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ABSTRACT

This study assessed whether or not classroom-based micro-computer applications can help improve students' performance on standardized tests, and which subject areas such programs are most effective in for fourth graders in two Mississippi schools. The Teaching and Learning with Computers (TLC) program placed a local area network in the school with networked computers and a printer in each class in grades 2 through 5. Stanford Achievement Test scores for students at both schools were analyzed for spring 1991 and spring 1992. For School A, scores for 105 students represented pretest and posttest values, and scores for 231 students in School B served as controls. An analysis of variance was used to test for significant growth for each subtest and the total battery of the achievement test. Findings suggested that the TLC program had the effect of raising mathematics scores at School A. Mathematics was the only area in which post-TLC scores were significantly higher in the between-schools and within-school analyses. Teachers indicated that the mathematics courseware was used more than the courseware for other disciplines because it was the most appropriate for the existing curriculum. On the total battery, School A raised its mean score 8.87 points, a significant change. Overall, data suggest that the TLC program did have a favorable impact on the standardized test scores. Three tables present study data. (Contains 12 references.) (SLD)

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# A COMPARISON OF FOURTH GRADERS' ACHIEVEMENT: CLASSROOM COMPUTERS VERSUS NO COMPUTERS

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**A COMPARISON OF FOURTH GRADERS' ACHIEVEMENT:  
CLASSROOM COMPUTERS VERSUS NO COMPUTERS**

During the past ten years, there has been a tremendous push to put computers in the classrooms of America. Early advocates of computer support indicated that computer usage promised greater student achievement, more efficient use of human and material resources, improved attitudes toward the learning process, and an enhancement of education. However, there have been difficulties in the implementation of computer technology in the classroom.

Many schools concentrated their computer purchases in a computer lab simply because the investment required to make computers available for every student is beyond the scope of limited educational budgets.(Thornburg, 1987). By using the laboratory approach most students had access to the machines about 20 minutes per week. This amount of time is about half the recommended time necessary to achieve gains. (Levine, 1986)

Accompanying the problem of acquiring computers is teacher attitude. In U.S. News and World Report, November 10, 1986, Art Levine reported that only 10 to 27 percent of all teachers were proficient at computer use. This rating was performed by Johns Hopkins researchers. To become proficient, teachers have to go through the painful process of self-education and learn how to embed the machines and software into their instructional process. (Levine, 1986)

Philip Elmer-Dewitt points out that if teachers want to use the technology provided by computers, they must make some fundamental changes in the way their educational time is organized. John Paulson of Springboard says that "Teachers enter the profession because they understand the importance of their various subject areas and they want to communicate that importance to their students. By shifting the routine aspects of education to the computer where possible, the teacher is better able to deliver that sense of importance to the class." (Elmer-Dewitt, 1991)

At first, computer software companies developed programs that were drill and practice. Often the programs were of minimum value for enabling students to learn. However, Cathy Carlston, Vice President of Educational Market Planning for Broderbund, an educational software publisher, feels that huge strides are being made in software materials. The programs being developed are attractive and well-designed. Jan Davidson with Davidson and Associates says that "As with any new technology, the technology alone is not the answer. What's important is that developers take advantage of new capabilities in ways that increase educational effectiveness while addressing student motivational factors and attention." (Ferrill, 1987)

## INTRODUCTION

This study grew out of a concern in school district A over the lack of success computer-assisted instruction in school. For over ten years Chapter I remedial instruction had been delivered to eligible students through a mini-computer system that consisted of drill and practice software programs. Chapter I students were pulled

out of the regular program for special instruction. In the spring of 1991, a committee was formed to launch an extensive investigation into possible alternative methods for delivering Chapter I services to students. This investigation coupled with the changes in state/national guidelines, resulted in the district initiating a pilot study to change the district Chapter I format. To accomplish this School A was designated as a Chapter I schoolwide project and the IBM *TLC(Teaching and Learning with Computers)* program was installed in grades 2-5 at School A. Schools are eligible for schoolwide designation when they have 70% of their students on free or reduced lunch. School A has 98% of its students on free or reduced lunch. School B, the control school for the study, with 96% of its students on free or reduced lunch is eligible for schoolwide designation but continues to deliver Chapter I services through the pull-out mini-based computer system. Interviews with the committee conducting the investigation indicate that the primary reasons for choosing this solution are: schoolwide designation enables ALL students in the school to benefit from the Chapter I services, and the *TLC* design and ideology are compatible with district philosophy and methodology.

