

The Relationship Between Teachers' Beliefs and Perceptions
About Student Use of Computers and
How They Integrate Technology Into Curricular Instruction

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Keywords: Technology integration, teacher beliefs, professional development, teacher training

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Abstract

Although U.S. public schools now boast an average of one computer to every 3.8 students, the statistics show that many teachers are not taking advantage of this technology to maximize student learning. While schools continue to invest millions in new computer technology, national research reports recommend improved professional development for teachers on integrating computers into curriculum. The purpose of this study was to identify differences between teachers who frequently integrate computers into curricular instruction and teachers who do not, in terms of how teachers believe students can use computers, the value that they believe computers can add to student learning, and the barriers that they perceive prevent them from integrating technology. A mixed methods study involving 106 third, fourth, and fifth grade teachers from a diverse school district in Orange County was used to gather data about teachers' beliefs and perceptions regarding student use of computers. Findings indicate significant differences between teachers who frequently integrate computers and other teachers, particularly in the values that they attribute to student use of computers and how they manage the school day to incorporate time for computer activities. The findings also show that perceived barriers to computer integration are similar for teachers who frequently integrate computers and those who do not. Implications include redesigning teacher professional development in technology to help teachers develop a vision of how integrated technology can look in the classroom and how it can benefit student learning.

Although the national average has now reached 3.8 students per instructional computer, schools continue to spend an average of \$103 per pupil each year for educational technology – primarily to fund the costs of hardware (Education Week, 2005, p. 8; Fox, 2005, p. 40). Yet research has shown that providing access to technology is not enough to revolutionize teaching and learning. Change will not take place on a large scale until teachers make it happen in their own classrooms, rethinking their daily routines in order to integrate technology into curriculum. The purpose of this study was to determine how beliefs and perceptions about the use of educational technology differ between teachers who frequently integrate computer technology into instruction and teachers who do not. I investigated differences between teachers who have access to similar resources but who integrate technology into the curriculum at varying degrees, identifying how teachers believe students can learn with computers, what teachers value about student computer use, and what barriers teachers believe prevent them from integrating computers into instruction.

THEORETICAL FRAMEWORK

Although numerous research findings have established the enormous potential impact of technology on student learning, it is unlikely that such results will take place on a large scale unless teachers know how to utilize the technology available to them. Rather than using technology to cultivate valuable higher-order thinking skills, the majority of computer-using teachers use them for routine drill-and-practice activities (Cuban, 2001; President's Committee of Advisors on Science and Technology, 1997; Sivin-Kachala & Bialo, 2000). The National Education Technology Plan calls for improved teacher training in the effective use of technology. Increased technology training results in teachers who use technology more

effectively, leading to greater student achievement (Ringstaff & Kelley, 2002; Sivin-Kachala & Bialo, 2000).

However, it cannot be assumed that just because technology training is offered, teachers will attend. The argument has been made that teachers who do not perceive technology as “useful” to their classrooms will not take advantage of opportunities to develop the skills they need (Mann, Shakeshaft, Becker, & Kottkamp, 1999; Zhao & Cziko, 2001). “Teachers must be convinced of its value in order to be willingly retrained, effectively use the technology, and integrate it into their curriculum” (Pachon, Macias, & Bagasao, 2000, p. 5).

The theoretical framework for this study is grounded primarily in Zhao and Cziko’s (2001) *Perceptual Control Theory*, which emphasizes teachers’ internal goals and how the use of technology can support or detract from those goals. A key factor in this model is that “perceived effectiveness” drives a teacher’s decisions – not necessarily the actual effectiveness. A person makes decisions based on what he believes will or will not be effective. If a teacher believes that the costs of using technology will outweigh the benefits, then he may decide against it. This model suggests that research should seek to understand teachers’ instructional goals and their perceptions of technology’s ability to help them reach those goals.

The theoretical framework was also informed by a study evaluating the effect of teacher motivation on the implementation of an educational innovation, conducted by Abrami, Poulsen, and Chambers (2004). The researchers identified the three motivational factors that were the most highly correlated with use of an innovation: perceived value of the innovation, expectancy of success, and perceived cost. Teachers need to believe that they have the ability and the context in which to successfully implement the innovation in order to take the initial risk of implementing and to maintain the innovation despite high costs (Abrami et al., 2004).

RESEARCH METHODS

The study was conducted in a Southern California school district that has 11 elementary schools, serving a diverse population of students. To maximize the impact of technology on student learning, the district has equipped every upper-elementary classroom with a minimum of three to six computers and maintains a full-time technology support team of professional development teachers and information services staff.

