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The Impact of SES and Teacher Exposure to Technology on Student Achievement Gain Scores

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The Impact of SES and Teacher Exposure to Technology on Student Achievement Gain Scores

In an age of educational standards, state after state joins the ranks of those that require technology competency of their teachers. States ranging from Colorado (Colorado Department of Education, 2002) to Maryland (Maryland State Department of Education, 2002) have followed the International Society for Technology in Education's (ISTE, 2002) lead in developing teaching technology standards and in requiring teachers to demonstrate technology competencies as part of their teaching certification. The State of Idaho (Idaho State Department of Education, 2002) is among the many states that now require teachers to certify their technology skills. The purpose of this paper is to describe a four-year, statewide Idaho investigation of the effect of teacher technology competency, given differing districts' socioeconomic status, on students' reading, language, and math standardized test score gains.

While there are a number of possible benefits to having technology competent teachers, legislative funding bodies are primarily concerned with increasing student achievement, which some believe can be one possible outcome of educational technology (Valdez et al., 1999). According to Lempke and Coughlan (1998), "Many policy makers see the primary benefit of school technology as preparing students to live and work in the Digital Age...but when the public says, 'You invest in this, and why don't our scores go up?' they are put on the defensive" and return to defending technology through the old paradigm of academic success (Trotter, 1998, p. 6).

This study is a follow-up to two studies completed for the Idaho Council for Technology in Learning that were presented to the Idaho State Legislature as part of an accountability report for monies spent for technology integration in Idaho's Schools (Green, 1998; 2000). The rationale and methodology for both studies were based on two premises: 1) Technology, if integrated properly, can improve academic achievement and enhance learning and 2) The Iowa Test of Basic Skills (ITBS) is an accurate indicator of academic achievement.

In this study we explored the following research questions: 1) Are there differences in academic gain among districts when taking into account the district's SES and the level of teacher technology competence? and 2) Does teacher technology competence predict academic achievement gains after controlling for school district's SES?

Background of the Study

As the nation moves toward a higher level of accountability in education, greater scrutiny will be focused on all instructional areas with an eye toward funding effective programs and eliminating those that appear to be more costly than needed, desired, or appropriate. At the same time, the role technology plays in what students must know and be able to do for advancement into the world of work or higher education must be considered. It is therefore incumbent on the educational community to support those experiences that address the value of appropriate integration of technology into curriculum.

According to Baker, Herman, and Gearhart (1996), technology alone cannot improve teaching and learning. How technology is integrated is the key to positive changes in student performance. Further, how effectively schools use technology in the classroom depends largely on planning, training, and implementation strategies.

> Technology use must be grounded firmly in curriculum goals, incorporated in sound instructional process, and deeply integrated with subject matter content. Absent this grounding, which too often is neglected in the rush to glittery application, changes in student performance are unlikely. (Baker et al., 1996)

Teachers cannot be expected to integrate technology into the daily classroom without adequate ongoing training (Poirot, 1992-93; Zoni, 1992). Callister and Dunne (1992) concurred, noting "All effective uses of classroom computer technology must be based on a trust of teachers ... if not, the classroom computer revolution will be just another expensive failure"(p. 326). To effectively accomplish integration, teachers need to learn how the computer can interact with the broader classroom environment and how they can bring this new way of teaching into their classrooms (Clements, Nastasi, & Swaminathan, 1993). Recently, state certification agencies have sought to increase educators' technology skills by mandating certification in technology (e.g., Colorado Department of Education, 2002; Connecticut State Department of Education, 2002; Idaho State Department of Education, 2002; Maryland State Department of Education, 2002; North Carolina Department of Education, 2002).

Early research on computer-based instruction supported its use. Kulik conducted meta-analysis studies between 1983 and 1986 that showed that computer-based instruction generally had a positive effect on achievement of elementary, secondary, and college students. The effect sizes of the studies ranged from .26 to .47 (Kulik, Bangart-Drowns, & Williams, 1983; Kulik & Kulik, 1986; Kulik, Kulik, & Bangart-Drowns, 1985). In response to Kulik's research, Clark (1985) noted that the vast majority of research on technology that found positive effects in academic gain as a result of technology was based on poor research methodology. Others concurred, stating that many meta-analytic studies use estimates from studies that were methodologically flawed (Fletcher-Finn & Garavett, 1995; Statham & Torrell, 1996; Wenglinsky, 1998). Clark proposed that learning is influenced more by the content and instructional strategy than by the type of medium. Many other researchers concur with Clark, citing instructional strategy and delivery as the key to academic gain (Daniels, 1989; Salomon, 1991).

Wenglinsky (1998) conducted a study using the 1996 National Assessment of Educational Progress (NAEP) data. When correlating technology to academic gain for NAEP's eighth grade group, Wenglinsky found that teacher's professional development in technology, the use of computers to teach higher-order thinking skills, and the frequency of home computer use were all positively related to academic achievement, while the frequency of school computer use was unrelated to the social environment of the school and negatively related to academic achievement. The size of the relationships between the various positive uses of technology and academic achievement was substantial for eighth graders and showed a one-third grade level increase.

With the proliferation of technology into classrooms and the advent of multimedia and the Internet, the nineties promised to be as exciting, revolutionary, and beneficial as the previous 40 years. However, even though computer technology has been available for school applications since the 1950's, early expectations regarding computer use have not been realized (Statham & Torrell, 1996). To date, educators have used computers for drill and practice, tutoring, computer-based instruction and, more recently, for problem solving, communication, and multimedia.