The primary questions that this study addresses are: can classroom-based micro-computer applications help improve performance on standardized tests, and on which subject areas are these programs most effective.

The study analyzed Stanford Achievement Test, 8th Edition, test scores of fourth graders at School A and School B for spring, 1991, and spring, 1992. Because the *TLC* computers and program were installed in School A in the fall of 1991, the

1991 scores represent pre-TLC performance and the spring, 1992 scores represent post-TLC performance . Test results from School B, which continued to administer Chapter I services through the mini-computer, serve as a control group for between school comparisons. The ONEWAY ANOVA procedure was used to test for significant growth for each subtest and the total battery of the Stanford Achievement Test between the two years within School A. The same procedure was used for School B and the results analyzed. Statistical analysis then compared performance on the SAT subtest and total battery between the two schools in 1991 and in 1992.

### Literature Review

There have been innumerable studies designed to ascertain the effectiveness of computer assisted instruction. In a summary of ten major studies on Computer Assisted Instruction (CAI) drill and practice, Vinsonhaler and Bass (1972) cited results that indicate a substantial advantage for CAI augmentation of traditional classroom instruction. All of the studies reviewed used a basic experimental group/control group design. Crucial to the design of these studies was the use of standardized achievement tests as the criterion for educational performance. In the majority of studies, the differences were statistically significant. CAI groups showed performance gains of one to eight months over groups receiving traditional instruction. In this report these two authors felt that there was little reason to doubt that CAI plus traditional classroom instruction was more effective than traditional instruction alone. (Vinsonhaler, Bass, 1972)

Judith Edwards, Shirley Norton, Sandra Taylor, Martha Weiss, Ralph Dusseldorp did a review of the research to answer the question "What happens when computer-assisted instruction is substituted, in whole or in part, for traditional instruction?" They cited the Suppes and Morningstar 1966-68 study that found a gain of 2.28 and 2.03 grade levels in computational ability of third grade students in one year in California and Mississippi. Their review also pointed out that Arnold and Scrivens found that after one year the differences in achievement between students whose arithmetic instruction was supplemented by CAI drill and practice and students who received normal instruction were only .3 grade levels for grade two, .5 for grades five and six. Wilson and Fitzgibbon reported that a group of fourth and fifth graders made an average of seven months growth in reading skills during four months as a result of having their normal instruction supplemented with CAI. In nine of the studies they reviewed it was found that when CAI was used as a substitute for traditional instruction, students achieved more. Eight of the studies they reported revealed little or no gain. Three of the studies revealed mixed results. Their review also indicated that studies have shown that although CAI does not always result in greater achievement, however, the time it takes students to learn is less. (Edwards, Norton, Taylor, Weiss, Dusseldorp, 1975)

Kulik performed a meta-analysis integrating findings from various levels of instructional programs using computer drill and practice. He found that students at the college level felt that computers apparently offer them very little beyond what can be provided by a teacher, a book, and paper and pencils. However in elementary

schools, the individualization provided by computers had positive effects. The drill and practice apparently kept children interested and actively responding. The immediate feedback and the guiding from one kind of problem to another proved productive. He did conclude that elementary school students may need more feedback, more individual contact, and more guidance than the self-paced systems may provide.(Kulik, 1981)

The impact of microcomputer applications on instruction is not as clear as the impact on clerical and administrative tasks in education. Of critical importance is the evidence of impact of microcomputer applications on traditional measures of educational effectiveness such as student attitudes, achievement, dropout rates and learning times. (Roblyer, 89). Dr. M. D. Roblyer conducted a review of the research from 1980-87 on the effectiveness of microcomputers in education to analyze the best information available from recent research. His review found differences from that of past reviews. Contrary to past reviews that elementary levels seem to profit more from use of computer, Roblyer found the highest effects in college and adult populations. Results also indicate that computer applications yield the highest effects in science, and math and the lowest in reading although all areas have demonstrated educationally significant effects. Roblyer did not find a significant impact on student attitudes with computer usage.(Roblyer, 1989)

