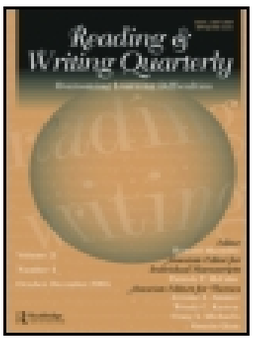

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Evaluations of Technology-Assisted Small-Group Tutoring for Struggling Readers

Nancy A. Madden[1,2] and Robert E. Slavin[1,2]

[1]Success for All Foundation, Baltimore, Maryland, USA; [2]Johns Hopkins University, Baltimore, Maryland, USA

ABSTRACT

This article reports on 2 experiments in inner-city Baltimore evaluating a computer-assisted tutoring approach, Tutoring With Alphie (TWA), in which 1 paraprofessional can work with up to 6 children at a time. In Study 1, we randomly assigned 14 schools to receive TWA or to continue with whatever approaches they were currently using. Each experimental school ($n = 8$) received a half-time paraprofessional tutor. Struggling readers in the lowest 30% of Grades 1–3 received tutoring using TWA. In comparison to control schools ($n = 6$), reading outcomes strongly favored TWA (effect size $= +0.46$, $p < .01$). In Study 2, new students in 7 of the 8 TWA schools received tutoring, and 6 schools continued as controls. Results again favored the TWA group (effect size $= +0.40$, $p < .001$). The findings support the effectiveness and cost-effectiveness of using technology to offer tutoring to many more students than could have received it individually.

Over the past 25 years, there have been extraordinary developments in research, policy, and practice relating to programs for elementary-age children who are struggling to learn to read. Although there has long been concern about reading disabilities, dyslexia, and underachievement, research and development since the 1980s has created a sense of optimism that most children who start off their time in school struggling to learn to read can be quickly brought into the mainstream in this crucial skill. A focus in special education on response to intervention (see Allington & Walmsey, 2007; Fuchs & Fuchs, 2006; Gersten et al., 2009), in which at-risk children often receive small-group interventions and then possibly one-to-one tutoring in an attempt to solve their problems before they are referred to special education, has encouraged development and research on small-group as well as individual tutoring. A widespread policy focus on reading by third grade has intensified interest in early reading interventions, especially in the states that have passed legislation requiring that third graders not reading at grade level be retained.

The importance of getting children off to a good start in reading is clear. For example, research has shown that children reading below grade level in third grade are 4 times as likely as other students to drop out before high school graduation (Lesnick, Goerge, Smithgall, & Gwynne, 2010). In the elementary grades, success in school is virtually synonymous with success in reading, and children without strong reading skills by middle school are headed for serious difficulty. Children who fail to read in the early grades incur so many costs to the education system in special education, remediation, grade repetition, delinquency, and ultimate dropout that even very expensive interventions can be justified on the grounds of cost-effectiveness alone while at the same time preventing damage to young peoples' lives (National Reading Panel, 2000). Furthermore, reading failure is concentrated among schools serving many disadvantaged, minority, and limited English proficient children. On the 2015 fourth-grade National Assessment of Educational Progress (National Center for Education Statistics, 2016), 21% of White fourth graders achieved below the basic level but 48% of African

CONTACT Robert E. Slavin rslavin@jhu.edu; rslavin@successforall.org Success for All Foundation, 300 East Joppa Road, Suite 500, Baltimore, MD 21286, USA.

American, 45% of Hispanic, and 48% of American Indian children scored at this very low level. Among students qualifying for free lunch, 44% scored below basic in comparison to 17% of students who did not qualify for free lunch.

Because of the importance of ensuring success in reading for all children, the policy focus on the problem, and the costs of reading failure, it is especially important to offer schools effective and cost-effective solutions likely to have a strong and lasting impact on the reading success of struggling children.