Surveys were administered to the third, fourth, and fifth grade teachers at every school to gather information about how often their students use computers for various activities and preliminary data about the values and barriers they perceive related to student use of computers. After collecting survey responses from 106 teachers, I divided the sample of teachers into four groups based on two variables: (1) how frequently they assigned any work that required their students to use computers and (2) how frequently they assigned higher-level activities involving computers. Higher-level activities were defined as those that generally engage higher-order thinking skills, identified from existing literature.

Table 1
Demographic Data of Four Groups

Group	No. of Teachers	Avg. Years of Teaching Experience	No. of Schools Represented	% of Group Teaching 3rd grade	% of Group Teaching 4th grade	% of Group Teaching 5th grade	% of Group Teaching a Combination Class
LFLL	39	11	11	59%	26%	10%	5%
LFHL	8	15	6	25%	50%	25%	0%
HFLL	18	12	10	39%	22%	28%	11%
HFHL	39	12	10	26%	28%	41%	5%

From the four groups, I selected a proportional sample of 22 teachers to interview. Interview questions focused on teachers' beliefs about how students can use computers, what they value about student use of computers, and what barriers they perceive that may prevent them from integrating technology into the curriculum. Both sets of data were analyzed for patterns that help identify the differences in beliefs among the four groups of teachers.

RESULTS

The findings show that particular characteristics are more common among particular groups of teachers, in terms of how they use computers for student activities, the values they perceive computers can add to instruction, and the barriers they perceive prevent them from integrating computers into instruction.

How Teachers Use Computers for Student Activities

The key differences among the groups of teachers were in the computer activities that they assign, the activities that they would assign if access to computers were not an obstacle, and the way they manage class time to accommodate computer activities.

Computer Activities That Teachers Assign

By definition, HF teachers assign at least one activity that requires students to use computers at least once a week, and HL teachers assign at least one higher-level activity at least once a month. Survey responses show that all teachers assign lower-level activities (keyboarding skills, word processing, and software for practicing basic skills) more often than higher-level activities (research using the Internet or CD-ROMs, sharing knowledge through PowerPoint presentations, and solving real-life problems or analyzing data). However, both interview and

survey data reflect that HF and HL teachers assign more types of computer activities than LF and LL teachers, respectively. Additionally, HFHL teachers report that they assign work that requires students to use the Internet far more frequently than the other groups: 49% assign this at least *1-4 days a week*, and 41% assign this *1-3 days a month*. Only half of the LFHL teachers assign these activities at least *1-3 days a month*. In addition, 47% of the LFLL teachers and 44% of the HFLL teachers say that the Internet is available, but they never use it.

Computer Activities that Teachers Would Like to Assign

During the interviews, teachers were asked to describe their ideal computer setup. Of the 22 teachers, 18 said they would want additional computers, although the four groups of teachers differed greatly on how they described using these computers. HL (8 of 10) and HF (9 of 12) teachers were far more likely than the LL (5 of 12) and LF (4 of 10) teachers, respectively, to describe different activities that were not able to do with the limited number of computers they currently had access to. Most (5 of 8) of the LFLL teachers described having their students do more of the same activities that they currently do. For example, the following LFLL teacher currently uses Type to Learn with her students, and when asked what she might do differently if each student had access to a computer, she envisioned having all of her students use Type to Learn at the same time:

They could all do it at the same time.... We have Type to Learn so they would all do that. I could just walk around and find out if they're positioning their hands ok all at once. It would be one activity that would be easier to monitor on the computer. (Toni, Bell Elementary, LFLL)

In contrast, the HFHL teachers had more ideas on new things they could do with additional computers, many involving application of skills that the students have learned, activities using

the Internet, and differentiation of instruction and enrichment for students. The following HFHL teacher enthusiastically described several things she would do if she had her ideal computer setup:

They would be able to do writing assignments, journal assignments, right there on their laptop. They could probably do PowerPoint slides too... if all the kids had access to the computers that would be something they could learn and incorporate into presentations in front of the classroom... And maybe even some kind of network where I could give them some kind of quickie quiz after a lesson to see if they learned it, and they could punch in their answers on the computer and I could see it at a main computer up in the front, to see if the majority of the class is getting it. (Katie, Jefferson Elementary, HFHL)

Overall, the HFHL teachers had more ideas about new activities they would do with their students if computer equipment was not a limiting factor.

Classroom Management

To look at what teachers are currently doing with the limited number of computers they have, one of the interview questions asked teachers to explain how they were able to give their students opportunities to access the computers. Teachers generally described the classroom management techniques that they used to allow students time on the computers available. The primary differences between how they manage computer time appeared to arise between the HF and the LF groups.

