State Challenge Grants
TAGLIT Data Analysis

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Prepared for the Bill & Melinda Gates Foundation
November 2003

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Executive Summary

Introduction

The stated purpose of the Bill & Melinda Gates Foundation's state challenge grants for leadership development is to "provide opportunities for principals and superintendents across the nation with access to quality leadership development." The grants focus on whole systems change using technology to create and sustain a learning environment that helps all students achieve. This program is intended to provide professional development opportunities to approximately 67,000 principals and superintendents nationwide over three years.

The purpose of this report is to provide baseline data for comparison to data collected at subsequent stages of the state grants project through the use of the TAGLIT ("Taking A Good Look at Instructional Technology") online data collection system. In addition, the interpretations of the data are designed to yield an understanding of the current status (as of the time of data collection) of the TAGLIT respondents in schools and states. Although this is a comprehensive data analysis, it will not, by itself, constitute an overall evaluation of the entire national project.

This is the third annual review of state TAGLIT data. Beginning next year (2004), school based TAGLIT data will be compared to those data collected two years previously at the same schools.

Study Design and Limitations

Design

The strategy for the overall analysis was to pose several questions inherent to the TAGLIT instruments dealing with technology in teaching and learning. These questions were arranged so that they focused the primary inquiry around the most salient issue: the extent to which technology has had an impact on the classroom. The analysis begins by examining this question directly, comparing the responses of teachers and students. This comparison helps to reveal any disparities that might exist in the perceptions of each group about the effects of technology actually used in the classroom. Subsequent questions proceeded "outward" to encompass areas that are thought to have a bearing on whether or not technology is introduced to the classroom: the structural issues of individual skills, access to technology, and availability of support. The following questions were used as a way to answer the overall question of whether or not technology is impacting teaching and learning:

1. What is the impact of technology on the classroom?
2. How often is technology used in the classroom?
3. What are the technology skill levels of teachers and students?

4. What access to hardware and software do teachers have?
5. What is the availability of support personnel?
6. How much professional development takes place?

Limitations

The interpretations and conclusions from these analyses are limited to the teacher, student, and technology leader respondents to the TAGLIT instruments provided by SAS. Due to the nature of the data, the findings do not represent all schools in the national project or generalize to non-respondents of the TAGLIT instruments.

Data Description

The final database was generated by SAS July 1, 2003, as per prior arrangement for an identified cutoff point. This yielded the total study pool of 258,574 teachers, 443,614 students, and 10,307 technology leaders in 46 states.

Findings

The TAGLIT data from teachers, students, and technology leaders were examined on each of the six evaluation questions.

1. What is the Impact of Technology on the Classroom?

According to the respondents teachers were generally more positive about the effects of technology on teaching and learning than were students. In some cases, the gaps between student and teacher perceptions were large, although it is difficult to assess this discrepancy with precision due to the different items used on the instruments. In addition, many students may not have had an understanding of some TAGLIT items that would enable them to make an informed response. For example, students may have been unclear about what constitutes "cooperative learning" or what it means to "solve complex problems, analyze and evaluate information, and form opinions."

Taken together the student responses indicated a less than powerful impact of technology on the way the classroom works. They were more likely to agree with teachers that grading is impacted, and that getting extra help from teachers is occurring more often. However, they were not as likely as teachers to believe that the work is more complex or analytical, that they are learning through interacting with the outside world, that they take an active role in learning (where teachers are coaches, not leaders), or that there is greater interest in schoolwork. Thus, the ability of technology to leverage greater gains in the actual learning process may be more a teacher than a student perception with this group of respondents.

2. How Often is Technology Used in the Classroom?

A large proportion of the teachers (both Middle/HS and Elementary) do not use technology routinely in the classroom. Many are just "beginning to understand its relevance." Some are making efforts to integrate it into class lessons, but it is being used "in powerful ways" by only a small percentage of teachers. These findings are reflected in the responses of students who reported that in the classes that use technology the most, it was not used that often. Over half of the students reported that they use technology at most once a week.

3. What are the Technology Skill Levels of Teachers and Students?

The skill levels reported by the respondents generally correspond to the information in the previous section that discussed the integration of technology applications in teaching and learning. To be sure, the widespread lack of proficiency by students and teachers with applications like spreadsheets and presentation software may account for why these applications are not embedded in teaching and learning at this point. However, in at least one case, that of the use of email, teacher respondents indicate proficient skill, but do not use it widely in the classroom, as noted in the previous section.

4. What Access to Hardware and Software do Teachers Have?

Teachers indicated generally positive attitudes toward availability of technology resources (i.e., software, communication, and research and problem solving tools). The degree of real availability of technology as reported in this section may have a bearing on why students reported that they are not being asked to use certain technology as part of their classes, and why teachers reported that they are just beginning to understand some technology uses and integrate it into their classes.

5. What is the Availability of Support Personnel?

A majority of respondents (over 62% of both Middle/HS and Elementary teachers) indicated either not enough or barely enough time that support personnel are available. Not having enough support for set up, maintenance, and repair will affect how much technology is available to be used. Not having enough support to learn to use the technology may strongly affect how much it becomes integrated into the classroom.

6. How Much Professional Development Takes Place?

Over 74% of teacher respondents reported less than 15 hours per year of technology-related professional development activities. Given the skill levels reported earlier, and the student respondents' perceptions of the extent to which technology does not figure largely in their lessons, these levels of professional development may not be sufficient preparation for teachers. At the same time, however, over 64% of teacher respondents reported not enough or barely enough time available from technology support personnel to deliver professional development activities. It will be important to compare these benchmarks with later iterations of data collection to determine if the levels of activity increase on both support and participation.

Summary of Multilevel Findings

The analyses in this section included a multilevel approach to understanding TAGLIT data. An exploratory factor analysis of teacher responses yielded four technology factors that were used in the analyses: Technology Impact, Technology Skills, Technology Access, and Technology Support. Data examined in previous sections were combined to yield findings for all schools on the relevant questions of the research study, using a variety of statistical techniques. Some of the primary findings were:

1. There is no meaningful relationship between a school's metro status and the technology factors.

2. While expenditure ratios for student hardware, student software, teacher professional development and teacher technical support differ by metro status, the differences are not considered meaningful.

3. In the aggregate, neither ethnicity nor poverty is strongly related to the technology factors.

4. The most prominent intra-factor correlations (approximately the same for both Elementary and Middle/High teacher factors) suggest a strong relationship between teachers' perceptions of adequate access to technology resources and availability of support personnel. The relationships also suggest that technology skill might affect the impact of the technology on teaching and learning.

5. Multiple regression analyses reveal that the majority of the explanation for the technology impact factor is probably due to a single variable, the technology skills factor. Other predictor variables provide a very small contribution by comparison.

Conclusions

The research focus of this report is to examine the extent to which technology impacts teaching and learning. While it is difficult to provide a general conclusion to this question, it is fair to characterize the responding schools as reporting some positive outcomes of using technology.