Many studies have found positive effects of one-to-one tutoring on the reading performance of struggling readers, especially when tutoring is provided by certified teachers (see the systematic review by Slavin, Lake, Davis, & Madden, 2011). The average effect size (ES) for one-to-one tutoring by certified teachers was found to be +0.38. Much of the research has focused on Reading Recovery, which is clearly effective but has been questioned in terms of its cost-effectiveness (Shanahan & Barr, 1995). Other one-to-one tutoring models with a strong phonetic emphasis have also had positive effects on reading for struggling readers, averaging an ES of +0.69 (Slavin et al., 2011). Small-group phonetic methods have also been effective but much less so than one-to-one tutoring by certified teachers. Slavin et al. (2011) estimated a mean ES of +0.31 for such models. There remains a need for small-group models in which many children can be effectively tutored and achieve results like those typical with the best one-to-one tutoring methods. The National Assessment of Educational Progress results show that there are far too many children struggling to read, especially among disadvantaged and minority students, for one-to-one tutoring to be a practical response for the great majority. Effective strategies capable of effectively serving many children at a time are essential.

Technology offers new approaches for enhancing the effectiveness of tutoring. Computer-mediated instruction software used without human tutors has not been found to be very effective with struggling readers (Cheung & Slavin, 2013; Slavin et al., 2011), perhaps because existing approaches limit a child's responses to those that can be made by pressing a key (instead of reading aloud). Because tutors can hear children read and help them sound out words and comprehend sentences and paragraphs, technology may have greater promise for making human tutors more impactful than for replacing tutors.

Studies of strategies combining human tutors with technology have shown strong positive effects. Chambers, Abrami, et al. (2008; see also Chambers, Slavin, et al., 2008) carried out a study that examined the effectiveness of technology-assisted one-to-one tutoring. A total of 159 first graders from two high-poverty schools using the Success for All (SFA) whole-school reform approach (Slavin, Madden, Chambers, & Haxby, 2009) were randomly assigned to technology or nontechnology conditions in a year-long study. In the treatment condition, all students were instructed in reading using Alphie's Alley, a computer-assisted one-to-one tutoring program aligned with the SFA curriculum. A paraprofessional tutor worked with each child for 20 min daily. Students in the control group used the regular SFA tutoring without the technology components. At the end of the study, the tutored students in the computer-assisted tutoring group significantly and substantially outperformed their counterparts in the control group on all five reading outcome measures: Letter-Word Identification (ES = +0.47), Word Attack (ES = +0.39), Gray Oral Reading Test (GORT) Fluency (ES = +0.58), GORT Comprehension (ES = +1.02), and GORT Total (ES = +0.76). The overall ES was +0.64.

Chambers et al. (2011) compared the relative effects of Team Alphie, a small-group technology-assisted tutoring approach, to one-to-one tutoring without technology. More than 300 first- and second-grade struggling readers were identified from 33 high-poverty SFA schools in nine states to participate in the study. Schools were randomly assigned to implement either Team Alphie or regular (nontechnology) SFA one-to-one tutoring for a year. Students in the control group received the nontechnology tutoring in a one-to-one format. The idea was to see whether computer-assisted tutoring to small groups could be as effective as one-to-one tutoring, thereby making tutoring more cost-effective. It is surprising that after adjustment for initial differences, first graders in the treatment group scored significantly higher than the children taught one to one without technology on all three measures: Woodcock Letter-Word Identification (ES = +0.17), Word Attack (ES = +0.21), and Passage Comprehension (ES = +0.15). For second graders, the one-to-one and small-group-with-computer approaches were equally effective.

One-to-one tutoring is clearly very effective for struggling readers, especially when the tutor is a specially trained certified teacher, but such programs are very expensive. The most widely used one-to-one program of this kind is Reading Recovery (Pinnell, Lyons, DeFord, Bryk, & Seltzer, 1994). The program provides extensive professional development for certified teacher tutors, who then work with first graders who are reading below grade level, providing about sixty 30-min daily lessons to each. Research on Reading Recovery has been extensive, with a mean ES of about +0.36 across 10 high-quality studies (Slavin et al., 2011).

Lindamood Tutoring also provides one-to-one tutoring using teachers or aides. One major study of this approach found very positive outcomes (Torgesen, Wagner, & Rashotte, 1997). Less widely used one-to-one programs have also had positive effects in evaluations. These include the Howard Street Tutoring Program (Morris, Tyner, & Perney, 2000), Reading Rescue (Ehri, Dreyer, Flugman, & Gross, 2007), and Targeted Reading Intervention (Vernon-Feagans et al., 2009). All have had positive effects like those of Reading Recovery. A one-to-one program that uses paraprofessionals as tutors, Sound Partners (Vadasy, Sanders, & Tudor, 2007), has been well evaluated and found to be particularly effective.