Of the two HF groups, 11 out of 12 teachers described using a rotation system to get the students to the computer. Only 1 HF teacher did not mention rotations – instead, she has a

mobile laptop cart to use with her students at certain times throughout the year, when all students can work on their own computers. More than half of the HF teachers talked about how they have students rotating on computers at many different times throughout the school day, in what could be described as a “whenever I can” mentality.

It’s just getting them on whenever you can – whenever you could think about it... you want to be able to get them on, just get them exposed to it. Because it’s so important now, in modern day, they need those skills for next year and the year after. And, especially when it’s just replacing basic, like routine things that we do everyday. I’d rather them get the chance to be on it. (Margaret, Jefferson Elementary, HFHL)

Several of the teachers described students taking turns on the computers throughout most of the day, during daily morning activity time, silent reading time, independent work time, and through math or reading centers. The sole HF teacher who did not use rotations found other innovative ways to get all of her students computer time when the mobile laptop cart was not available – when she assigned an activity that required the whole class to use computers, she divided her class into three groups and sent two of the groups into neighboring classrooms to borrow their computers.

In contrast to the HF groups, only 5 of the 10 LF teachers mentioned *rotations* when asked how they were able to allow their students to access the computers. Of these five teachers, none described having rotations take place on a regular basis.

It’s really hard for me to say even though it’s your computer rotation time that you need to be on there, but you’ve got three assignments that still are not completed for me. I am

not letting them go to the computer until we at least get those things done. So the computer loses out if they're working slowly. (Sarah, Franklin Elementary, LFLL)

One of the LFHL teachers said that she rotates her students, and then explained that this means she keeps a checklist of who has been on the computer and “I just put them on as needed...some kids go more often than others,” and that if they are not getting their work done, no one is allowed on the computers. These sentiments point to the finding that LF teachers generally see computer activities as an addition to the curriculum, rather than as a tool for accomplishing necessary learning.

Perceived Value

Sixty-four percent of the teachers surveyed agreed that technology enabled them to meet a learning need they could not otherwise meet. Figure 1 breaks down teachers' responses to this question into the four groups. A much larger percentage of HFHL teachers (80%) responded *yes* to this question than in the other three groups.

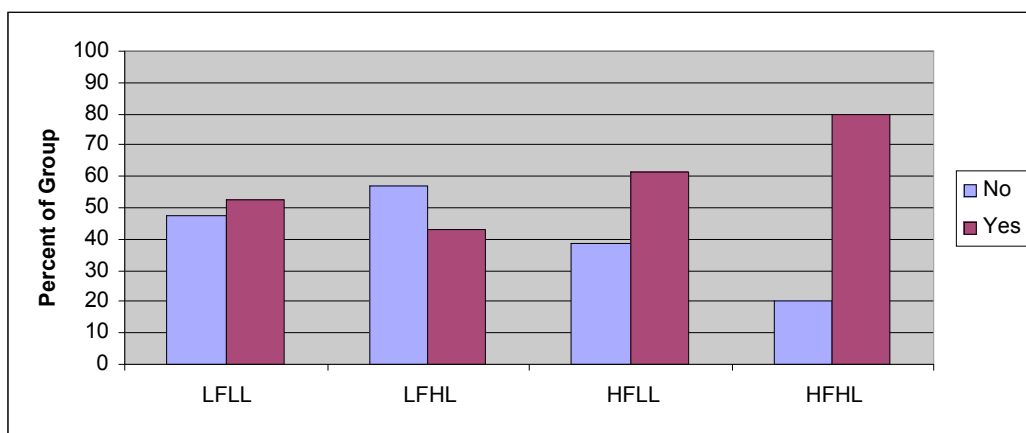


Figure 1. Teachers' survey responses indicating whether allowing their students to use technology meets a learning need that they could not otherwise meet.

Another survey item asked teachers to indicate any of the following areas where they have seen technology enhance student performance: attendance, discipline, engagement in school, collaboration/teamwork, academic achievement, and quality of student work. Figure 2 shows that in almost every one of these areas, a greater percentage of HFHL teachers indicated that they have seen improvement than in the other three groups of teachers.