Generally, teachers are more positive than students about the effects of technology on teaching and learning. Students are likely to admit that some aspects of teaching and learning (but certainly not all) are impacted by technology, but they report that teachers do not use technology in the classroom routinely. Consonant with this finding is the fact that a large proportion of the teacher respondents indicated they do not use technology routinely in teaching and learning. Some applications are used more often than others.

Using technology requires that the teacher have some skill with various applications, be supported by staffing, and have hardware and software appropriate to their curricular needs. The data indicate that the teachers have some proficiency with basic technology applications, but not with applications like spreadsheets and presentation software. It would appear that teachers indicate generally positive attitudes toward availability of technology resources. However, a majority of teacher respondents (over 62% of both Middle/HS and Elementary teachers) indicated either not enough or barely enough time support personnel are available.

A large majority of teacher respondents reported less than 15 hours per year of technology-related professional development activities, and that not enough or barely enough time was available from technology support personnel to deliver professional development activities. It will be important to compare this benchmark information with later iterations of data collection to determine if the levels of activity increase on both support and participation.

The overall conclusions appear to be similar when viewed from the school-level analyses. Multiple regression analyses revealed that the majority of the explanation for the technology impact factor is probably due to a single variable, the technology skills factor. Thus, whether or not technology is having an impact on the classroom depends on the teachers' skill levels. Additional insight into this process is provided by correlation analyses, which suggested that technology access is related to technology support and (a bit more weakly) to technology skill.

According to these analyses, school ethnicity and poverty levels do not directly affect the impact of technology on teaching and learning in the classroom. Further, differences among rural, urban, and suburban schools in terms of expenditures for student hardware, student software, professional development and technical support are not considered practically significant.

Further exploration from longitudinal data comparisons will be helpful in confirming these trends, and may point the way to identifying additional influences on the use of technology in teaching and learning. Additional multivariate analyses (in particular, structural equation modeling) may also help to clarify the direct and indirect influences of certain study variables on the outcome of using technology in the classroom.

With minor exceptions, the TAGLIT results from the schools in this set of states are quite similar to the results from the study schools reported over the last two years (2001 and 2002). In each case, the results will be compared to assessments from the same study schools in two-year increments (beginning 2004) in order to observe what changes may have occurred in TAGLIT responses.

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INTRODUCTION

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The purpose of this report is to provide baseline data for comparison to data collected at subsequent stages of the state grants project through the use of the TAGLIT ("Taking A Good Look at Instructional Technology") online data collection system. In addition, the interpretations of the data are designed to yield an understanding of the current status (as of the time of data collection) of the TAGLIT respondents in schools and states. Although this is a comprehensive data analysis, it will not, by itself, constitute an overall evaluation of the entire national project.

This is the third annual review of state TAGLIT data. Beginning next year (2004), school based TAGLIT data will be compared to those data collected two years previously at the same schools.

STUDY DESIGN AND LIMITATIONS

Design

Analyses were based on five separate data files: Elementary Students, Elementary Teachers, Middle/HS Students, Middle/HS Teachers, and School Technology Leaders. In addition, aggregated school-level data were used for key item comparisons through a variety of statistical procedures such as exploratory factor analysis, correlation, and multiple regression to establish baseline findings. The focus of the univariate analyses was on the patterns emerging from the percentage analyses, which often included an assimilation of findings from several different data sources (i.e., different TAGLIT respondent data files).

The strategy for the overall analysis was to pose several questions inherent to the TAGLIT instruments dealing with technology in teaching and learning. These questions were arranged so that they focused the primary inquiry around the most salient issue: the extent to which technology has had an impact on the classroom. The analysis began by examining this question directly, comparing the responses of teachers and students. This comparison helps to reveal any disparities that might exist in the perceptions of each group about the effects of technology actually used in the classroom. Subsequent questions proceed “outward” to encompass areas that are thought to have a bearing on whether or not technology is introduced to the classroom: the structural issues of individual skills, access to technology, and availability of support. The following questions were used as a way to answer the overall question of whether or not technology is impacting teaching and learning:

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6. How much professional development takes place?

Limitations

1. The analyses were conducted on data provided by SAS, the responsible agent for the accuracy and integrity of the data.
2. The findings of the study are not intended to generalize beyond the individual respondents of the TAGLIT instruments. Because individual respondents were not selected as a representative group, it cannot be assumed that non-respondents among teachers, students, and technology leaders share similar characteristics or opinions.

3. The reported school-level information is taken from technology leader responses to the TAGLIT (except for metropolitan status, ethnicity, and poverty).
4. This is a cross-sectional analysis designed to focus on a particular set of data at one point in time and does not constitute an overall evaluation of the project. Later iterations of data collection may reference the data used in this study for analysis of changes in TAGLIT data (regarding teaching and learning in the area of technology) during a targeted period of time.
5. A strict comparison of items on the TAGLIT instruments between teachers and students was not always possible since the wording of some of the items, or the response categories, were different.

DATA DESCRIPTION

Prior to presenting the individual level analyses of respondent groups, it is important to describe the overall study data. Table 1 lists descriptive information including the number of teacher, student, and technology leader respondents and the number of participating states. The final database consists of schools assessed between July 1, 2002 and June 30, 2003, and was generated by SAS July 1, 2003, as per prior arrangement for an identified cutoff point. This yielded the total study pool described in Table 2. Aggregated, school-level analyses are performed on leader and teacher data with the following restrictions: 10 or more students, 2 or more teachers, and a student-teacher ratio of at most 50:1.

Table 1. Project Description

	Total Project
Elementary Teachers	136,912
Middle/High School Teachers	121,662
Middle/High School Students	243,817
Elementary Students	199,797
Technology Leaders	10,307
States	46

Table 2. Number of Schools in National TAGLIT Analysis by State

STATE	NUMBER	STATE	NUMBER
AK	10	NB	24
AL	194	NC	237
AR	6	ND	149
AZ	165	NE	209
CO	10	NH	52
CT	104	NJ	333
FL	330	NM	126
GA	139	NY	228
HI	54	OH	417
IA	688	OK	165
ID	77	OR	141
IL	141	PA	729
KS	207	RI	85
KY	21	SC	127
LA	183	SD	46
MA	114	TN	229
MD	85	TX	924
ME	338	UT	142
MI	417	VA	379
MN	442	VT	43
MO	476	WI	395
MS	45	WV	10
MT	183	WY	22
TOTAL			10,307

Note: Table 2 does not include 666 schools that had no state designator.

FINDINGS

Individual Respondents

As noted in the Introduction, the findings are organized around six key questions suggested by the TAGLIT instruments. These begin with an examination of data surrounding the use of technology in the classroom from the point of view of both teachers and students. This is the most important aspect of the impact of technology on teaching and learning. Does it make a difference in the way the classroom operates and how it is experienced?

1. What is the Impact of Technology on the Classroom?

This section addresses the part of the TAGLIT that discusses the use of technology in the classroom. Respondents were asked to indicate how the use of technology in teaching and learning affected several aspects of the classroom. Since respondents were both teachers (Middle/High School) and students (Middle/High School), there was an opportunity to compare the perceptions of both groups on how technology has impacted the classroom.