Kulik, Chen-Lin and others examined the effects of CBA in grades one through six in a meta-analysis which examined 29 studies. The achievement of the control students slightly exceeded the achievement of students taught with computer



management in two studies. Another study found that sixty-eight percent of the students from the CAI classes outperformed the average student from the control classes. When reported in grade equivalents the approximate gain was nearly 5 months higher than the scores of comparable students taught by conventional teaching approaches. The major finding in this meta-analysis was the positive effect that CAI had on achievement of elementary school children. In the typical application the students received approximately 15 minutes per day for 4 days a week for 26 weeks. The effect of this instruction was to raise student achievement scores by 0.48 standard deviations or from the 50th percentile to the 68th percentile. (Kulik, Chen-Lin, others, 1984))

In another study examining the effectiveness of CAI, David Thomas surveyed 65 evaluations and found a clear pattern confirming the effectiveness of CAI as well as the speed of learning. The saving of time was evident in 16 out of 17 studies. He also found that students using CAI achieved higher on standardized test scores, had favorable attitudes toward computers as a mode of instruction, and retained what they learned as well as non CAI students. (Thomas, 1979)

In comparing CAI to traditional instruction Catherine Morgan found the test results revealed that CAI students using Operation Whole Numbers (OWN), a computer assisted instructional approach, in grades three, four, five, and six made statistically significant greater improvements than did students in the control schools. Over a period of fourteen months of school CAI students averaged from 1.1 to 3.6 months greater gain in mathematics achievement than control students. She also

investigated the achievement gains of students below average. Using four subgroups, CAI above average, CAI below average, control above average, and control below average, the study concluded that below average students appeared to benefit more in lower grades(3,4) whereas the above average students appear to benefit more in the upper grades(5,6). (Morgan, 1977)

Kendl and Broihier raised a major question in their longitudinal study regarding student responses to computers. Their findings demonstrated clear evidence of novelty effects. Preferences for computers declined significantly as did the student perceptions of learning from the technology over the three year study. They warned that positive outcomes will tend to decline as the technology becomes more familiar and its novelty wears off. Research that is being conducted regarding the success of computer instruction must be controlled to assure that the results are not inflated due to a variety of uncontrolled effects, including novelty effects and differences in instructional method or instructional content rather than to the delivery medium, the computer(Kendl, Broihier, 1991).

#### **Program Description:**

In 1991 School A was designated a schoolwide Chapter I project making every student in the school eligible for Chapter I services. In August, 1991, Chapter I installed a *TLC* networking system in grades 2-5. The *TLC* program (*Teaching and Learning with Computers*) placed a local area network in the school with 5 networked computers and a printer in each classroom in grades 2-5.

**TLC** is an instructional model for using networked computers as a basic tool for everyday learning. This model works through a combination of IBM hardware, courseware, teachers' guides and teacher training. Teachers tailor the use of the courseware to the classroom objectives and the individual needs of the students using a learning center environment. There are separate stations for pre-computer activities, computer lessons and post computer activities. The courseware available to each student consisted of a combination of tutorial and drill and practice software developed by IBM, Wicat and other vendors. Most programs used a task-analytic, learning by objectives approach. The courseware focuses on the areas of language arts, reading, and math. Specifically the following courseware was available at School

**A:**

Vocabulary Series, Level I, II

Reading for Information Level I, II, III

Reading for Meaning, Level II, III

Spelling, Level I, II, III

Combining Sentences, Level II

Punctuation Series, Level II, III

Parts of Speech, Level II, III

Math Concepts, Level I, II, III

Math Practices, Level I, II, III

Measurement, Time and Money, Level I, II, III

Touch Typing for Beginners

Also included in the package were teacher tools such as an electronic gradebook and quiz designer, an authoring software called *Linkway*, a desktop publisher called *Express Publisher*, and an integrated package of word processing, spreadsheet and database, called *Microsoft Works*.