Stone (1996), in his study on the academic impact of classroom computer usage on second grade elementary school children, studied the possible causes and effects of CAI on academic achievement in math, vocabulary, reading, and spelling. The ITBS was used as the method of measuring student ability. The results of the study indicated a significant difference in those students who used CAI in the areas of reading, math, spelling, and vocabulary. Stone concluded that CAI does in fact have a positive impact on achievement of elementary school children. Additionally, Bailey (1991), Pike (1991), and Wodarz (1994) all found similar significant effects of technology on academic gain using the ITBS as the measurement instrument.

As Wenglinsky (1998) reported "All of the data suggests that computers are neither the cure-all for the problems facing schools nor mere fads that have no impact on student learning. Rather,

when they are properly used, computers may serve as important tools for improving student proficiency..." (p. 4).

Data Collection

This study consists of all Idaho students who were in 4th grade in the Fall of 1996 and 8th grade in the Fall of 2000. We identified these students by matching the their names and birth dates between Fall of 1996 and Fall of 2000 (*N*=10,998) on their Iowa Test of Basic Skills. We measured their academic gain from fourth through eighth grade with the Iowa Test of Basic Skills. The ITBS is a nationally recognized test of academic proficiency (Riverside, 1994). Using the ITBS as a measurement instrument, we calculated each student's gain score in reading, language, and math. We used developmental standard scores (SS) that were provided by the test developer for the calculations. Developmental standard scores describe a student's location on an achievement continuum. To interpret the SS, the values associated with typical performance in each grade must be used as reference points (Hoover, Hieronymus, Frisbie, & Dunbar, 1994). Those students who emigrated or immigrated during the period of study were not in the data set.

We also collected each Idaho school district's (*N*=109) socioeconomic status and level of teacher technology competence. We measured the socioeconomic status by the percentage of district free and reduced lunches. We measured the teacher technology competency by the percentage of district teachers who passed the Idaho Teacher Competency Assessment (ITCA). Student achievement gains were aggregated by district. We created four subgroups based on the following criteria:

- High Technology is defined as a district with more than 55% of its certified staff meeting the requirements of the ITCA.
- Low Technology is defined as a district with less than 30% of its certified staff meeting the requirements of the ITCA.
- High SES is defined as a district with less than 30% of students on free and reduced lunch.
- Low SES is defined as a district with more than 45% of students on free and reduced lunch.

Five districts had less than five student matches and these districts were not used for the data analysis.

Results

Districts with high teacher technology competency showed greater student academic gains. Effect sizes based on Cohen's *d* ranged from .30 to .43. The student gains when technology competency and SES were considered together is shown in Table 1.

Table 1
Academic Gain Across Subject Areas Reported in Developmental Standardized Scores

	Reading Gain		Language Gain		Math Gain	
	M	*SD*	*M*	*SD*	*M*	*SD*
High Tech / High SES	57.3	5.82	61.3	2.40	64.1	5.64
High Tech / Low SES	54.7	6.65	59.6	7.74	61.6	8.77
Low Tech / High SES	53.0	5.76	43.5	13.74	60.1	7.49
Low Tech / Low SES	53.5	5.59	54.5	9.16	58.8	8.81

When taking into account socioeconomic status, one might conclude that those students who were from a district with a high socioeconomic status and taught by a technology savvy teacher would have the largest gain scores. This was, in fact, the case in Idaho. However, using the same line

of logic one might also conclude that if socioeconomic status were the one factor that affects gain, those students who were from a district with a high socioeconomic status with a teacher who had low technology competency would have the second largest gains out of the four groups. Interestingly, this is not the case. The data reveal that those students who were from districts with low socioeconomic status and had technology savvy teachers had the second highest gains in math, language, and reading. The socioeconomic status of the districts with low technology was not a factor in student gain scores.

Based on these results, we anticipated that teacher technology competency could be used to predict academic gains in reading, language arts, and mathematics. This was not the case. Neither the percentage of teachers who met the Idaho Teacher Competency Assessment nor the percentage of students receiving free and reduced lunches was a significant predictor of reading, language, or mathematics gains with hierarchical regression analyses. This would indicate that the pattern of achievement seen between the extreme groups was not present across the full range of skill levels.

Discussion and Implications

One possible explanation for the discrepancy in our findings may be the extent to which teachers implemented the technology. It is unlikely that teachers who had not passed the state technology competencies were frequently implementing technology in their classroom. Districts with high numbers of teachers demonstrating competency may have implemented technology into their classrooms, thus explaining their positive results. The amount of implementation probably varied a great deal in districts between these extremes. It is unlikely that the percent of teachers passing the technology competency was directly related to the amount and quality of its implementation in the classroom. Since previous research indicated that it is the manner in which technology is implemented that influences achievement and not the mere possession of technology skills, it is not surprising that the percentage of teachers demonstrating technology proficiency did not predict academic gain.

Green used similar gain score data in 1998 and 2000. He found higher gain scores for students who reported greater exposure to technology. One criticism of his work was that it failed to account for SES, since one might expect that higher SES students would exhibit greater growth and high SES students would experience more technology. When he accounted for home exposure to computers (a potential indicator of high SES), the effect size of his gain scores dropped, but they were still significant. The limited finding for SES in our study may be a ceiling effect. Those students in the high SES group typically have higher achievement scores and therefore have a smaller margin in which to increase their scores. Ceiling effects are a limitation of using gain scores. If there were ceiling effects they also would inpact the regression results.

These findings support the importance of teacher certification that results from appropriate teacher training that translates into classroom implementation. Technology competency and the ability of the teacher to effectively integrate technology into the classroom curriculum is and will continue to be a factor in the academic success. Further research is warranted into how to ensure that teacher competency in technology translates into effective use of technology in the classroom.

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