> A strict comparison of teacher and student responses on the TAGLIT was not possible since, in many cases, the items are worded differently or the response categories are not the same. This is due to the fact that there were different forms of the instrument designed for different response groups. The interpretation of the resulting data was therefore done with caution, and focused on descriptive information for each group (student and teacher).

Eight items on the TAGLIT instruments address different aspects of how the use of technology in teaching and learning might have an impact. Student and teacher respondents agreed on the impact of some of those aspects but disagreed in four of the eight areas.

Items with Similar Patterns Between Student and Teachers

Of the eight items in this section, students and teachers exhibited similar response patterns to four:

1. Giving/Receiving Extra Help
2. Assessment of Student Work
3. Interdisciplinary Activities
4. Cooperative Learning

On these items, students and teachers indicated similar perspectives on whether technology in teaching and learning had an impact. The following table on the availability of extra help illustrates one of these cases. More than 58% of the teachers indicated (“quite a bit” or “very much”) that technology resulted in being more inclined to find time to work with students who need extra help. Student respondents indicated a similar pattern (approximately 50%) as illustrated in Table 3.

Table 3. Giving/Receiving Extra Help

M/H Students: “In your class where technology is used the most, do students get extra help from the teacher when they need it?”
Teachers: “As a result of your use of technology in teaching and learning, are you more inclined to find the time to work with students who need extra help?”

	Middle/HS Students	Middle/HS Teachers
No	12.4%	13.2%
Yes, Sometimes	37.2%	
Yes, Somewhat		28.3%
Yes, Most of the Time	29.0%	
Yes, Quite a Bit		31.2%
Yes, All the Time	21.5%	
Yes, Very Much		27.3%
Totals	243,777	121,662

This pattern of responses is similar to whether student and teacher respondents believe that the use of technology in the classroom results in students being assessed on their “products, progress, and effort.” Teacher and students also are in general agreement in two further areas: that technology in teaching and learning involves students in interdisciplinary subjects/activity; and the use of technology in teaching and learning results in the students being involved in cooperative, rather than competitive learning.

Two things are evident from the analyses of these four TAGLIT items. First, the teachers and students have about the same perception of the impact of technology on the availability of extra time, assessment of student work, interdisciplinary activity, and the extent of cooperative learning. Second, the overall responses of all groups do not indicate strong effects of technology in these areas. For example, more than half of the student group indicated that technology impacted the use of interdisciplinary activities only sometimes, or not at all.

Areas of Difference Between Students and Teachers.

On many of the items in this section, however, the Middle/HS students have quite different perceptions of the impact of technology than Middle/HS teachers:

- Higher Thinking Skills
- Nature of Schoolwork
- Interaction With the World Outside School

- Role of the Teacher

The area that shows perhaps the largest discrepancy between students and teachers was in the area of "higher thinking skills." The student responses indicated that the work in classes utilizing technology did not appear to have an impact on the "higher order" thinking involved. Over 64% of the Middle/HS students who responded indicated that these classes either did not call for complex and analytical thinking, or that it only occurred sometimes. This is quite at variance with the teachers' responses, which indicated much stronger effects of the use of technology on higher level thinking involvement. Table 4 compares the responses of each group to this TAGLIT item.

Table 4. Higher Thinking Skills

Students: "In your class where technology is used the most, do students solve complex problems, analyze and evaluate information, and form opinions?"
Teachers: "As a result of your use of technology in teaching and learning, are you more inclined to involve students in activities that require higher level thinking skills?"

	Middle/HS Students	Middle/HS Teachers
No	23.8%	7.1%
Yes, Sometimes	40.5%	
Yes, Somewhat		26.4%
Yes, Most of the Time	23.3%	
Yes, Quite a Bit		38.0%
Yes, All the Time	12.4%	
Yes, Very Much		28.5%
Totals	243,777	121,662

Another area where there were large differences between student and teacher respondent groups was in the area of whether or not technology results in students being involved in "engaging activities." Table 5 compares the responses to this aspect of the impact of technology on the classroom.

Table 5. Nature of Schoolwork

Students: "In your class where technology is used the most, do students show interest in schoolwork?"
Teachers: "As a result of your use of technology in teaching and learning, are you more inclined to involve students in activities that they find engaging?"

	Middle/HS Students	Middle/HS Teachers
No	20.9%	6.2%
Yes, Sometimes	40.0%	
Yes, Somewhat		26.8%
Yes, Most of the Time	26.1%	
Yes, Quite a Bit		40.3%
Yes, All the Time	13.0%	
Yes, Very Much		26.6%
Totals	243,777	121,662

Although the items on student and teacher questionnaires are worded a bit differently, both relate to how engaging the class work is as a result of technology. As noted in Table 5, students were much less likely than teachers to indicate that technology is connected to being engaged with schoolwork. Almost 61% of the students responded "no," or "yes, somewhat," to this question, which does not strongly endorse the view that students show interest in schoolwork in classes where technology is used the most. Teachers, on the other hand, were far more likely to indicate that the use of technology results in involving students in engaging activities.

Students were also less certain than teachers about other items in this section: the impact of technology in terms of whether they learn by interacting with the world outside of school; and the role of teachers (e.g., whether they are more like "coaches" than "lecturers").

Summary

Overall, the response patterns in this area of the TAGLIT indicated that teachers were generally more positive about the effects of technology on teaching and learning than were the students. In some cases, the gaps between student and teacher perceptions were large, although it is difficult to assess this discrepancy with precision due to the different items used on the instruments. In addition, many students may not have had an understanding of some TAGLIT items that would enable them to make an informed response. (For example, students may have been unclear about what constitutes "cooperative learning" or what it means to "solve complex problems, analyze and evaluate information, and form opinions.")

Taken together, however, the student responses indicated a less than powerful impact of technology on the way the classroom works. They were more likely to agree with teachers that grading is impacted and that getting extra help from teachers is occurring more often. However, they clearly were not as likely as teachers to believe that the work is more complex or analytical, that they are learning through interacting with the outside world, that they take an active role in learning (where teachers are coaches, not leaders), or that there is greater interest in schoolwork. Thus, the ability of technology to leverage greater gains in the actual learning process may be more a teacher than a student perception.

2. How Often is Technology Used in the Classroom?

If technology is to have an impact on teaching and learning, it must be utilized in the classroom. This section examines the extent to which it is used from the point of view of both students and teachers.

Tables 6 and 7 provide perspective on this question by comparing the responses of Middle/HS students, Middle/HS teachers, and Elementary teachers on a question about the overall use of technology in the classroom. Teachers and students were asked slightly different questions, but both items related to the extent to which technology is used.

Table 6. Overall Use of Technology in Teaching and Learning - Teachers

Teacher Question: "Overall, how far along are you in using technology to enhance teaching and learning?"