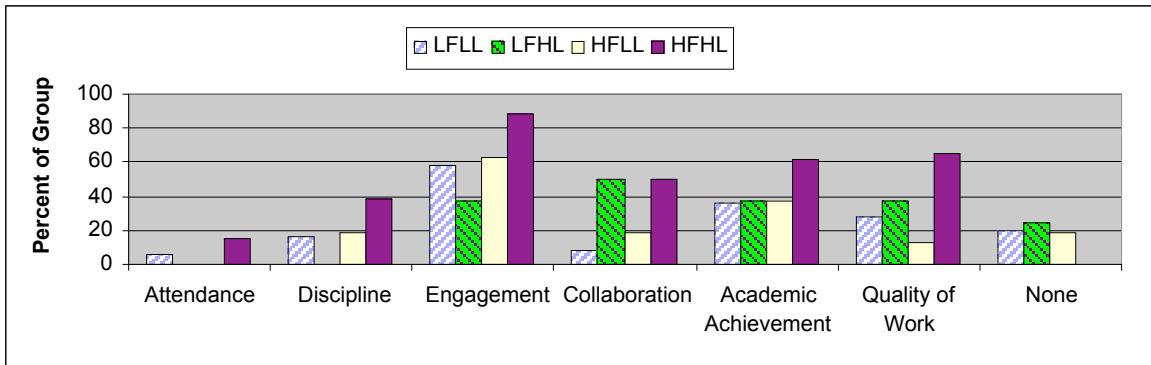


Figure 2. Areas where teachers have seen technology enhance student performance.

To see whether there were any patterns in the number of areas teachers indicated, I totaled the number of areas that each teacher indicated and looked at the frequency of responses across the four groups. Figure 3 shows that the majority of HFHL teachers indicated 3, 4, or 5 areas where they have seen technology enhance student performance, whereas the majority of LFLL teachers indicated none, 1 or 2 areas.

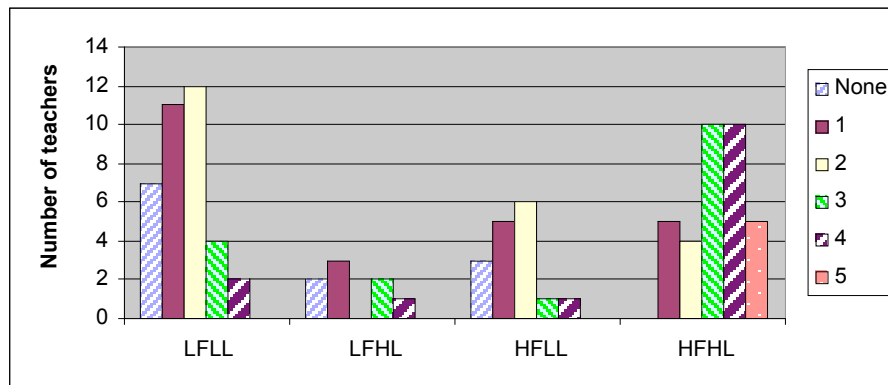


Figure 3. Number of areas where teachers indicated they have seen technology enhance student performance, out of a total of six areas.

For a closer analysis, I broke down the responses by LL and HL groups and by LF and HF groups. Both analyses showed statistically significant differences in the number of items the high and low groups responded to. The analysis by LL and HL groups showed a stronger statistical difference, $\chi^2(5) = 29.381, p < .001$, where the majority of HL teachers indicated three or more areas (67%), while the majority of LL teachers indicated two or fewer areas (85%). The difference between LF or HF groups and the number of areas they indicated was not quite as strong, although still significant, $\chi^2(5) = 13.36, p = .02$. A majority of HF teachers indicated three or more areas (54%), while the majority of LF teachers indicated two or fewer areas (78%). These findings demonstrate that HL and HF teachers have seen technology enhance student performance in more areas than LL and LF teachers, respectively, showing that they recognize greater value to computer use.

A separate survey item asked teachers how strongly they agree with three positive statements about learning as a result of using technology: 80% of teachers agree that as a result of using technology, students take a more active role in their learning; 79% of teachers agree that as a result of using technology, multimedia opportunities or information from the Internet have made learning experiences richer; 77% of teachers agree that as a result of using technology, they are better able to meet the varying needs of students. Statistically significant differences between the groups' responses appeared between the LL and HL groups and their responses about richer learning experiences $\chi^2(3) = 14.238, p = .003$. HL teachers were more likely to say they strongly agree with this statement (53%), whereas LL teachers were more likely to say they somewhat agree (62%). The other difference between groups appeared in their responses about meeting varying needs of students. There were statistically significant differences between the LF and HF groups $\chi^2(3) = 19.787, p < .001$ and between the LL and HL groups $\chi^2(3) = 13.577,$

$p = .004$. The majority of both the low and high groups somewhat agreed with this statement. However, the rest of the low group was more likely to disagree, while the rest of the high group was more likely to strongly agree.

The values that teachers spoke about during their interviews were generally reflective of the survey findings. Table 2 provides a summary of the values that were described by more than two teachers during the interviews. It is interesting that the HFHL group had the highest proportion of teachers who cited engagement and motivation in both the interviews and the surveys (77% vs. less than 56% in the other three groups). Overall, on average, HFHL teachers discussed more values to computer use than other teachers.

