

# Computer Assisted Instruction: Successful Only with Proper Implementation

by Paul Macaruso and Pamela E. Hook

The use of computer software programs can have a positive impact on the development of literacy skills (for review, see Blok, Oostdam, Otter, & Overmaat, 2002). In particular, computer programs may be especially beneficial for low performing students by providing the opportunity for ample practice of skills (e.g., Macaruso, Hook, & McCabe, 2006a; Torgesen & Barker, 1995; Wise, Ring, & Olson, 2000). However, regardless of how carefully constructed and effective intervention approaches of any type may be, without appropriate implementation, children will not benefit from them. Unfortunately, educators implementing computer programs often face significant challenges (Conlon & Simpson, 2003; Van Dusen & Worthen, 1994).

This article highlights three key challenges to effective implementation. The first challenge is for the school systems to provide sufficient technical support to run the software programs. The second is to ensure that the software programs are integrated properly into the reading curriculum. But even if these two challenges are met, the efficacy of the software hinges on meeting a third challenge, which is establishing sufficient use of the software programs by the students. This third challenge is the focus of this article and will be discussed in the context of two research studies—one with a high-use pattern and the second with weaker use.

## Challenge 1: Provide sufficient technical support

One of the initial challenges with regard to implementing computer programs in schools centers on the technology itself (Sandholtz, 2001). As Conlon & Simpson (2003) suggest, “infrastructure deficiencies,” particularly in technical support, decrease the effective use of computer programs in schools. Teachers without much technical expertise may find themselves in a bind trying to install the programs and troubleshoot problems.

Often teachers may hesitate to invest time to learn how to use the programs for fear that they may run into technical difficulties and find themselves at an impasse. Sandholtz & Reilly (2004) address one solution to this concern in a case study of a school district near San Diego, California. This district utilizes a centralized, server-based network maintained by a well-trained staff of skilled technicians. In this context, teachers are not expected to be experts in technology; they call upon the technical staff to han-

dle hardware and installation concerns. Teachers are then free to spend their time finding constructive ways to utilize the programs with their students.

## Challenge 2: Properly integrate software into the curriculum

Cuban (2001) highlights a second key challenge, which is the degree to which teachers are invested in using the software programs in their classes. According to Conlon and Simpson (2003), insufficient professional development in which teachers learn how to integrate software programs into their curriculum is often a deterrent to successful implementation. Given extensive demands on their time and limited training, teachers may not put the necessary effort into learning the new programs and trying to incorporate them into their daily instruction. This issue comes to the forefront in the contrasting findings of Paterson, Henry, O’Quin, Ceprano, and Blue (2003) and Cassidy and Smith (2005). Both studies investigated the benefits of Waterford Early Reading Program (WERP) in early elementary grades. WERP provides computer-based instruction in five essential areas of reading—phonemic

skills, such as sound segmenting and blending, phonics skills, vocabulary, fluency, and comprehension. The program is designed for independent use, making use of self-paced activities and immediate feedback. Paterson et al. (2003) reported a null result—no differences in early literacy skills between children in WERP classes and children in control classes. As Cassidy and Smith (2005) pointed out, a main factor contributing to the null outcome is the fact that teachers in the Paterson et al. study showed low

effort to integrate WERP into their literacy instruction. In contrast, the teachers in the Cassidy and Smith study (2005) specifically selected WERP because of its compatibility with their existing literacy curriculum. Cassidy and Smith found significant gains in reading achievement for classes receiving WERP compared to control classes, and that benefits were most pronounced for children with the lowest initial reading levels (see also Hecht & Close, 2002).

## Challenge 3: Establish strong use patterns

**High use.** A recently published study by Macaruso et al. (2006a; see also Macaruso & Walker, in press) illustrates successful implementation of computer software with good technical support, alignment of the software with the curriculum, and high use. The study participants were first-grade students in an urban public school district outside of Boston, Massachusetts. The students received daily phonics lessons based on *Scott Foresman Reading* (McFall, 2000) and *Bradley Reading and Language Arts* (Bradley, 1999). *Scott Foresman Reading*

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is a comprehensive program that includes activities in phonemic awareness, fluency, vocabulary, and comprehension. *Bradley Reading and Language Arts* is a multisensory, systematic, explicit phonics program. The software programs called *Phonics Based Reading and Strategies for Older Students* (Lexia Learning Systems, 2001) were designed to supplement this classroom instruction. The Lexia programs contain numerous activities that support learning and application of phonics word-attack strategies at the letter, word, sentence, and paragraph levels to enhance automatic word recognition. Phonological awareness is taught in conjunction with these phonic word-attack strategies. The activities make use of visual graphics and are highly interactive, often requiring timed motor responses followed by immediate feedback. Students can work to improve their time through repetition of the same activity. The activities branch automatically, based on the student's individual performance, reviewing when necessary and moving to more advanced items when students have mastered the easier ones. Figure 1 shows screen shots of two of the activities: the first addresses phonemic awareness and letter-sound correspondences (the child hears the word and pulls down the letters to segment it into sounds), and the second activity involves finding the correct vowel combination to complete a dictated word.