Teacher Responses	Middle/HS Teachers	Elementary Teachers
I do not use it in teaching and Learning.	9.8%	10.8%
I am beginning to understand its relevance in teaching and learning and to experiment using it with students.	34.7%	42.4%
I make a conscious effort to include it in teaching and learning and to integrate it effectively into my lessons.	40.9%	39.0%
I naturally include it in teaching and learning and use it in powerful ways.	14.6%	7.8%
Totals	121,666	136,908

Table 7. Overall Use of Technology in Teaching and Learning – M/H Students

Student Question: "In the class where you use technology the most, how often do you use it?"

Middle/HS Student Responses	
Almost Never	15.7%
About Once a Month	17.2%
About Once a Week	20.7%
More than Once a Week	46.5%
Total	243,778

A large proportion of the teachers (both Middle/HS and Elementary) do not use technology routinely in the classroom. Many are just "beginning to understand its relevance." Some are making efforts to integrate it into class lessons, but it is being used "in powerful ways" by only a small percentage of teachers. These findings are reflected in the responses of students who reported that in the classes that use technology the most, it was not used that often. Over half of the students reported that they use technology at most once a week. If this is true in an overall sense, then technology cannot have a dramatic effect on the nature of teaching and learning.

Middle/HS Teachers and Elementary Teachers

The previous section discussed the overall use of technology in teaching and learning. The analyses in this section examine the extent to which various technology applications are used in the classroom. Table 8 shows how teachers integrate technology.

Several observations can be made from the data in this table. First, Middle/HS teachers and Elementary teachers are generally comparable in terms of the extent to which they use technology in the classroom with these specific applications (although the M/H teachers in this study group used the technology applications more than the Elementary teachers). Second, in an overall sense, there is not widespread use of technology in the classroom across the board. This trend is present even with "basic technology" applications like word processing. Whereas teachers are more likely to use word processing and the WWW in their lessons than the other applications, there are still sizeable percentages of the respondents who do not use it routinely. Over 27% of the Middle/HS teachers and almost 40% of the Elementary teachers either do not use word processing, or are just beginning to understand it and experiment using it with students. Similarly, a majority of teachers (over 52% of Middle/HS teachers, and over 63% of Elementary teachers) do not use email in teaching and learning, or do so experimentally.

Table 8. Teachers' Use of Technology Applications in the Classroom

Teacher Question: "How far along are you in enhancing teaching and learning using . . ?"

	I do not use it in teaching and learning.	I am beginning to understand its relevance in teaching and learning and to experiment using it with students.	I make a conscious effort to include it in teaching and learning and to integrate it effectively into my lessons.	I naturally include it in teaching and learning and use it in powerful ways.	TOTALS
M/H Teachers					
Word Processing	9.3%	18.1%	36.5%	36.1%	109,703
Spreadsheet	44.0	27.2	18.5	10.3	109,702
Presentation Software	39.5	26.0	20.0	14.5	109,703
Email	31.5	20.7	22.9	24.8	109,703
WWW	8.2	19.7	35.3	36.8	109,703
Elem. Teachers					
Word Processing	12.9%	26.9%	37.3%	22.9%	122,097
Spreadsheet	59.6	24.6	11.7	4.0	122,097
Presentation Software	53.5	25.5	14.4	6.6	122,097
Email	39.4	23.7	19.3	17.6	122,097
WWW	13.8	28.7	33.7	23.9	122,097

The use of other technology applications in the classroom is even less frequent, some markedly less frequent. Up to 71% of Middle/HS teachers and 84% of Elementary teachers do not routinely integrate the use of spreadsheets in the classroom. This application may be less relevant to some Middle/HS and Elementary teachers' work, but the frequency of use appeared to be quite low. Surprisingly, about the same percentage of respondents (65.5% of Middle/HS teachers and 79% of Elementary teachers) reported either not using or experimentally using presentation software to enhance teaching and learning. This may partially be a function of accessibility to appropriate computer hardware, and the structural capability of classrooms, but it may also reflect the basic skill level of teachers with these kinds of applications.

There are some applications that teachers are integrating more fully to enhance teaching and learning. The table shows one of these – using the World Wide Web for research. In this case, about 72% of Middle/HS teachers, and almost 58% of Elementary teachers responded that they include it in lessons and/or use it in powerful ways.

Middle/HS Students

As noted in Table 7 about 53.5% of the students reported on the TAGLIT that technology use generally was "about once a week" or less. Table 9 reports the frequency and nature of technology applications that teachers expected of students.

Table 9. Students' Reported Technology Use in the Classroom

Question: "Considering all of your classes, how often do your teachers have you . . . ?"

Student Responses	Word Processing	Spreadsheets	Email	WWW	Presentation Software
Almost Never	15.6%	54.3%	64.5%	21.5%	50.8%
About Once a Month	33.6%	23.5%	10.8%	31.4%	30.8%
About Once a Week	28.9%	13.7%	9.3%	25.7%	11.2%
More than Once a Week	21.9%	8.5%	15.4%	21.3%	7.1%
Totals	205,563	205,563	205,563	205,563	205,563

A comparison of the student responses above with those of the teachers (reported earlier) reveals general agreement about the extent to which some technology applications are used. Generally, students agreed with teachers regarding the frequency with which word processing, spreadsheets, and presentation software are used in classes. However student respondents were much more likely than teachers to point out that email and the WWW are not used in class. For example, 31.5% of Middle/High teachers and 39.4% of Elementary teachers reported that they do not use email in teaching in learning, whereas 64.5% of students reported that email is almost never used.

A second general observation, from the perspective of students, is that most all technology applications are rarely used routinely in class. Between 49.2% and 81.6% of the student respondents reported that all the technology applications cited above are used at best once per month. Teachers appear to rarely require the use of spreadsheets, email, or creating a presentation using presentation software. Word processing (to write reports and other documents) and the use of the World Wide Web are more prevalent, but nearly half of the students (49.2%) reported that they are asked to use word processing only about once per month or less, while 52.9% reported not being required to find information on the World Wide Web.

3. What are the Technology Skill Levels of Teachers and Students?

In order for technology to be introduced into lessons by teachers, and for students to be required to use them, both teachers and students need to have the skill to use the various applications. The next series of tables reports on the basic skills for each respondent group (Elementary students, Middle/HS students, Middle/HS teachers, and Elementary teachers). In each case, respondents were asked, "How far along are you in learning to . . . " In some cases, the groups are generally equivalent, as shown in Table 10 that addresses the use of a word processor.

Table 10. Technology Skills: Word Processing

	Elementary Students	Middle/High Students	Elementary Teachers	Middle/High Teachers
I don't know how to do this	15.6%	6.7%	4.3%	3.1%
I can do this but sometimes I need help	30.8%	14.7%	12.3%	9.1%
I can do this by myself	29.6%	32.6%	32.3%	28.5%
I can teach others how to do this	24.1%	46.0%	51.1%	59.4%
Totals	199,759	243,788	136,909	121,662

All groups are generally equivalent with the exception of the Elementary students. This could reflect a developmental stage in addition to other factors. Nevertheless, the majority of Elementary students reported that they have some proficiency with word processing. Clearly the other groups reported strong skills in this area.