Table 2
Values Cited By Teachers During Interviews

Value	Number of Teachers				Total
	HFHL	LFLL	HFLL	LFHL	
Engagement and Motivation	8	5	1	2	16
Students' Future Success	6	3	3	0	12
Independent Learning	5	3	0	0	8
Differentiation of Learning	5	0	2	1	8
Quality of Student Work	4	1	0	1	6
Reinforcement or Remediation of Skills	2	0	2	1	5
Typing Skills	1	2	1	1	5
Total # Interviewed	8	8	4	2	22

Perceived Barriers

In the survey, teachers were asked to indicate the obstacles they face in using technology at school for instruction, from a list of 13 options. The options that were selected as obstacles by the most teachers were *lack of time in the school day* (86% of teachers), *computers don't work regularly* (79%), and *not enough computers* (72%). Figure 4 represents the number of teachers that indicated each obstacle.

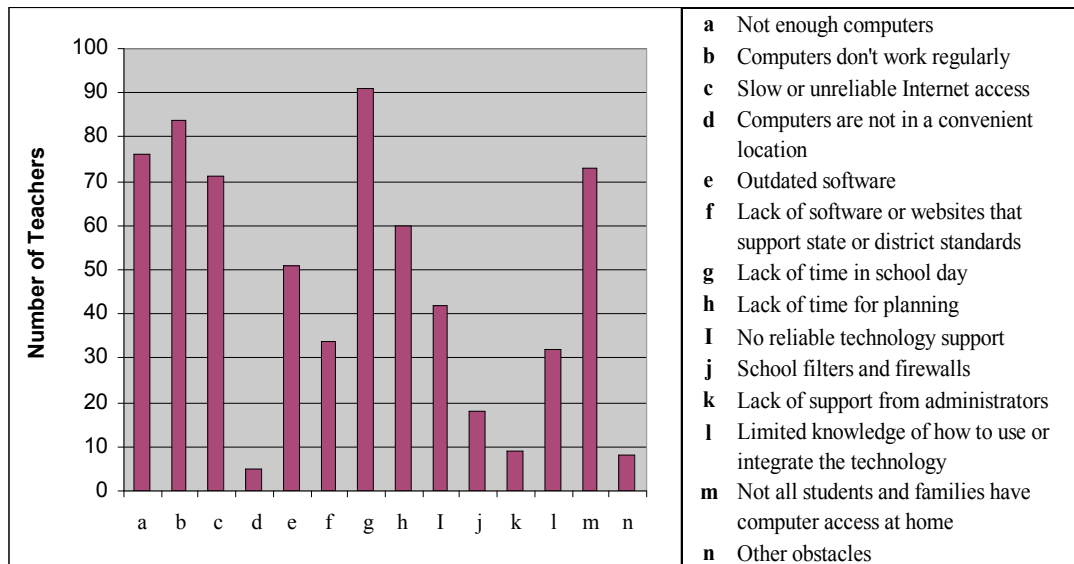


Figure 4. Number of teachers who indicated each option as an obstacle they face in using technology for instruction.

In the LFLL group, there are four obstacles that were indicated by over 70% of teachers, while in the HFHL group, there is only one. The LFHL and HFLL groups each had three obstacles that were indicated by over 70% of teachers. It would seem that the HFHL group cited less obstacles than the other three groups, however, the differences between the groups in terms of the number of obstacles each teacher cited are not statistically significant.

What is also interesting is that HFHL teachers were more likely to cite *lack of time in the school day* and *lack of time for planning* as obstacles than the other groups. They were less likely to cite *not enough computers*, *computers don't work regularly*, and *slow or unreliable*

Internet access as problems when compared to the other groups. In fact, there is a statistically significant difference between the groups in whether they cited *not enough computers* as an obstacle – 83% of LF teachers compared to 61% of HF teachers: $\chi^2(1) = 6.140, p = .013$, and 79% of LL teachers compared to 62% of HL teachers: $\chi^2(1) = 3.944, p = .047$. Although the survey data do not tell us whether the HFHL teachers have more reliable computer equipment, they do show that HFHL teachers find computer hardware slightly less of an obstacle than other groups and find lack of time more of an obstacle than other groups.

A separate survey item provided the same list of 13 options and asked teachers to indicate the single most important barrier, that if solved, would allow them to better integrate student use of computers into instruction. The single barrier cited the most frequently was *computers don't work regularly* (33%), followed by *not enough computers* (19%), and *lack of time in the school day* (18%). There did not appear to be any significant differences between the four groups' responses to this item.

