The Effectiveness of Education Technology for Enhancing Reading Achievement: A Meta-Analysis

Educator's Summary
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This review examines research on the effects of technology use on reading achievement in K-12 classrooms. It applies consistent inclusion standards to focus on studies that met high methodological standards. A total of 85 qualified studies based on over 60,000 K-12 participants were included in the final analysis. Four major categories of education technology are reviewed:

(1) **Computer-managed learning,** which included only *Accelerated Reader*. This program uses computers to assess students' reading levels, assigning reading materials at students' levels, scoring tests on those readings, and charting students' progress. Students do not work directly on the computer with *Accelerated Reader*.

(2) **Innovative technology applications,** such as *Fast ForWord*, *Reading Reels*, and *Lightspan.*

(3) **Comprehensive models,** such as *READ 180*, *Writing to Read*, and *Voyager Passport*. These programs use computer-assisted instruction along with non-computer activities as students' core reading approach.

(4) **Supplemental technology,** such as *Destination Reading*, *Plato Focus*, *Waterford*, and *WICAT*. These programs provide additional instruction at students' assessed levels of need to supplement traditional classroom instruction.

Review Methods

A literature search of articles written between 1970 and 2010 was carried out to find studies that met the following inclusion criteria:

- Students taught in classes using a given technology-assisted reading program had to be compared to randomly-assigned or well-matched control groups.

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- Pretest data had to be provided, unless studies used random assignment of at least 30 units (individuals, classes, or schools) and there were no indications of initial inequality. Studies with pretest differences of more than 50% of a standard deviation were excluded.

- Dependent measures needed to be quantitative measures of reading performance, such as standardized reading measures and informal reading assessments.

- Study duration had to be at least 12 weeks.

- Studies had to have at least two teachers in each condition to avoid possible teacher effect.

- Studied programs needed to be replicable in realistic school settings. Studies providing experimental classes with extraordinary amounts of assistance that could not be provided in ordinary applications were excluded.

Key Findings

Researchers examined the relationship between education technology effectiveness and five key study variables: grade levels, types of intervention, program intensity, level of implementation, and socio-economic status. Key findings were as follows:

Grade levels. Studies were organized in three grade levels: kindergarten (N=8), elementary (N=59), and secondary (N=18). The effect sizes for kindergarten, elementary, and the secondary level were +0.15, +0.10, and +0.31, respectively. The between-group difference (QB=9.52, df=2, $p<0.01$) was significant. The post hoc test suggests that the effect size at the secondary level was significantly higher than that at the kindergarten and elementary levels.

Types of intervention. In an analysis of the studies by program type, a marginally significant between-group effect (QB=7.15, df=3, $p<0.07$) was found, indicating some variations among the four intervention types (computer-managed learning, innovative technology applications, comprehensive models, and supplemental technology). Eighteen studies of comprehensive models produced the largest effect size, +0.28, and four computer-managed learning and six innovative technology application studies produced similar moderate effect sizes of +0.19 and +0.18, respectively. The average effect size for 57 studies of supplemental technology programs was only +0.11. The results of the analyses of computer-managed learning and innovative technology application data have to be considered carefully, however, due to the small number of studies in these categories.

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Program intensity. Program intensity was divided into two categories: low intensity (the use of technology less than 15 minutes a day or less than 75 minutes a week) and high intensity (over 15 minutes a day or 75 minutes a week). Analyzing the use of technology as a moderator variable, no significant difference was found between the two intensity categories (QB=3.04, df=1, p=0.08). This result suggests that more technology use does not necessarily result in better outcomes. The effect sizes for low and high intensity were +0.11 and +0.19, respectively.

Level of implementation. Significant differences were found among low, medium, and high levels of implementation as reported by the researchers. The mean effect sizes for low, medium, and high implementation were +0.01, +0.18, and, +0.22, respectively. Over half of the studies (53%) did not provide sufficient information about implementation. It is clear from the findings that no effect was found when implementation was described as low. A significant and positive effect was detected for groups that had a medium or high level of implementation rating. The implementation ratings must be considered cautiously, however, because authors who knew that there were no experimental-control differences may have described poor implementation as the reason, while those with positive effects might be less likely to describe implementation as poor.

Socio-economic status (SES). Studies were divided into three categories: low, mixed, and high SES. Low SES refers to studies that had 40% or more students receiving free and reduced-price lunch and high SES less than 40%. Four studies that involved a diverse population, including both low and high SES students, were excluded in these analyses. The p-value (0.31) of the test of heterogeneity in effect sizes suggests that the variance in the sample of effect sizes were within the range that could be expected based on sampling error alone. The effect sizes for low and high SES were +0.17 and +0.12, respectively, indicating a minimal effect of SES. In addition to the between-study comparison, we also looked at the differential impact of instructional technology on students with different SES backgrounds within studies. There were a total of ten studies identified. Findings showed that education technology had a slightly higher positive impact on low SES students with an average effect of +0.31, whereas the effect for high SES students was +0.20. Due to small numbers of studies, no significant difference was found between low SES and high SES groups.

Within-Study Subgroup Analyses

Subgroup analyses of comparisons within studies were also conducted to compute differential mean effect sizes based on student demographic characteristics such as student ability, gender, race, and language. Key findings were as follows:

Ability. Out of the 85 qualifying studies, there were a total of 13 studies that examined the impact of instructional technology on students with different academic abilities, yielding 29 effect sizes. The mean effect sizes for low, middle, and high ability students were +0.37, +0.27,

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and +0.08, respectively. The post hoc tests suggest that instructional technology had a more positive impact on low and middle ability students than it did on high ability students.

Gender. Instructional technology generated a more positive impact among males than females. The effect sizes for males and females were +0.28 and +0.12, respectively. No significant difference according to gender was found, however, due to low power.

Race. A total of seven studies examined the interaction effect of race with the use of education technology. The mean effect sizes for students who were African American, Hispanic, and White were +0.12, +0.42, and +0.11. The numbers of studies with each group was small, however, and there was only one study on a Hispanic population.

English Language Learners. Only three studies examined the effect of instructional technology on English language learners. The effect size was +0.29 ($p<0.05$).

Conclusions

Consistent with previous reviews of similar focus, the findings of this review suggest that education technology generally produces a positive, though small, effect (ES=+0.16) in comparison to traditional methods. However, the effects may vary by education technology type. In particular, the types of supplementary computer-assisted instruction programs that have dominated the classroom use of education technology in the past few decades are not producing educationally meaningful effects in reading for K-12 students. In contrast, innovative technology applications and integrated literacy interventions with the support of extensive professional development showed somewhat promising evidence. However, too few randomized studies for these promising approaches are available at this point for firm conclusions.

Full Report

Cheung, A., Slavin, R.E. (2011, May). *The Effectiveness of Education Technology for Enhancing Reading Achievement: A Meta-Analysis*. Baltimore, MD: Johns Hopkins University, Center for Research and Reform in Education.

The full report can be downloaded at www.bestevidence.org/reading/tech/tech.html

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