In Table 11, addressing skill with presentation software, the groups are also somewhat equivalent (although M/H teachers and M/H students were more proficient than their Elementary counterparts). However, unlike the responses with word processing, the majority of all groups did not report strong skills in this area. Between 22.9% and 45.6% of the groups reported that they do not know how to use presentation software at all.

In Table 12, both Middle/HS students and teachers reported slightly greater skill levels than their Elementary counterparts with spreadsheet applications. This may be due to the nature of the Middle/HS curriculum, although according to the last section, it is apparently the case that spreadsheet applications are not included in class work extensively. The majority of all groups still reported either that they do not know how to use spreadsheets, or that they need help.

Table 11. Technology Skills: Presentation Software

	Elementary Students	Middle/High Students	Elementary Teachers	Middle/High Teachers
I don't know how to do this	45.6%	22.9%	41.3%	32.8%
I can do this but sometimes I need help	22.6%	21.4%	27.0%	24.4%
I can do this by myself	16.9%	25.5%	16.9%	20.4%
I can teach others how to do this	14.9%	30.3%	14.8%	22.4%
Totals	199,759	243,788	136,909	121,662

Table 12. Spreadsheet Skills

	Elementary Students	Middle/High Students	Elementary Teachers	Middle/High Teachers
I don't know how to do this	52.9%	19.8%	29.3%	19.8%
I can do this but sometimes I need help	23.0%	30.8%	37.7%	33.0%
I can do this by myself	16.7%	31.7%	21.2%	24.5%
I can teach others how to do this	7.4%	17.6%	11.9%	22.7%
Totals	199,759	243,788	136,909	121,662

Table 13, addressing Email skills, shows that with the exception of the Elementary students the other respondent groups indicated some proficiency. Between 85% and 94.3% of the Middle/HS teachers and students and the Elementary teachers reported that they could either independently use email to send and receive messages, or could teach others to do so.

Table 13. Technology Skills: Email

	Elementary Students	Middle/High Students	Elementary Teachers	Middle/High Teachers
I don't know how to do this	26.9%	7.7%	1.9%	1.3%
I can do this but sometimes I need help	20.6%	7.4%	6.3%	4.3%
I can do this by myself	21.6%	18.9%	30.3%	26.9%
I can teach others how to do this	30.9%	66.1%	61.4%	67.4%
Totals	199,759	243,788	136,909	121,662

The last table (Table 14) in this section shows the extent to which respondents could use the World Wide Web to gather information. Like Table 13 (reporting the use of email), the majority of both teacher groups and the Middle/HS students reported some proficiency in this area. Elementary student respondents did not indicate these same levels of skill, but nevertheless, a sizeable group (over 57%) reported that they could use the WWW independently or could teach others.

Table 14. Technology Skills: World Wide Web

	Elementary Students	Middle/High Students	Elementary Teachers	Middle/High Teachers
I don't know how to do this	19.7%	10.0%	5.8%	3.7%
I can do this but sometimes I need help	22.7%	12.3%	11.2%	8.1%
I can do this by myself	26.3%	26.6%	35.5%	34.3%
I can teach others how to do this	31.3%	51.1%	47.5%	53.9%
Totals	199,759	243,788	136,909	121,662

Summary

The skill levels reported by the respondents generally correspond to the information in the previous section that discussed the integration of technology applications in teaching and learning. To be sure, the widespread lack of proficiency by students and teachers with applications like spreadsheets and presentation software may account for why these applications are not embedded in teaching and learning at this point. However, in at least one case, that of the use of email, teacher respondents indicate proficient skill, but do not use it widely in the classroom, as noted in the previous section.

4. What Access to Hardware and Software do Teachers Have?

Differential skill levels of teachers may help to account for the way the classroom operates, but there are other possible factors as well. One important issue is the extent to which teachers and students have access to computer hardware and software so that these can be used to promote teaching and learning.

This section examines teacher respondents' perceptions of their access to technology resources, as well as information from technology leaders about what resources are available. (Data were taken from schools identified by Leaders as having more than 2 teachers, and 10 students responding on the TAGLIT.) Table 15 is a summary of how teachers responded to questions about the adequacy of their access to specific technology resources.

Table 15. Teacher Access to Technology Resources

	Inadequate	Somewhat Adequate	Adequate	Excellent	Totals
Basic Software Tools (e.g., word processing, database, and/or spreadsheet)					
Middle/HS Teachers	5.8%	20.0%	39.5%	34.7%	121,661
Elementary Teachers	6.3%	20.0%	40.8%	32.9%	136,905
Communication Tools (e.g., email, web page authoring, etc.)					
Middle/HS Teachers	11.0%	24.2%	39.3%	25.5%	121,661
Elementary Teachers	9.9%	22.3%	40.9%	26.8%	136,905
Research and Problem Solving Tools (e.g., WWW, CD-ROM, etc.)					
Middle/HS Teachers	9.8%	27.6%	40.8%	21.7%	121,661
Elementary Teachers	10.0%	27.1%	41.8%	21.1%	136,905

The data from this table show that over 73% of teachers (both groups) responded that they believed their access to basic software tools (word processing, database, and/or spreadsheet), was either "adequate" or "excellent." Teachers were similarly positive about their access to communication tools (e.g., email), and research and problem-solving tools (e.g., WWW, CD-ROM). Nevertheless, between 32% and 35% of the teachers indicated that access to these tools was either "inadequate" or only "somewhat adequate."

Table 16 provides information from the Technology Leaders who responded to the TAGLIT. The Leaders were asked about the technology equipment in their school that is used exclusively for instructional purposes. Based on this information, ratios were created for teachers and students in the Elementary and M/H teachers' schools.

Table 16. Instructional Technology Media at School - How many of each?

	# Per Student:	# Per Teacher	# Schools
	M/H Teachers' Schools		
Computers	.30	3.84	3,968
Computers with Internet Access	.28	3.58	3,968
	Elementary Teachers' Schools		
Computers	.24	3.23	6,140
Computers with Internet Access	.21	2.78	6,140

Table 16 shows that there are between .30 (M/H) and .24 (Elementary) computers per student in these schools. There are slightly fewer computers with internet access per student (.28 – M/H; and .21– Elementary) in the study schools. Thus, on average, from 3 to 5 students share a computer in the study schools. Based on the same data, teachers have access to between 2.78 and almost 4 computers for instruction.

Additional information regarding the question of accessibility to technology is an examination of how technology funds were expended at the schools. Table 17 shows the per student expenditure for hardware and software in the study schools. Overall, expenditures for both were a bit higher in the M/H Teachers' schools.

Table 17. Technology Expenditure by Student (Mean Dollars)

	Per Student:	SD	Leader N
	M/H Teachers' Schools		
Hardware	248.77	10087.60	3,965
Software	20.32	86.06	3,965
	Elementary Teachers' Schools		
Hardware	72.02	790.72	6,140
Software	19.42	254.93	6,140

Because expenditure figures are typically skewed, the information in Table 17 should be viewed with extreme caution. These results should serve as only broad characterizations of expenditure patterns in the study schools. Teachers seem to indicate generally positive attitudes toward availability of this technology.