Other Factors Affecting Teachers' Perceptions of Computer Use

Aside from perceived values and barriers, there were two other factors that differentiated between the groups of teachers: computer training and sharing ideas with other computer-using teachers.

During the interviews, 8 of the 10 HL teachers talked about things they had learned from attending trainings on using computers for teaching, compared to only 4 of the 12 LL teachers. In the survey, teachers were asked how many hours of formal professional development in the use of computers they have participated in during the last three years: 9% said they had none, 45% said they had 1-8 hours, 20% said they had 9-20 hours, 11% said they had 21-40 hours, and

15% said they had over 40 hours. There was a significant difference between teachers' responses in the LL versus HL groups $\chi^2(4) = 12.465, p = .014$. LL teachers were more likely to say they had 1-8 hours or less training (66%) whereas HL teachers were more likely to say they had 9-20 hours or more training (62%).

Another question asked: *In your opinion, how well prepared are you to use computers for classroom instruction?* 50% of teachers stated that they were *somewhat prepared* and 33% stated that they were *well prepared*. There was a statistically significant difference between responses to this item from HL versus LL teachers $\chi^2(3) = 15.053, p = .002$. Nineteen percent of the HL teachers reported being *very well prepared* whereas none of the LL teachers reported this. Twelve percent of the LL teachers reported being *not at all prepared* whereas only 2% of the HL teachers reported this.

During the interviews, 9 of the 12 HF teachers said that they have seen how other teachers use computer technology in their classrooms or they speak with other teachers to share ideas, compared to only 4 of the 10 LF teachers. Additionally, the survey asked teachers to indicate how often they ask another teacher for help when they have a question about how to integrate technology into their teaching: there is a significant difference between the LL and HL groups' responses to this question. The majority of LL teachers (76%) never or sometimes ask another teacher for help, while the majority of HL teachers (58%) frequently or always ask another teacher for help.

Table 3
How Often Teachers Ask Another Teacher For Help When They Have Questions on How to Integrate Technology Into Teaching

	LL	HL	Total
Never	10	2	12
	18.90%	4.40%	12.20%
Sometimes	30	17	47
	56.60%	37.80%	48.00%
Frequently	6	17	23
	11.30%	37.80%	23.50%
Always	7	9	16
	13.20%	20.00%	16.30%
Total	53	45	98

$$\chi^2 = 13.879 (3) p = .003$$

Interestingly, there is no significant difference between teachers' responses in the HF and LF groups. Teachers who use computers for higher-level activities ask other teachers for help more often, but teachers who use computers more frequently do not necessarily ask for help more than teachers who use them less frequently.

DISCUSSION

The following discussion presents a picture of three types of computer-using teachers based on the research findings: those who assign computer activities the most frequently, those who assign higher-level activities on computers, and those who are able to combine both high frequency and higher-level use. Identifying the characteristics that set these teachers apart is one

step toward improving professional development that encourages more teachers to integrate computers into instruction.

Teachers Who Assign Computer Activities Frequently

Teachers who assign computer activities the most frequently were those that had established classroom management routines for ensuring that students have time to access computers during the school day. They were more likely to cite certain benefits to having students use computers. Moreover, they seemed to take more initiative in learning about ways to incorporate computers.

Teachers in the high frequency (HF) groups described a routine rotation system that they used to allow their students to access the limited number of computers available. Most of these teachers also displayed a “whenever I can” mentality, talking about how they look for many times throughout the school day when they can have computer rotations taking place, with the goal of allowing more students to spend time on the computer. These teachers made it a point to incorporate computer time into the routines of the school day: they often had computer rotations taking place during daily morning activity time, silent reading time, independent work time, and through math or reading centers. This was in contrast to the LF teachers, who generally did not describe any regular routines that they use to schedule computer time. They were more likely to say that other class work took priority over computer activities, thus students who were not finished with their assignments might not be allowed time on the computer.

The findings suggest that HF teachers make efforts to ensure that students have access to computers on a regular basis because they recognize the importance of incorporating computer activities. During their interviews, the majority of HF teachers explained that it is very important for students to use computers because these activities provide skills that students will need to

succeed in the future, whether later in school or in the workplace. The vast majority of HF teachers (95%) agreed that technology helps teachers meet the varying needs of students, compared to 62% of LF teachers. They were also more likely to indicate that allowing their students to use technology meets a learning need that they cannot otherwise meet, when compared to LF teachers (74% vs. 52%). All of these findings show that teachers who frequently assign computer activities recognize the value that they can bring to student learning.

