separated from the next closest level of use (46-90 minutes), but also separated from the point corresponding to more than 10 classroom computers. There is at least a preliminary suggestion in these results that extensive use of the Internet in particular (as opposed to a more general curricular use of technology), while strongly associated with technology access, may also be influenced by additional factors. Further research is necessary to determine what (if any) additional factors influence extensive use of Internet technologies.

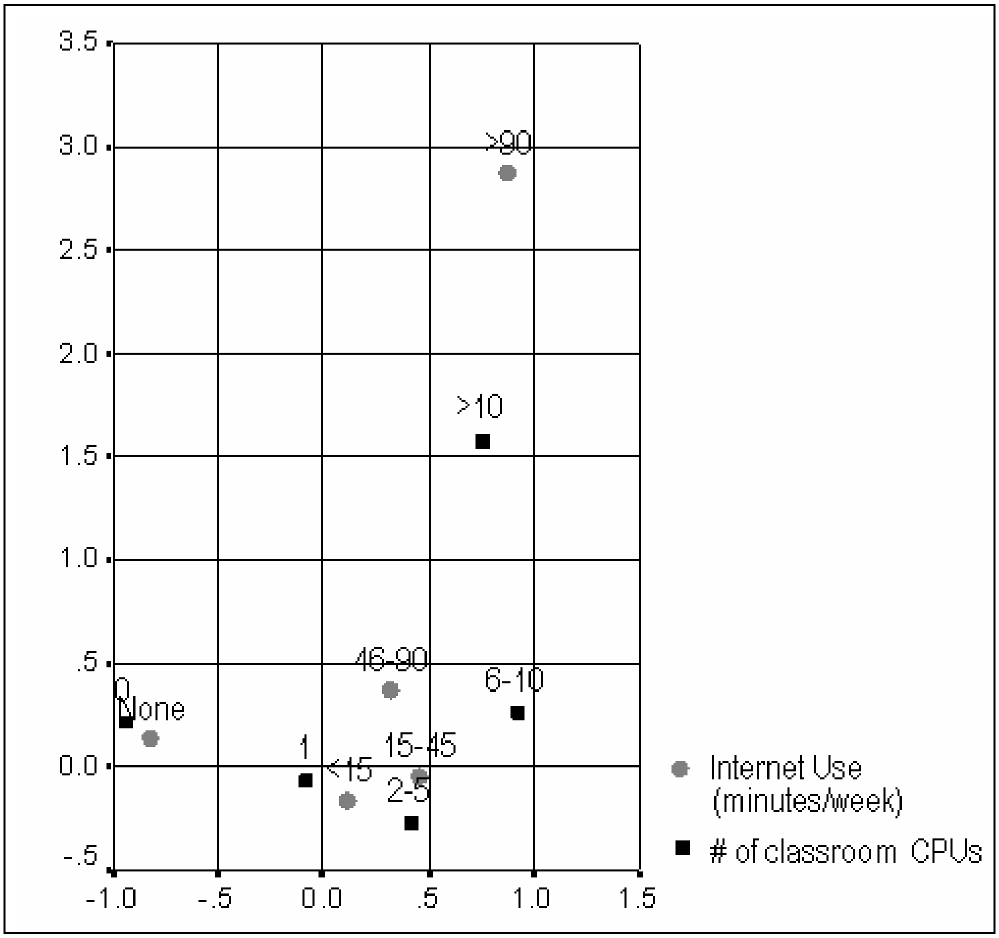

Figure 5. Correspondence Map of Internet Use and Number of Classroom Computers

4. Concluding Remarks

Taken as a whole, these results refute the conventional wisdom that adoption and integration of technology into K-12 classrooms are somehow based upon (or even related to) individual educator attitudes. Rather, *these results indicate that teachers' use of technology for curricular purposes is almost exclusively a function of their access to that technology*. The magnitude of the relationship between technology access and technology use is so strong as to support meaningful prediction of teachers' technology use based on particular patterns of technology access both in individual classrooms and in shared computer labs.

Technology naysayers then, may be right, but for the wrong reasons. It's true that classroom technology has not had a positive impact on teaching and learning, but it's equally true that that lack of impact is overshadowed by a widespread lack of technology access. If students don't have access to classroom computers, then classroom computers can't possibly have a measurable impact on students' learning!

Frankly, the findings reported here are common knowledge to classroom teachers. Our contribution is simply in asking them for their input and organizing its presentation. We sincerely hope that the findings reported here will help the educational community to reassess and realign their expectations about technology, and to encourage educators to better understand how technology has had an impact in other areas of human endeavor with an eye to bringing those benefits back to K-12.

References

Becker, H. (2000) *Who's Wired and Who's Not*, http://www.gse.uci.edu/doehome/DeptInfo/Faculty/Becker/packard/saveall.html#top

Berry, W. (1984). *Nonrecursive Causal Models*, Sage Publications, Thousand Oaks, CA

Cattagni, A., Farris, E., Westat, (2001) *Internet Access in U.S. Public Schools and Classrooms, 1994-2000*, National Center for Educational Statistics, Office of Educational Research and Improvement, U.S. Department of Education, http://nces.ed.gov/pubs2001/internetaccess/3.asp

Clausen, S.E. (1998). *Applied Correspondence Analysis*, Sage Publications, Thousand Oaks, CA

Corporation for Public Broadcasting (2003) Connected to the Future, http://www.cpb.org/ed/resources/connected/

Cordes, C., Miller, E. (1999) *Fool's Gold: A Critical Look at Computers in Childhood*, Alliance For Childhood, http://www.allianceforchildhood.net/

Cuban, L. (2001) *Oversold and Underused: Computers in the Classroom*, Harvard University Press, Cambridge, MA.

Healy, J. (1998) *Failure to Connect: How Computers Affect Our Children's Minds and What We Do About It*, Simon and Schuster, NY

Honey, M. (2001) Testimony Before The Labor, HHS, and Education Appropriations Subcommittee, United States Senate, July 25, 2001

Norris, C., Smolka, J., Soloway, E. (2000) Extracting Value from Research: A Guide for the Perplexed, *Technology & Learning*, June, Vol. 20, No. 11, pages 45-48

Oppenheimer, T. (1997) *The Computer Dilusion*, Atlantic Monthly Online, http://www.theatlantic.com/issues/97jul/computer.htm

Stoll, C. (1995) *Silicon Snake Oil: Second Thoughts on the Information Highway*, Doubleday, NY

U.S. Department of Commerce (2000). Statistical abstract of the United States. [Available online: http://www.census.gov/prod/www/statistical-abstract-us.htm l]

Volz, M. (2003) Mississippi's Cyber Milestone, The Associated Press, http://www.cbsnews.com/stories/2003/01/02/tech/main534968.shtml?cmp=EM8705