The degree of real availability of technology as reported in this section may have a bearing on why students reported that they are not being asked to use certain technology as part of their classes, and why teachers reported that they are just beginning to understand some technology uses and integrate it into their classes. Other factors to consider are whether teaching staff are supported by technical and instructional staff, and receive professional development opportunities. Access to technology resources is a crucial element, but so is the structural capacity to ensure that teachers and others understand the technology resources that can be used in order to develop teaching and learning.

5. What is the Availability of Support Personnel?

Having the hardware and software available for use in teaching and learning is very important. However, it is equally important to be able to have assistance for teachers who need help to use it effectively, especially for those with less than adequate skills.

Tables 18 and 19 report how teachers responded to the questions of whether or not there was enough time spent by support personnel to set up, maintain, and repair hardware (Table 18), and to teach staff members how to use technology (Table 19).

Table 18. Availability of Technical Support

In light of your school's instructional goals, how would you characterize the amount of time that support personnel are available to set up, maintain and repair hardware?	Middle/HS Teachers	Elementary Teachers
Not Enough	26.8%	29.4%
Barely Enough	35.4%	35.0%
Enough	30.7%	29.2%
Plenty	7.1%	6.3%
Totals	121,660	136,903

Table 19. Availability of Instructional Support

In light of your school's instructional goals, how would you characterize the amount of time that support personnel are available to teach individual staff members how to use technology?	Middle/HS Teachers	Elementary Teachers
Not Enough	28.7%	31.1%
Barely Enough	34.8%	34.8%
Enough	29.0%	27.2%
Plenty	7.5%	6.9%
Totals	121,660	136,903

As noted in both cases, a majority of respondents (over 62% of both Middle/HS and Elementary teachers) indicated either not enough or barely enough time that support personnel are available for these activities. Not having enough support for set up, maintenance, and repair will affect how much technology is available to be used. Not having enough support to learn to use the technology may strongly affect how much it becomes integrated into the classroom.

According to the School Technology Leader respondents, the average expenditures for technical support per instructional staff were as follows:

$295.79 - M/H Teachers' Schools (N=3965)
$240.41 - Elementary Teachers' Schools (N=6140)

Average expenditures per instructional staff were a bit higher in M/H schools, but roughly equivalent at both types of schools.

6. How Much Professional Development Takes Place?

Another factor that may affect the use of technology in teaching and learning is the extent to which teachers engage in technology-related professional development. Table 20 lists the responses of teachers regarding the number of hours of professional development in which they participated the last year.

Table 20. Amount of Teachers' Professional Development Activity

In the past school year (including a summer), in approximately how many hours of technology-related professional development did you participate? (Consider all types of staff development activities-workshops, courses, conferences, individualized instruction from technology specialist, study teams, mentoring, etc.)	Middle/HS Teachers	Elementary Teachers
4 hours or less	41.1%	46.1%
5-14 hours	33.8%	33.1%
15-24 hours	11.9%	10.3%
25 hours or more	13.2%	10.5%
Totals	121,658	136,895

As noted, over 74% of teacher respondents reported less than 15 hours per year of professional development activities. Given the skill levels reported earlier, and the student respondents' perceptions of the extent to which technology does not figure largely in their lessons, these levels of professional development appear to be insufficient preparation for teachers.

Part of this issue is how much support staff time is available to deliver professional development activities. Table 21 presents the teachers' responses to the question of availability of professional development support personnel.

Table 21. Availability of Support Personnel for Teachers' Professional Development

In light of your school's instructional goals, how would you characterize the amount of time that support personnel are available to design and deliver technology-related professional development activities?	Middle/HS Teachers	Elementary Teachers
Not Enough	30.1%	32.3%
Barely Enough	34.3%	34.0%
Enough	28.8%	27.3%
Plenty	6.8%	6.3%
Totals	121,660	136,903

As noted, over 64% of teacher respondents reported not enough or barely enough time available from technology support personnel to deliver professional development activities. Coupled with this information is the following from School Technology Leader respondents:

1. Average hours per week spent designing and delivering technology-related professional development activities:
   1.74 – M/H Teachers' Schools (N=3968)
   2.73 – Elementary Teachers' Schools (N=6141)

2. Average expenditure by schools on professional development per instructional staff member, at the time of the survey:
   $118.46 – M/H Teachers' Schools (N=3965)
   $92.13 – Elementary Teachers' Schools (N=6140)

These are important benchmark data for comparison with later iterations of data collection to determine if the levels of activity increase on both support and participation.

Teacher Responses

In order to get a clearer picture of the overall questions presented in this study, we factor analyzed items on the teachers' TAGLIT questionnaires. Factor analysis procedures help to create composite variables (or factors) that are made up of questionnaire items that correlate highly with one another. Because these factors identify common items, they can be used to represent those items in subsequent data analyses procedures.

An exploratory factor analysis on the Elementary and Middle/High School teachers' files yielded four factors (the same for both data files): Technology Impact, Technology Skills, Technology Access, and Technology Support. Tables 22 and 23 summarize the items comprising each factor. These will be referenced in later sections of the report.

Table 22. Summary of TAGLIT Items for Varimax Orthogonal Four-Factor Solution – Middle/High Teachers

	Factor Coefficients			
Item	1	2	3	4
Factor 1: Impact of Technology on the Classroom (α =.92)				
"As a result of your use of technology in teaching and learning, are you more inclined to:"				
involve students in cooperative, not competitive, learning?	0.79			
involve students in activities that require higher level thinking skills?	0.82			
involve students in interactions with the world outside of school?	0.76			
involve students in interdisciplinary activities?	0.79			
involve students in activities that they find engaging?	0.84			
find the time to work with students who need extra help?	0.75			
serve as coach, not lecturer or whole-group discussion leader?	0.78			
assess student achievement based on products, progress, and effort?	0.80			
Factor 2: Technology Skills (α =.81)				
"How far along are you in learning to:				
use a word processor to create documents?		0.82		
use a spreadsheet to enter and calculate numbers?		0.71		
use presentation software to create a presentation?		0.70		
use email to send and receive messages?		0.75		
use a search engine to find information on the www?		0.77		
Factor 3: Access to Technology ($\alpha = .85$)				
"In light of your school's instructional technology goals, how would you characterize access to:"				
basic tools (e.g., word processing, database and/or spreadsheet)?			0.83	
communication tools (e.g., email, web page authoring, etc.)?			0.87	
research and problem-solving tools (e.g., CD-ROM, www . .,etc.)?			0.85	
Factor 4: Technology Support ($\alpha = .80$)				
"In light of your school's instructional technology goals, how would you characterize the amount of time that support personnel are available to . . ."				
set up, maintain and repair hardware?				0.87
teach individual staff members how to use technology?				0.88