Neither students nor teachers had prior formal computer experience. Teachers were trained for 5 days in the summer of 1991 prior to the opening of school and the equipment was installed and fully operational in September, 1991. Teacher training was conducted by a certified *TLC* trainer who had been using *TLC* in her classroom for 2 years. Two of the days of training were devoted to operational instruction such as basic literacy, and fundamentals of hardware and software operation. The remainder of the training focused on integrating the courseware into the existing curriculum and incorporating the computerized learning center approach into the classroom. Teachers developed actual lesson plans using the *TLC* model and their own textbooks and teacher manuals.

In School A, teachers used the computers as a learning center for language arts, reading and math, depending on the content of the daily lesson in each subject area. Some days students would go to the computers several times, other days only once. However, all students received computerized instruction for a minimum of 30 minutes a day. Since the school was a schoolwide project, all students in the school had equal access to the *TLC* computer system.

In School B, Chapter I continued to function as a pullout program for eligible students. The mini-computer based system delivered drill and practice activities to Chapter I students on an intermittent basis an average of 10 minutes 2 times a week.

### Sample

The sample for the study consisted of 105 fourth grade students at School A and 231 fourth grade students at School B. This study is NOT a longitudinal study. The within-school comparison spanned two years, 1991 (pre-TLC) and 1992 (post-TLC). Each school houses grades K-5.

~~The fourth grade was used for the research because that is the grade level in~~ which the state of Mississippi mandates the Stanford Achievement Test. Because the test is strictly monitored by the state, the testing conditions are uniform. The tests are given on the same day at the same time under parallel test settings. This eliminated many extraneous variables that could impact the study.

The schools are socioeconomically similar with 98% and 96% student on free or reduced lunch, respectively. Based on spring, 1990 data, each school had over 50% of its students score below the 50th percentile on the Stanford Achievement Test. The school populations are demographically similar with School A having a 96% black, 4% white and School B having 94% black and 6% white (Spring, 1992).

### **Procedure/Analysis of Data**

In this study, the Stanford Achievement Test, 8th Edition, test data for School A and School B for the spring, 1991, fourth graders and spring, 1992, fourth graders were analyzed using the SPSSPC (4.0) program available at the Mississippi State University, Meridian Branch. The ONEWAY ANOVA procedure was utilized for 2 types of comparisons, within school and between schools.

Within each school, A and B, 1991 test scores were compared to 1992 test scores for significant growth. School A's fourth grade students' SAT test scores from spring, 1991, (before *TLC* installation) with the SAT test scores of the spring, 1992, (after *TLC* installation) fourth graders on each subtest and the total battery of the SAT. School B's fourth grade SAT test scores from spring, 1991, were then compared to School B's 1992 fourth graders test scores on the same subtests and total battery using the ONEWAY ANOVA. This was done on both the experimental school(A) and the control school (B) test scores so that a comparison could be made as to the effect of the *TLC* program on test scores. No other factors changed at either school. The teachers in fourth grade remained the same as did the curriculum, the grouping and the principal. That the tests were given to two different groups of fourth graders in each school since it was given to CURRENT fourth graders each year.

The between-schools test of significance compared School A with School B in each subtest and total battery by year, 1991, and then 1992. The ANOVA was used again for this comparison. In this procedure the relationship between the two schools

test scores were analyzed to determine if School A's test scores showed any gain as compared to the traditional school's (School B) scores.

### **Results and Discussion**

#### **Within the Schools-1991 vs. 1992**

In School A, the statistical analysis revealed that the mean was higher for 1992 in all of the subtests (Reading, Math, Language Arts, Science, Social Studies) and the Total Battery of the SAT. The ONEWAY ANOVA found there was statistically significant growth ( $P < .05$ ) in the 1992 fourth grade test scores in the areas of math, science and social studies and the total battery as compared to the spring, 1991 results.

