Reading CAI with First Grade Students

by
Marley W. Watkins and Sandra Abram

Computer applications in education have grown at what appears to have been an exponential rate in the past several years. Relatively inexpensive but powerful microcomputers have become available to the educational community and are being utilized in a variety of ways. Although math applications have traditionally been more popular, computerized reading instruction has also received attention.

A study of the effect of using CAI reading tutorials was begun by the Stanford Project in 1964. First grade students who received reading CAI scored significantly higher than students who received traditional reading instruction. The program was modified over the next two years from tutorial to drill and practice, but CAI students continued to score significantly higher than control students. The project expanded to other areas, but reading achievement remained significantly higher for the CAI groups each year (Atkinson, 1968; Major, 1973).

The effectiveness of CAI in reading was also supported by the PLATO project. Positive results in reading have been reported for primary school children through adults (Slattow, 1976). Litman (1977) found that reading achievement scores of fourth through sixth grade students who received reading CAI improved across a two-year follow-up period. Knief (1979) found that 74 percent of his students achieved one month for every month of instruction using CAI. In addition to improving reading achievement, the attitudes of students, parents and teachers toward CAI have been favorable and student motivation has improved (Atkinson, 1969). Three studies (Green; Fletcher & Atkinson; Atkinson; cited in Mason & Blanchard, 1978) have shown primary-level boys scoring as well or better in reading than girls. This trend was contrary to what is usually found with traditional reading instruction (Bank, Biddle & Good, 1980).

These results are positive and encouraging, but reflect relatively old research on large computers which typically did not enjoy the economic and graphics advantages of modern microcomputers. The current research was designed to test the effectiveness of microcomputer based reading CAI drill and practice with young children.

Materials

Educational software used to deliver CAI were *The Math Machine* (Watkins, 1981) and *The Reading Machine* (Watkins, 1982). Both programs were classified as drill and practice. They were selected because they contained a positive reinforcement component to ensure student motivation, because their multiple skill levels closely fit the regular curriculum, and because they provided management and record keeping so that teachers could monitor and direct student progress. *The Reading Machine* was also chosen because it used high resolution graphics pictures keyed to phonic concepts and thus reflected a primarily phonic approach to beginning reading (Chall, 1967; Resnick, 1978; Pflaum, 1980). Previous research with *The Math Machine* has demonstrated its effectiveness with elementary-aged special needs pupils (McDermott & Watkins, 1983; Millman, 1984). Regular classroom instruction included the Addison-Wesley Basal Reading Program and the Holt mathematics series.

Procedure

The complete first grade class of a suburban elementary school (47 females and 56 males) served as subjects for this investigation. Students were pre-tested with the Iowa Tests of Basic Skills (ITBS) reading and math subtests and the Cognitive Abilities Test. They were post-tested with the ITBS reading subtest, the California Achievement Test (CAT) math computation subtest and a school district criterion-referenced math computation test.

The project began operation in October, 1982 and continued for 12 weeks. A computer laboratory was established at the target school. The lab contained 10 Apple II+ microcomputers, each with a color television monitor and a disk drive. While in the lab, students were supervised by a trained paraprofessional.

Children were assigned to CAI reading and CAI math treatment groups via stratified random sampling where sex and ability level served as stratification variables. Each student spent 45 minutes per week, broken into three 15-minute sessions, participating in CAI reading or CAI math. On the average, the math CAI group received 486 minutes of math CAI and the reading CAI group received 492 minutes of reading CAI over the course of the project. Computer-assisted instruction was used to replace an equivalent amount of regular classroom instruction without a corresponding increase in total instructional time. That is, students received similar amounts of instruction in reading and math with the reading CAI group receiving a portion of their instruction via reading CAI and the math CAI group receiving a portion of their math via math CAI. Classroom teachers reviewed student progress once per week and assigned CAI instructional objectives for the coming week. The project paraprofessional entered program changes and maintained project records.

Results

Raw ITBS reading scores were converted to NCE scores (standard scores with a mean of 50 and a standard deviation of 21) for data analysis. Because reading was the dependent variable, the math CAI group served as a placebo control for the reading CAI students.[1] Data analysis was accomplished via a two-way analysis of covariance (ANCOVA) with treatment group (reading CAI versus math CAI) and sex serving as factors, ITBS pre-test reading and Cognitive Ability Test scores serving as covariates, and ITBS post-test reading scores serving as the dependent variable. A main effect for treatment group ($F = 2.25$; $df = 5,97$) approached traditional levels of significance ($p < .13$).

Based upon the parameters of this experiment, statistical power was calculated at approximately .5 (Hopkins, Coulter & Hopkins, 1981). That is, real group differences would be statistically detected only 50 percent of the time. To better ascertain the meaning of these results, difference or gain scores were calculated by subtracting pre-test reading scores from post-test reading scores for each subject. Mean gain scores for boys and girls in both treatment groups are presented in Table 1. Silbert, Carnine and Stein (1981) defined an "educationally significant difference" as one-fourth of a standard deviation. Table 1 reveals educationally significant results for reading CAI when this criterion is applied. It is also apparent from Table 1 that boys and girls profited equally from computer-assisted instruction in reading.