Eigenvalues= 6.312, 2.67, 2.242, 1.030   N = 121,662

Table 23. Summary of TAGLIT Items for Varimax Orthogonal Four-Factor Solution – Elementary Teachers

	Factor Coefficients			
Item	1	2	3	4
Factor 1: Impact of Technology on the Classroom (α =.93)				
"As a result of your use of technology in teaching and learning, are you more inclined to:"				
involve students in cooperative, not competitive, learning?	0.81			
involve students in activities that require higher level thinking skills?	0.85			
involve students in interactions with the world outside of school?	0.76			
involve students in interdisciplinary activities?	0.82			
involve students in activities that they find engaging?	0.85			
find the time to work with students who need extra help?	0.79			
serve as coach, not lecturer or whole-group discussion leader?	0.80			
assess student achievement based on products, progress, and effort?	0.81			
Factor 2: Technology Skills (α =.82)				
"How far along are you in learning to:				
use a word processor to create documents?		0.80		
use a spreadsheet to enter and calculate numbers?		0.71		
use presentation software to create a presentation?		0.70		
use email to send and receive messages?		0.75		
use a search engine to find information on the www?		0.78		
Factor 3: Access to Technology ($\alpha = .85$)				
"In light of your school's instructional technology goals, how would you characterize access to:"				
basic tools (e.g., word processing, database and/or spreadsheet)?			0.81	
communication tools (e.g., email, web page authoring, etc.)?			0.88	
research and problem-solving tools (e.g., CD-ROM, www . .,etc.)?			0.85	
Factor 4: Technology Support ($\alpha = .81$)				
"In light of your school's instructional technology goals, how would you characterize the amount of time that support personnel are available to . . ."				
set up, maintain and repair hardware?				0.87
teach individual staff members how to use technology?				0.88

Eigenvalues=6.62, 2.64, 2.21, 1.05 N = 136,906

MULTILEVEL ANALYSES OF SCHOOL DATA

The analyses in this section include a multilevel approach to understanding the TAGLIT data. The data examined in previous sections are combined to yield findings for all schools on the relevant questions of the research study, using a variety of statistical techniques.

It should be noted that the interpretation of statistical findings are based on "practical significance" (utilizing effect sizes) rather than simply reporting "statistical significance." This is the accepted protocol with research studies of this nature, and is a more straightforward way of understanding the meaning of the findings. Thus, the <u>magnitude</u> of the findings is the focus rather than significance levels used primarily in inferential processes. This is especially important since sample sizes dramatically affect statistical processes, thereby resulting in findings that may be "significant" but not necessarily meaningful.

Table 24 lists the technology factors by level of teacher (Elementary and Middle/High) and metropolitan status of schools[1]. A visual inspection of the data suggests that the factor scores are not very different across metropolitan levels. MANOVA results show that there are statistically significant differences between the metro status conditions for each of the technology factors. However, the very small effect sizes (partial eta^2 values range from .003 to .015 for both teacher groups) indicate that the differences lack practical significance.

Table 24. Technology Factors (means) by Metropolitan Status of Schools

	Urban	Suburban	Rural	Unclassified	Total	N
M/H Teachers						
Technology Skills	3.08	3.08	3.10	3.18	3.09	2,601
Technology Impact	2.81	2.74	2.74	2.93	2.76	2,601
Technology Access	2.80	2.86	2.86	3.03	2.85	2,601
Technology Support	2.12	2.16	2.09	2.26	2.13	2,601
Elementary Teachers						
Technology Skills	2.85	2.89	2.86	3.04	2.87	4,191
Technology Impact	2.70	2.65	2.61	2.68	2.65	4,191
Technology Access	2.80	2.86	2.81	2.99	2.83	4,191
Technology Support	2.07	2.09	1.99	2.27	2.06	4,191

Table 25 shows the technology access items (in dollar amounts) by the metropolitan status categories. There are statistically significant differences between the metro status conditions in two of the expenditure categories (Professional development

[1] "Metro Status-3 Level" QED data obtained by SAS.

expenditure per instructional staff member and technical support expenditure per instructional staff member). However, the effect sizes indicate that these differences are negligible. (In comparing the mean dollar amounts, it is also important to remember that average dollar values tend to be skewed and should be interpreted with caution, as noted earlier.)

Table 25. Technology Access Items by Metropolitan Status of Schools (Dollar Amounts)

	Technical Support Expenditure per Instructional Staff	Professional Development Expenditure per Instructional Staff	Hardware Expenditure per Student	Software Expenditure per Student	N
Urban	179.49	53.77	93.98	10.45	1,557
Suburban	210.84	95.43	262.86	19.22	3,180
Rural	332.74	125.88	87.16	22.41	1,743
Unclassified	168.23	69.97	57.48	14.99	134
Total	234.72	93.13	172.64	17.91	6,614

Correlation/Multiple Regression Findings

Another way of examining TAGLIT data is to look at correlation and Multiple Regression results. In Table 26, two school-level demographic variables (%CAUCASIAN, and CHAP1PCT)[2] were correlated with the technology factors that were described in an earlier section of the report. If the technology factors should be highly correlated with either or both of the demographic variables, it would be important to further explore these relationships.

Table 26. Ethnicity, Poverty, and Technology Factor Correlations

		1	2	3	4	5	6	7	8	9	10
1	CHAP1PCT	1.00									
2	% CAUCASIAN	-0.29	1.00								
3	ELEM. TECH. SKILLS	-0.13	0.11	1.00							
4	ELEM. TECH. IMPACT	0.09	-0.09	0.49	1.00						
5	ELEM. TECH. ACCESS	-0.12	0.14	0.40	0.35	1.00					
6	ELEM. TECH. SUPP	-0.06	-0.04	0.26	0.30	0.64	1.00				
7	M/H TECH. SKILLS	-0.09	0.09	0.24	0.12	0.18	0.12	1.00			
8	M/H TECH. IMPACT	0.10	-0.10	0.10	0.16	0.12	0.11	0.49	1.00		
9	M/H TECH. ACCESS	-0.10	0.13	0.23	0.14	0.52	0.41	0.36	0.32	1.00	
10	M/H TECH. SUPP	-0.06	-0.01	0.16	0.12	0.40	0.58	0.19	0.24	0.63	1.00

Note: N sizes range from 2,601 to 4,191 for ethnic and poverty variables with teacher factors; N=6,142 for elementary teacher intrafactors; N=3,968 for m/h teacher intrafactors; and N=976 for elementary to m/h teacher interfactors

[2] These two demographic variables were obtained by SAS from the QED national database. Percent Caucasian is used as a broad indicator of ethnicity, a common practice with reports of this nature. CHAP1PCT refers to Percent Free Lunch, a commonly used indicator of low income or poverty, since the variable is based on the percent of students by school qualified to receive compensatory education funding.