In School B, the means for 1992 were higher than for 1991 in all subtests and the total battery except for science, where the mean for 1991 was higher. In analyzing the growth, significance was found in two areas, reading and science. However the F ratio for science revealed that the scores for 1992 were significantly LOWER than for 1991. (see Table 1 & 2)

#### **Between the Schools By Year-School A vs. School B**

The between school analysis compared the two schools within the same year. In 1991, the year prior to the implementation of the TLC program in School A, there was no significant difference in the test scores of fourth graders between schools in the areas of reading and math. In each subtest, the means of School B were higher. There was a significant difference between the two schools test scores in language arts, science, social studies, and in the total battery. School B's 4th grade SAT test

scores were significantly higher than School A in language arts, science social studies and in the total battery. (Table 1 & 3)

In 1992, the year after the implementation of *TLC*, the picture had changed. School B's means in reading, language arts, science, social studies and the total battery were still higher than in School A; however, School A's math mean was much higher than School B. Also although School B still had statistically significantly higher scores in reading, language arts, and social studies, School B had only slightly higher(not significant) scores in science and on the total battery. School A's 1992 math scores did show statistical significance as compared to School B's math scores. However, there was no significant difference between the spring 1991, and spring 1992 test scores at school B in any of the SAT subtests.

These preliminary results of the first year of this study raise almost as many questions as answers. It would appear from the data that the *TLC* program had the effect of raising test scores in School A in 1992 in area of math. The mean score for the fourth grade math rose by 20.56 points from 1991 to 1992 and the NCE gain was +13.6. Math was the only area in which the post-*TLC* test scores were significantly higher in both the between-school analysis and the within-school analysis. Admittedly the between-school comparison for 1991 did not show a significant difference between the two schools math scores, however, the difference in the mean between the two schools in 1991 rose from 4.6 points to 11.24 points. When interviewed the fourth grade math teachers indicated that the math courseware was used more than the reading or language arts software because the skills presented were appropriate



to the existing curriculum, it was easy to use for teacher and student, and it was the most visually appealing. Teachers agreed that they used the math courseware "every day" and the reading "when they could". In School B the 1991 vs. 1992 math mean rose about 3.5 points but was not significant.

The reading scores offer some support for the interviewed teachers comments. While School A had some growth in their mean reading score (3.26 points) and an NCE gain of 1.2, the growth was not significant. In discussing the reading courseware, the teachers indicated that its integration into the existing curriculum was more difficult than math and required a greater degree of familiarity with the courseware. ~~If this is indeed a relevant factor, then the second year of the study~~ should show increased use and integration of the *TLC* courseware into the curriculum.

In contrast, school B's mean rose 11.46 points and was statistically significant. In trying to find possible explanations for the rise in scores the principal and teacher were interviewed. Both expressed the opinion that the 1992 fourth grade reading class was especially "good" in reading. They indicated no special effort above the normal had been attempted to bring scores up.

Language arts test scores showed very little movement. In School A the mean moved up only 1.17 points and in School B the mean actually declined 1.32 points. Comparing the years between the school, School B continued to perform significantly better than school A, although the F ratio did decline. When questioned as to the usage of the *TLC* language arts courseware, teachers indicated they used the spelling

program most often and the others infrequently. A common statement was that they were still discovering what was in the courseware and how best to use it in the classroom.

Although there were no specific pieces of courseware in the *TLC* package that dealt with science and social studies, it is interesting to note what happened to the test scores. School A's means rose significantly, 12.37 points, while School B's mean dropped significantly, 15.47 points. From 1991 to 1992 School A closed the gap in the science mean between the two schools. In 1991, the mean difference was 33.71 points, in 1992 the mean difference was 5.88 points. Social Studies scores followed a similar pattern to the science scores. School A's means rose significantly, 9.19 points, while School B's mean rose 2.73 points (not significant). Again the gap between the schools decreased. In 1991, the gap was 18.12 points and in 1992 it was 11.4. Whether any of this growth is due to the utilization of the *TLC* program which is designed to involve students actively in learning and to promote critical thinking and problem solving skills is a matter for further investigation.

On the total battery, School A raised its mean score by 8.87 points, which was significant growth. School B raised its mean by 2.57 points, which was not significant. In 1991 School B performed significantly better than School A on the total battery of the SAT with an overall mean 10.33 points higher than School A. After the implementation of *TLC* in 1992, School A had raised its mean to within 4 points of School A.