Finally, teachers who use technology more are also the teachers that take more initiative in learning how to plan activities involving computers. They were more likely to say that they have seen how other teachers use computers in their classrooms or speak with other teachers to share ideas about this. Additionally, the HF teachers were more likely to say in their interviews that they “play around” with computers to figure things out on their own when coming up with activities for their students. This implies both more teacher preparation time spent on computers and also a greater comfort level with the technology. In his study of exemplary computer-using teachers, Becker (1994) found that exemplary teachers spent significantly more time using computers at school than other teachers, although there were only small differences in the time they spent using computers at home. He concluded that these teachers possibly have more opportunities to use computers at school. Since the teachers in my study had similar opportunities at school, it is likely that there are other reasons some teachers spend more time researching and preparing computer activities. I propose that it is because these teachers recognize a need to incorporate computer activities for the benefit of student learning.

Teachers Who Assign Higher-level Computer Activities

Teachers who assign higher-level computer activities were more likely than others to recognize that having students use computers results in richer learning experiences and enhanced quality of work. They also had more training in computers and felt more prepared to use them for instruction.

Like the HF teachers, teachers in the high-level (HL) groups agree that technology helps them meet the varying needs of students: 40% of HL teachers strongly agree, compared to only 11% of LL teachers. In addition, HL teachers strongly agree that the Internet and multimedia opportunities have made learning experiences richer (53% of HL vs. 17% of LL). During their interviews, HL teachers spoke about having students use the Internet for research and about using the Internet to enrich their lessons. This may also be related to the finding that more HL teachers report that they have seen technology enhance the quality of student work (60% of HL vs. 23% of LL). These are the teachers who more often assign activities that involve computers to produce student work, rather than simply having them practice basic skills on computer software programs.

In terms of preparation to use computers in teaching, HL teachers reported participating in more professional development in the use of computers during the last three years. The majority of HL teachers had 9-20 hours or more training, while LL teachers had 1-8 hours or less. This logically relates to the finding that more HL teachers say they feel well or very well prepared to use computers for instruction when compared to LL teachers (53% vs. 33%).

Even though HL teachers felt more prepared to use technology, they also seem to be more willing to learn from others. HL teachers were more likely to report that they frequently or always ask another teacher for help when they have questions about integrating technology.

Factors Characterizing Teachers Who Frequently Integrate Technology

For this study, teachers who were both HF and HL were considered to be those who frequently integrate technology (HFHL). Aside from the factors related to the two types of teachers described above, the distinguishing characteristic of teachers who frequently integrate technology is that they have a stronger vision of what is possible with computers. These teachers not only describe more activities that their students typically do with computers, but they describe more new activities they would do if they could have their ideal computer setup. Moreover, they cite more areas where they have seen technology enhance student performance and talk about different values that computers add to learning. In effect, these teachers are characterized by a combination of knowing how students can use technology and recognizing the value that it adds to learning.

When asked what they would do if they had their ideal computer setup, HFHL teachers responded very differently than the other teachers. I asked this question because the majority of teachers reported in the survey that computers not working regularly (79%) and not enough computers (72%) were obstacles that they faced in using technology for instruction. Thus I wanted to find out what teachers would do if the problems of reliability and access were resolved. The HFHL teachers were far more likely than the other teachers to talk about new activities that they would do if they had their ideal computer setup. Most of the activities they described would increase the integration of computer activities with curriculum in other subjects,

particularly by using computers to conduct research and by allowing for more interactive lessons. The other three groups of teachers were more likely to say that they would use the computers to do more of the same activities that they currently do, but allowing more students to participate at one time. Ertmer (1999) proposed that finding out *why* teachers are frustrated by a barrier such as limited computer equipment can help to reveal their goals for technology use as well as their beliefs about how technology should fit into curricular instruction. She described similar findings related to the barrier of computer access, where some teachers want more computers so that they can be more efficient in covering current content, and others want more computers so that they can expand what they are able to cover. This was apparent in the responses of teachers from the different groups in my study.

In addition to having a vision of how technology might be integrated, HFHL teachers recognized greater value to student use of computers both in the survey and interviews. In the surveys, this was evidenced by their responses to a question asking teachers whether they have seen technology enhance student performance in particular areas. The majority of HFHL teachers reported that they have seen enhancement in three or more areas, while the majority of teachers in the other groups reported two or fewer areas. Similar findings arose from the interviews – on average, HFHL teachers talked about more types of benefits to computer use than teachers in the other groups.

Clearly, teachers who frequently integrate computers are the teachers who have a vision of what this looks like and who recognize the value that it can bring to student learning.