One widespread approach to providing one-to-one tutoring cost-effectively is to use volunteers as tutors. Two large randomized evaluations of volunteer tutoring models, Experience Corps (Morrow-Howell, Jonsen-Reid, McCrary, Lee, & Spitznagel, 2009) and Teaching Partners (Jacob et al., 2015), both found statistically significant but small impacts, with ESs around +0.10.

Studies of widely used small-group tutoring models have found effects that are much smaller than those for one-to-one models (What Works Clearinghouse, 2009). These include Corrective Reading, Spell Read, Wilson Reading, and Failure Free Reading, all of which had ESs of less than +0.20 in a large randomized study by Torgesen et al. (2007). Studies of Quick Reads (Vadasy & Sanders, 2008) showed ESs of around +0.20. Small-group adaptations of Lindamood (Torgesen et al., 2009) and Voyager Passport (Ehri et al., 2007) found ESs of around +0.30.

Tutoring with Alphie (TWA)

The present study was undertaken to evaluate the current form of the technology-assisted tutoring model created by the Success for All Foundation for use in its comprehensive school reform model. The small-group tutoring approach, TWA, uses paraprofessionals to work with up to six children at a time. Tutors work half-day schedules in the middle of the school day, starting after a 90-min reading period, and assist approximately 30 children in groups of six each day.

TWA is a distinctive approach to small-group tutoring incorporating the following elements.

Tutor

Paraprofessional tutors with training from the Success for All Foundation work with children in Grades 1–3 who are significantly below grade level in reading. The tutors first carefully assess all children to place them in groups and pairs using SFA assessments. In tutoring sessions, tutors read individually with students to help them with problems, ensure that children are working well with each other, help children who get stuck, and assess children's mastery of specific skills when directed to do so by a green flag on the computer screen indicating that a child is ready. The computer displays a red flag if students are having difficulties at any point in the process, and tutors help students with whatever problem they are having. Tutors also help students stay on task, encourage them to help each other, and keep the process going efficiently.

Tutoring sessions

Children work 30 min each day in groups of six, sharing three laptops. Tutoring takes place in any small teaching space in the school.

Children at similar reading levels work in pairs, alternating roles as coach and player. For instance, the player reads sounds, words, or phrases presented by a character on the computer; an animated

narrator reads the correct answers; and the coach indicates on a keypad whether the player's response is right or wrong. The computer shows the word *bike*, for example, and the player is asked by an animated character to read the word. The animated narrator then says, "Did your partner say 'bike'?" and the coach indicates correct or incorrect. When questions can be typed, the player types them. As children reach a certain point in the sequence of activities, a green flag appears in the corner of the screen, as noted previously. The tutor sees it and takes each partner aside for an assessment of the skills they have just covered. This provides an external check on the accuracy of the coaches' responses and gives the tutor an opportunity to ensure that children are making good progress.

Leveled, phonetic readers are provided on screen to children. When prompted by the computer, pairs of children take turns reading back and forth to each other, alternating pages, and giving each other feedback and help supported by clickable clues on the screen. Students then answer questions about the books. These activities prepare the children to read to the tutor and answer questions, and the pair receive points toward celebrations based on their success.

Cooperative learning

Children work in pairs to help each other through the materials, taking turns as player and coach. Cooperative learning has long been known to enhance student motivation and achievement (Slavin, 2013; Webb, 2008).

Integration of technology and human tutoring

Tutoring to individuals and small groups by teachers and paraprofessionals can be very effective for struggling readers (Slavin et al., 2011). Adding computer-assisted pair learning is designed to organize the pair activities, ensure that all elements of reading are appropriately introduced, and assist in assessing progress. The computer activities enable tutors to teach up to six students at a time, greatly increasing cost-effectiveness. However, unlike ordinary computer-assisted instruction, TWA provides a human tutor to help ensure that students are making good progress, to assist students when they get stuck, to keep students motivated and on task, and to assess students' progress as a check on assessments embedded in the program.