The top shaded cell of Table 26 indicates an inverse relationship between ethnicity and poverty, a finding repeatedly observed in the research literature. What is important to note, however, is that neither of these variables was strongly related to the technology factors.[3]

On the other hand, there are several intra-factor correlations that do indicate moderately strong relationships.[4] The most prominent are the following (approximately the same for both Elementary and Middle/High teacher factors) and are highlighted in Table 26:

Technology Support – Technology Access (r^2 of 40 - 41%)
Technology Skill – Technology Impact (r^2 of 24%)

Examining the correlations in this fashion cannot establish causal direction. However, at least in the second case, these relationships suggest that technology skill might affect the impact of the technology on teaching and learning. The first finding indicates a strong relationship between teachers' perceptions of adequate access to technology resources and availability of support personnel. Although weaker (r^2 values of 13% - 16%), there is also a relationship between technology access and technology skill. Further analysis (e.g., using structural equation modeling) is needed to examine the specific nature of the relationships among all of the technology factors.

The inter-factor correlations are interesting, but not a major focus for this report. With the possible exception of the access and support factors (Elementary – Middle/High), the other inter-factor correlations are not as high as might be expected if both teacher groups expressed equivalent views. These results show that the teacher groups do indeed have somewhat different views of the items comprising the technology factors.

When these correlations are considered along with other important variables in a multiple regression procedure, it is possible to gain additional information about the central research question of this report: whether or not the use of technology impacts teaching and learning. One value of using multiple regression is that it enables the researcher to understand the total explanation of a set of variables upon one target (or predicted) variable. In addition, it accounts for the inter-correlations of the separate predictor variables, thereby providing a view of the unique effects of each on the predicted variable.

Table 27 provides the multiple regression results for both Elementary and Middle/High teachers where the target variable (or the variable that is being predicted) is

[3] One way of making this kind of decision is to square the correlation figure under consideration. This provides the amount of variance in one variable explained by the other. Thus, by this measure, there is at most only about 2.0% of the variance in any factor explained by % Caucasian, and at most about 1.7% of any factor explained by the % Poverty variable.
[4] While there are no absolute r^2 figures that indicate the meaningfulness of a relationship between two variables, 20% is used here as an approximate guide.

the technology impact factor. As described earlier, this factor summarizes the TAGLIT items that address various aspects of the effects of using technology in teaching and learning, and addresses the central research question of this study. The results below provide some understanding of what the major influences are on this technology factor.

The overall analyses for both teacher groups are statistically significant (see results under "Total Model"). With multiple regression, "R-Square" indicates the proportion of variance in the dependent variable predicted by the total set of independent variables. These figures are 30% (M/H teachers) and 31% (Elementary teachers), which are both moderately strong.

Closer inspection of the results in table 27 reveals that the majority of the variance in technology impact is probably due to a single variable, the technology skills factor. This conclusion is based on the "part correlation," which, when squared provides the amount of the change in the total R-Square as a result of adding this variable to the analysis. As the table shows under "Unique Contribution," Technology skills accounts for approximately 15% - 17% of the variance in technology impact when the other variables are held constant. The remaining variables provide very small contributions by comparison.

Table 27. Multiple Regression Analysis Summaries for Study Variables Predicting Elementary and MH Teachers' Technology Impact Factor

UNIQUE CONTRIBUTION	Elementary	M/H
Technology Skills	15.37%	17.31%
Technology Access	1.02%	0.79%
Technology Support	0.50%	0.37%
Free/Reduced Lunch	1.66%	1.64%
% Caucasian	1.28%	1.66%

TOTAL MODEL	Elementary	M/H
R Square	0.31	0.30
F	367.98	219.67
Sig.	0.001	0.001
N	4191	2601

Summary of Multilevel Findings

The analyses in this section included a multilevel approach to understanding TAGLIT data. An exploratory factor analysis of teacher responses yielded four technology factors that were used in the analyses: Technology Impact, Technology Skills, Technology Access, and Technology Support. Data examined in previous sections were combined to yield findings for all schools on the relevant questions of the research study, using a variety of statistical techniques. Some of the primary findings were:

1. There is no meaningful relationship between a school's metro status and the technology factors.

2. While expenditure ratios for student hardware, student software, teacher professional development and teacher technical support differ by metro status, the differences are not considered meaningful.

3. In the aggregate, neither ethnicity nor poverty is strongly related to the technology factors.

4. The most prominent intra-factor correlations (approximately the same for both Elementary and Middle/High teacher factors) suggest a strong relationship between teachers' perceptions of adequate access to technology resources and availability of support personnel. The relationships also suggest that technology skill might affect the impact of the technology on teaching and learning.

5. Multiple regression analyses reveal that the majority of the explanation for the technology impact factor is probably due to a single variable, the technology skills factor. Other predictor variables provide a very small contribution by comparison.

CONCLUSIONS

The research focus of this report is to examine the extent to which technology impacts teaching and learning. While it is difficult to provide a general conclusion to this question, it is fair to characterize the responding schools as reporting some positive outcomes of using technology.

Generally, teachers are more positive than students about the effects of technology on teaching and learning. Students are likely to admit that some aspects of teaching and learning (but certainly not all) are impacted by technology, but they report that teachers do not use technology in the classroom routinely. Consonant with this finding is the fact that a large proportion of the teacher respondents indicated they do not use technology routinely in teaching and learning. Some applications are used more often than others.

Using technology requires that the teacher have some skill with various applications, be supported by staffing, and have hardware and software appropriate to their curricular needs. The data indicate that the teachers have some proficiency with basic technology applications, but not with applications like spreadsheets and presentation software. It would appear that teachers indicate generally positive attitudes toward availability of technology resources. However, a majority of teacher respondents (over 62% of both Middle/HS and Elementary teachers) indicated either not enough or barely enough time support personnel are available.

A large majority of teacher respondents reported less than 15 hours per year of technology-related professional development activities, and that not enough or barely enough time was available from technology support personnel to deliver professional development activities. It will be important to compare this benchmark information with later iterations of data collection to determine if the levels of activity increase on both support and participation.

The overall conclusions appear to be similar when viewed from the school-level analyses. Multiple regression analyses revealed that the majority of the explanation for the technology impact factor is probably due to a single variable, the technology skills factor. Thus, whether or not technology is having an impact on the classroom depends on the teachers' skill levels. Additional insight into this process is provided by correlation analyses, which suggested that technology access is related to technology support and (a bit more weakly) to technology skill.

According to these analyses, school ethnicity and poverty levels do not directly affect the impact of technology on teaching and learning in the classroom. Further, differences among rural, urban, and suburban schools in terms of expenditures for student hardware, student software, professional development and technical support are not considered practically significant.

Further exploration from longitudinal data comparisons will be helpful in confirming these trends, and may point the way to identifying additional influences on the use of technology in teaching and learning. Additional multivariate analyses (in particular, structural equation modeling) may also help to clarify the direct and indirect influences of certain study variables on the outcome of using technology in the classroom.

With minor exceptions, the TAGLIT results from the schools in this set of states are quite similar to the results from the study schools reported over the last two years (2001 and 2002). In each case, the results will be compared to assessments from the same study schools in two-year increments (beginning 2004) in order to observe what changes may have occurred in TAGLIT responses.

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