Table 1

ITBS Reading NCE Difference Score Means by Treatment Group and Sex

	Male	Female	Total
Math CAI	1.29	2.25	1.71
Reading CAI	9.19	9.78	9.47
Total	5.24	6.25	

An alternative method of describing the educational results of this study is the meta-analytic effect size (ES) statistic (McGaw & Glass, 1980). The ES provides a measure of treatment effect, which is independent of statistical significance, by transforming findings into a standardized mean difference (Kavale & Mattson, 1983). The ES statistic is comparable to a z-score and allows a similar interpretation. An ES of .363 was calculated by subtracting group mean difference scores and dividing by the post-test reading standard deviation of the math CAI group. This statistic indicates that reading CAI raised student reading achievement from the 50th to the 64th percentile and is consonant with the .3-.4 average ES found in reports of computer-based instruction at the elementary (Hartley, 1977; Ragosta, Holland & Jamison, 1981) and secondary levels (Kulik, Bangert & Williams, 1983).

Discussion

First grade students received beginning reading instruction for 45 minutes per week via microcomputer assisted drill and practice. After 12 weeks of CAI instruction, educationally significant results were apparent on the reading subtest of the ITBS. These results are consistent with older research reports which utilized large mainframe computers. Thus, microcomputer CAI appears to be as effective as instruction delivered via large, expensive computers. Additional research must be conducted to better define the results of CAI within varying populations and to ensure generalizability, but both academic and economic considerations seem to support the use of microcomputer-based reading CAI at the present time.

Academic implications of the current results are especially important for the instruction of boys in beginning reading skills. Boys performed as well or better

[1] Preliminary analysis of CAT and criterion referenced mathematics post-treatment scores via ANOVA resulted in statistically significant differences ($p < .01$ and .03, respectively) in favor of the math CAI group.

than girls on a reading test following CAI, which offers considerable promise for attacking the well-documented boy-girl differences in beginning reading skills (Bank, Biddle & Good, 1980). This use of computers to improve the reading skills of young boys is especially provocative given McNeil's (1964) findings that boys performed as well as girls when taught reading via mechanized programmed learning materials. **END**■

[Marley W. Watkins, SouthWest EdPsych Services, Inc., Phoenix, AZ; Sandra Abram, Deer Valley School District, Phoenix, AZ.]

References

Atkinson, R. "Computerized Instruction and the Learning Process." *American Psychologist,* 1968, 23, 225-239.

Atkinson, R. "Computerized Instruction and the Learning Process." In R. Atkinson & H. Wilson's (Eds) *Computer-assisted Instruction.* New York: Academic Press, 1969.

Bank, B.J., B.J. Biddle & T.L. Good. "Sex Roles, Classroom Instruction, and Reading Achievement." *Journal of Educational Psychology,* 1980, 72, 119-132.

Chall, J. *Learning to Read: The Great Debate.* New York: McGraw Hill, 1967.

Hartley, S.S. "Meta-analysis of the Effects of Individually Paced Instruction in Mathematics" (Doctoral dissertation, University of Colorado, 1977). Dissertation Abstracts International, 1978, 38(7-A), 4003.

Hopkins, K.D., D.K. Coulter & B.R. Hopkins. "Tables for Quick Power Estimates when Comparing Means." *Journal of Special Education,* 1981, 15, 389-394.

Kavale, K. & P.D. Mattson. "One Jumped Off the Balance Beam": Meta-analysis of perceptual-motor training. *Journal of Learning Disabilities,* 1983, 16, 165-173.

Knief, L. "Effects of Computer-based Instruction and Tutoring in an Elementary School System." *AEDS Proceedings,* 1979.

Kulik, J.A., R.L. Bangert & G.W. Williams. "Effects of Computer-based Teaching on Secondary School Students." *Journal of Educational Psychology,* 1983, 75, 19-26.

Litman, G. "Relation Between Computer-assisted Instruction and Reading Achievement Among Fourth, Fifth and Sixth Grade Students (Doctoral dissertation, 1977). Dissertation Abstracts International, 38, 2003A.

Majer, K. "Computer Assisted Instruction in Reading: How, What, When and Where?" *Educational Technology,* 1973, 23-27.

Mason, G. & J. Blanchard. "Computerizing Reading: A Review." *AEDS Proceedings,* 1978, 181-186.

McDermott, P.A. & M.W. Watkins. "Computerized vs. Conventional Remedial Instruction for Learning-disabled Pupils." *Journal of Special Education,* 1983, 17, 81-88.

McGaw, B. & G.V. Glass. "Choice of the Metric for Effect Size in Meta-analysis." *American Educational Research Journal,* 1980, 17, 325-337.

McNeil, J.D. "Programmed Instruction Versus Usual Classroom Procedures in Teaching Boys to Read." *American Educational Research Journal,* 1964, 1, 113-119.

Millman, P.G. "The Effects of Computer-assisted Instruction on Attention Deficits, Achievement, and Attitudes of Learning Disabled Children" (Doctoral dissertation, University of Virginia, 1984).

Pflaum, S. "Reading Instruction: A Quantitative Analysis." *Educational Researcher,* 1980, 9, 12-18.

Ragosta, M., P.W. Holland & D.T. Jamison (1981). "Computer-assisted Instruction and Compensatory Education; The ETS/LAUSD Study: Final Report." (ERIC Documentation Reproduction Service No. ED 222 169)

Resnick, L. (1978). "Theory and Practice in Beginning Reading Instruction." Pittsburgh: University of Pittsburgh, Learning Research and Development Center.

Silbert, J., D. Carnine & M. Stein. *Direct Instruction Mathematics.* Columbus: Merrill, 1981.

Slattow, G. (1976). "Demonstration of the PLATO IV Computer-based Education System: Final Report." (ERIC Document Reproduction Service No. ED 158 767)

Watkins, M.W. (1981). *The Math Machine* (Computer Program). Phoenix, SouthWest EdPsych Services.

Watkins, M.W. (1982). *The Reading Machine* (Computer Program). Phoenix, SouthWest EdPsych Services.