Computer-assisted tutoring infused with video

The TWA software includes engaging, humorous video content to motivate and excite students.

Threaded throughout the lesson sequences, video content is designed to model letter sounds, sound blending, letter substitutions, long-word strategies, comprehension skills, and vocabulary. In each case, humorous puppets or talking and singing cartoon characters introduce the skills. The tutor awards points to the partnership based on how each partner is doing on these independent assessments, and the points lead to opportunities for celebrations, in which students may earn stickers, perform cheers, sing songs, or jump to higher levels.

Computer-assisted assessment, recordkeeping, and placement

Like any computer-assisted instruction approach, TWA carries out regular assessments and summarizes assessment outcomes to facilitate placement decisions made by teachers and tutors.

The TWA program was evaluated in two studies in inner-city Baltimore.

Study 1

Methods

Subjects

The subjects in Study 1 were students in Grades 1–3 in 14 schools using SFA in the Baltimore City Public Schools. Principals volunteered their schools for participation in the project, and the schools

were then randomly assigned to experimental or control conditions from November 2013 to May 2014. Experimental schools ($n = 8$) received a half-time paraprofessional tutor to add to their school staff, paid for by Baltimore's Abell Foundation. Control schools ($n = 6$) were encouraged to use their existing staff to do as much tutoring as they could, as tutoring is a standard part of the SFA design. However, little tutoring was in fact done in the control schools. The fact that all schools were implementing SFA and that schools were randomly assigned to conditions made it highly likely that experimental and control schools were using very similar approaches other than the technology-assisted tutoring.

The 14 schools served very disadvantaged populations. Almost all students qualified for free or reduced-price lunches, and almost all were African American or Hispanic.

Within schools, participating students were those scoring in the lowest 30% of their grade levels at pretest and were in Grades 1, 2, or 3. Students who were considered to have received the tutoring were those who received at least 15 tutoring sessions over the course of the school year.

Measures

The reading measure used to assess program outcomes was a standard assessment used in all SFA schools combined with evidence of progress from classwork and teacher observation. The data were collected by classroom teachers, not by tutors, and were collected in the same way at experimental and control schools, as this measure and assessment strategy are central to all SFA schools. The assessment is given four times a year and consists of individually administered tests of word attack, letter-word identification, fluency, and comprehension, as appropriate to each grade level. The combination of the formal assessment and the classroom indicators produces a single indicator of reading level. Reading levels were obtained at the beginning and end of the school year for use in assessing the tutoring intervention.

Analyses

Data were analyzed using analysis of covariance, with pretests as covariates.

Results

The Study 1 results are summarized in Table 1. Table entries are scores in grade equivalents at pretest (November 2013) and posttest (May 2014). Students were well matched overall (ES = 0.00). At posttest, adjusted for pretests, tutored students scored 38% of a grade equivalent higher than controls (ES = +0.46, $p < .01$). First graders scored 17% of a grade equivalent higher than controls (ES = +0.38, $p < .05$). The largest impacts were for second graders, who scored 58% of a grade

Table 1. Reading scores for TWA and control students, in grade equivalents, Study 1.

		Pre		Post		
Group	*N*	*M* (*SD*)	ES	*M* (*SD*)	Adjusted post	ES
All grades						
TWA	127	1.01 (0.44)	0.00	2.14 (0.90)	2.17	+0.46**
Control	309	1.02 (0.45)		1.80 (0.82)	1.79	
Grade 1						
TWA	53	0.91 (0.14)	0.10	1.63 (0.35)	1.61	+0.38*
Control	140	0.90 (0.10)		1.44 (0.46)	1.44	
Grade 2						
TWA	46	1.02 (0.31)	−0.13	2.27 (0.77)	2.29	+0.74*
Control	78	1.08 (0.39)		1.73 (0.73)	1.72	
Grade 3						
TWA	28	1.55 (0.70)	0.26	2.89 (1.18)	2.78	+0.43*
Control	91	1.40 (0.59)		2.40 (0.81)	2.43	

Note. TWA = Tutoring With Alphie; ES = effect size.
*$p < .05$. **$p < .01$.

equivalent higher than controls (ES = +0.74, $p < .05$). Third graders scored 35% of a grade level higher than controls (ES = +0.43, $p < .05$).