## Conclusions and Recommendations

The data suggest that the introduction of the *TLC* program into the fourth grade classrooms at School A did have a positive impact on the standardized test scores. It remains to be seen if the means will continue to rise as students and teachers get more experienced and proficient with *TLC*. However, the results from this study represent only the beginnings of a probe into what effect *Teaching and Learning with Computers* has on student performance. This is the first year of a three year study to determine the effect of integrating computer instruction directly into the classroom. Sustained gains have not been proved, and it remains to be seen if the students are achieving due to some variable not measured in this study such as the novelty effect, differences in classes of students or if the computerized instruction is making a real impact on their achievement. One variable not measured is the actual amount of time the students spent each day on each subject area courseware. It is evident from teacher interviews that this could have an important impact on the results of the study. There was no formal collection of data on the degree of implementation of the computerized learning centered approach in the classroom and the accompanying changes in instructional delivery and classroom methodology. This data will be gathered in the second and third year of the study using several methods. Teachers and principals will continue to be interviewed. Questions will address any changes in instructional processes and strategies as well as information on quantity and quality of time spent on each subject area

courseware. An outside evaluator will also conduct on-site visitations and use a checklist to gather data on what instructional strategies are present.

The primary questions addressed in this study--*can classroom-based micro-computer applications help improve performance on standardized tests, and on which subject areas are these programs most effective*--must be further examined before a clear trend is evident. Preliminary results from year 1 do indicate that classroom based microcomputer applications can improve performance on standardized tests. Data on the other question are sketchy at best in year 1. Further study into both questions is forthcoming in year 2 and year 3.

## A COMPARISON OF FOURTH GRADERS' ACHIEVEMENT: CLASSROOM COMPUTERS VERSUS NO COMPUTERS

**Table 1-Within School Comparison**

Test	Yr	School A			Yr	School B		
		Mean	Std.Dev	N		Mean	Std.Dev	N
Read	91	31.4291	12.6038	105	91	33.1935	14.0403	231
Read	92	34.6966	15.0667	105	92	44.6620	14.3215	231
Math	91	40.1491	16.5460	105	91	45.7057	18.9267	231
Math	92	60.7103	17.2042	105	92	49.4787	16.1520	231
Lang	91	44.0218	16.9065	105	91	65.2715	19.4799	231
Lang	92	45.2000	16.2024	105	92	63.9546	16.7363	231
Scie	91	37.6200	16.8631	105	91	71.3301	20.1845	231
Scie	92	49.9862	15.5540	105	92	55.8630	20.5000	231
SocS	91	34.4436	14.3095	105	91	52.5691	19.5270	231
SocS	92	43.6345	13.8161	105	92	55.0352	20.1789	231
TotB	91	36.8745	13.7793	105	91	47.2008	16.1191	231
TotB	92	45.7448	13.0577	105	92	49.7667	15.3729	231

**Table 2-Growth Analysis**

Test	School A				School B			
	F	Prob	D.F	Sig	F	Prob	D.F	Sig
Read	1.1131	.2945	82	No	37.6570	.0000	228	Yes
Math	28.5316	.0000	82	Yes	2.6176	.1071	228	No
Lang	.0949	.7589	82	No	.2995	.5848	228	No
Scie	10.7595	.0015	82	Yes	33.2777	.0000	228	Yes*
SocS	8.0189	.0058	82	Yes	.8890	.3467	228	No
TotB	8.1526	.0054	82	Yes	1.5214	.2187	228	No

\* The statistical analysis showed a significant decline in 92 scores as compared to 91 scores.

## COMPARISON OF FOURTH GRADERS' ACHIEVEMENT: CLASSROOM COMPUTER VERSUS NO COMPUTERS

**TABLE 3-Comparative Analysis between Schools**

TEST	1991				1992			
	F	PROB	DF	SIG	F	PROB	DF	SIG
READ	.6275	.4293	174	NO	10.8295	.0013	134	YES
MATH	3.0169	.0842	174	NO	10.7543	.0013	134	YES
LANG ARTS	45.585	.0000	174	YES	29.0866	.0000	134	YES
SCIENCE	114.71	.0000	174	YES	2.0601	.1535	134	NO
SOCIAL STUDIES	36.613	.0000	174	YES	8.2010	.0049	134	YES
TOTAL BAT	17.065	.0001	174	YES	1.6607	.1997	134	NO

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