The Effect of Perceived Barriers

The barriers that the most teachers indicated as obstacles they face in using technology for instruction were related to limited time and problems with computer equipment. This was true for all four groups of teachers, however, more of the LFLL teachers indicated in the survey that not enough computers was a problem, and more of them said in their interviews that their computers are too old or problematic. LFLL teachers were also the most likely to say that the district takes too long to respond to technical problems, and to report that outdated software is a barrier that they face to using computers for instruction. This is particularly interesting in that the district provides the same technical support services and the same basic software programs to all of the schools. Even within the same schools, some teachers thought these were obstacles to using technology for instruction while others did not. This points to the theory that although the actual barriers may be similar for all teachers, how they perceive these as barriers can have an impact on what they decide to do about them. Ertmer (1999) proposed that although we may assume that teachers who are higher-level users of technology face fewer barriers, this may not actually be the issue:

The more significant difference between high- and low-level users may be related to teachers' perceptions of the criticality of these barriers.... For example, limited access may be assigned relatively high weight by teachers who are not convinced that technology is relevant to their curriculum. Yet others, who consider technology central to the curriculum, may assign relatively low weight, regarding limited access as an inconvenience, or a challenge, but not a deterrent. (p. 3)

The finding that all teachers perceive the same types of barriers, regardless of what kind of computer users they are, seems to indicate that the barrier itself does not necessarily prevent a

teacher from frequently integrating computers. The determining factors may be closer related to the importance that teachers place on these perceived barriers and their attitudes in approaching them. Although this study was not able to establish the relationship between actual barriers and different types of teachers' perceptions of barriers, this would be a revealing topic for further research.

EDUCATIONAL IMPORTANCE

What these findings tell us is that it is not enough for schools to provide computers for each classroom, but they need to take extra steps to support teachers in developing a vision of why it is important for computers to be integrated into lessons and what students can learn through activities that involve computers. Additionally, administrators can work to provide an environment where teachers feel supported as they experiment with integrating computers in new ways. Teachers who frequently integrate technology (those who are both high frequency and high-level) were found at all of the elementary schools in the district, in every grade level. This demonstrates that differences in environmental factors cited in previous research, such as administrative support, technical support, and availability of training, may only have a minimal impact on differences in how teachers within a school district decide to use their computers. The findings show that these differences in use are clearly related to teachers' beliefs and perceptions about computer use, areas that can be addressed through future professional development opportunities. Some recommendations resulting from this study include: 1) Plan professional development that provides a vision of how integrated technology can look in the classroom. 2) Create opportunities for teachers to share about how they use computers within and between schools, 3) Offer training on how to integrate technology into curricular content, rather than how

to use specific software programs, 4) Provide training on classroom management and how to maximize the amount of computer time available.

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Teachers who frequently integrate technology into curriculum are more likely to...

Recognize greater value to having students use computers

- Know that experience with computers is necessary for students' future success
- Believe computers help teachers meet varying needs of students
- Agree that Internet and multimedia make learning experiences richer
- Have seen technology enhance quality of student work

Have a stronger vision of what integrated technology can look like

- Assign different types of computer activities
- Have more ideas about other activities they would like to assign if time and equipment were not barriers
- Use computers as a tool to produce student work, rather than limiting computer use to drill-and-practice activities








Develop classroom management routines that maximize student time on computers

- Use a regular rotation system to allow students to access classroom computers
- Are resourceful in finding time during the day to conduct rotations

Learn about ways to use computers from various sources

- Have attended more technology training than other teachers
- Share computer ideas with other teachers through discussion or observation
- Take initiative to develop new student computer activities
- Ask other teachers for help with questions about integrating technology

Some strategies to consider for supporting teachers in the integration of technology:

-  Plan professional development that provides a vision of how integrated technology can look in the classroom.
-  Model ways that technology can be used to support standards-based curriculum.
-  Create opportunities for teachers to share about how they use computers within schools and between schools.
-  Offer more training on how to integrate technology into curriculum and how to use computers to teach content in instructional areas, rather than how to use specific software programs.
-  Consider creative ways to increase the number of teachers who attend technology training sessions, since teachers who are already integrating technology more are also the ones who seem most likely to seek out more training.
-  For teachers who are hesitant to integrate computers into curricular instruction, provide more training on classroom management and how to maximize the amount of computer time available.
-  Incorporate funds for updating hardware and software in technology budgets any time new technology is acquired. Outdated and unreliable computers are a major barrier to the integration of technology.

Research Brief based on UCLA Educational Leadership Program dissertation: *The Relationship Between Teachers' Beliefs and Perceptions About Student Use of Computers and How They Integrate Technology Into Curricular Instruction* by Wendy Tan Lee, 2006. For further details or a copy of the complete report, contact wendytleee@gmail.com.