Study 2

Methods

Subjects

The subjects in Study 2 were students in 13 of the same 14 Baltimore City schools involved in Study 1. One experimental school dropped out, leaving seven experimental and six control schools. Schools randomly assigned to receive tutoring in Study 1 also received it in Study 2, but almost all of the students who received tutoring in Study 2 had not received it in Study 1. All but one of the half-time tutors in Study 2 were new to the project.

In the experimental schools, tutoring was provided every day from October 2014 to May 2015. However, many students were excused from tutoring as they caught up to grade level and were replaced by other students in greater need of assistance. Students were considered to have been tutored if they received at least 15 sessions. Control students were individually matched to tutored children based on pretest scores before posttest scores were known.

Measures

The measures in Study 2 were the same as those used in Study 1.

Analyses

As in Study 1, data were analyzed using analysis of covariance, with pretests as covariates.

Results

The results of Study 2 are summarized in Table 2. TWA and control groups were well matched at pretest (ES = +0.03). Overall, posttest outcomes, adjusted for pretests, were quite similar to those of Study 1. Including all students the ES was +0.40 ($p < .001$). Effects were smallest in first grade (ES = +0.22, $p < .07$) but larger for second graders (ES = +0.46, $p < .001$) and third graders (ES = +0.94, $p < .001$). Adjusted grade-equivalent differences were 9% in first grade, 23% in second grade, 41% in third grade, and 25% overall.

Table 2. Reading scores for TWA and control students, in grade equivalents, Study 2.

		Pre		Post		
Group	*N*	*M* (*SD*)	ES	*M* (*SD*)	Adjusted post	ES
All grades						
TWA	242	1.60 (0.41)	−0.03	2.35 (0.87)	2.36	+0.40***
Control	236	1.61 (0.42)		2.10 (0.68)	2.09	
Grade 1						
TWA	105	1.05 (0.20)	0.10	1.74 (0.47)	1.75	+0.22†
Control	103	1.07 (0.24)		1.68 (0.41)	1.66	
Grade 2						
TWA	71	1.77 (0.57)	−0.13	2.42 (0.56)	2.38	+0.46***
Control	69	1.66 (0.48)		2.11 (0.51)	2.15	
Grade 3						
TWA	66	2.28 (0.58)	0.26	3.24 (0.85)	3.31	+0.94***
Control	64	2.44 (0.65)		2.76 (0.67)	2.69	

Note. TWA = Tutoring With Alphie; ES = effect size.
†$p < .10$. ***$p < .001$.

Discussion

The results reported here show substantial impacts of a technology-assisted tutoring model, TWA. For the students who received tutoring, effects of treatment averaged +0.38 overall in Study 1 and +0.40 overall in Study 2. These ESs are very similar to the average effects of one-to-one tutoring by certified teachers as reported by Slavin et al. (2011). The gains were obtained at modest cost. The cost per tutored child was estimated at $400. This was almost entirely due to the cost of paying the half-time tutors, so for a school that already has paraprofessionals available to work as tutors, the cost of TWA would be very small.

It is interesting to note that in both studies, ESs were larger in Grades 2 and 3 than in Grade 1. Averaging across the studies, ESs were +0.30 for Grade 1, +0.60 for Grade 2, and +0.69 in Grade 3. One possible reason for the large impacts in Grades 2 and 3 could be that at those grade levels, students started off further behind and had greater room to grow. Because tutors were able to work with so many students (compared to one-to-one tutoring), many of the first graders who received tutoring were not so far below grade level, whereas second and third graders were much further behind their expected grade levels. Still, this is only speculation, and these differential effects might be an interesting focus for future research.

As the need to ensure reading success for every child becomes more clear, there is a corresponding need to have available programs that can be used with paraprofessionals and small groups to reach large numbers of students at an affordable cost. TWA offers one model of a means of doing this using sophisticated software on widely available technology. At present, the approach has only been evaluated within SFA schools, but it is now important to design and evaluate a related approach that can be used in any school.

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