The Lexia programs were installed on the networks in each school building and mapped to individual classroom and laboratory stations. Successful installment required the active involvement and support of the district's technical staff. Nearly all of the program use occurred in laboratory setups. Teachers in the treatment classes and staff members in the computer lab took part in orientation and training sessions for software implementation. The orientation session introduced the contents of the products, the basic use of the program features, and a description of the research project. The initial trainings were relatively brief, approximately 1 hour, and executed in both small and large groups. A second phase of training consisted of visits to each building

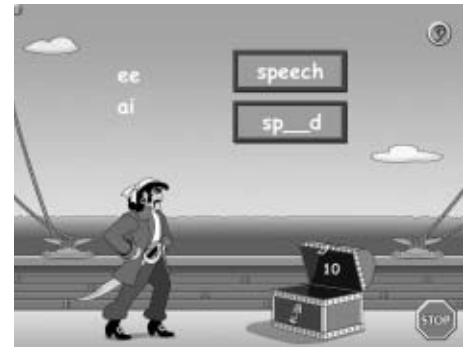
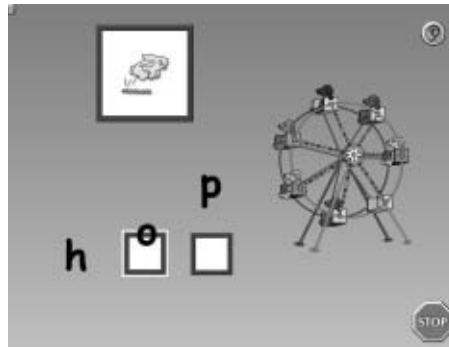


Figure 1. Screen shots of two activities from the Lexia programs.

approximately 6 weeks after the launch of the program to familiarize teachers with the program's reporting features and to address outstanding questions; follow-up trainings were generally informal, one-on-one or small group sessions.

The software is designed for regular weekly use (two to four weekly sessions of 20–30 minutes each). Based on these guidelines, we considered the completion of 60 or more sessions over the school year to reflect high use, and the completion of 40–60 sessions to constitute moderate use. Completion of 60 sessions is equivalent to approximately 25 hours of computer use. Nearly all students in this study showed moderate or high use—the mean number of sessions completed was 64 with a range of 37–91 sessions.

Initial results of the study indicated that students in treatment classes with the Lexia programs, and in control classes, all made significant gains in reading. Scores on the *Gates-MacGinitie Reading Test* (MacGinitie, MacGinitie, Maria, & Dreyer, 2000) improved from a mean of 46.4 at pretest to a mean of 62.7 at post-test for students in the treatment classes and from a mean of 49.0 at

pretest to a mean of 61.4 at post-test for students in control classes. (Scores on the *Gates-MacGinitie* are normal curve equivalent (NCE) scores that have a mean of 50 and standard deviation of 21.1). These significant gains indicate that students in all classes were receiving effective reading instruction in school. Subsequent analyses revealed, however, that when low-performing students eligible for Title I services were examined separately, they showed particular benefits from using the Lexia programs. Post-test scores of Title I students in treatment classes were significantly greater than post-test scores of Title I students in control classes. In fact, Title I students in treatment classes improved so much that at post-test they caught up to the non-Title I students in treatment classes (see Figures 2a and 2b).

**Weak use.** In a recently completed study, Macaruso, Hook, and McCabe (2006b) attempted to replicate and extend the findings of Macaruso et al. (2006a) by examining the effects of Lexia program use across grades 1–3 in the same school district. However, weak use patterns marred the results. In particular,

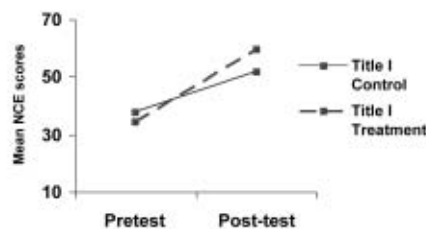


Figure 2a. A comparison of pre- and post-test reading scores for Title I students in control and treatment classes.

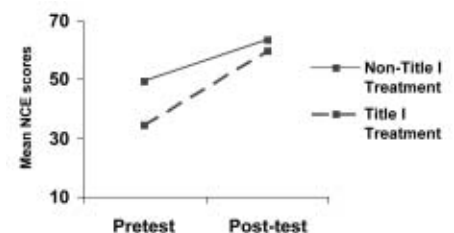


Figure 2b. A comparison of pre- and post-test reading scores for non-Title I and Title I students in treatment classes.

the results obtained for grades 1 and 3 were compromised by the fact that the vast majority of students completed fewer than 40 sessions (17 hours) over the school year. In the initial Macaruso et al. study (2006a), the low performing first-grade students with moderate to high use made significantly greater reading gains than the low performing first-grade students in control classes. Unfortunately, the current sample of first-grade students did not include enough low performers with moderate to high use to conduct a meaningful analysis. For grade 3, students with moderate to high use produced greater gains in reading comprehension than students with weak use and the control students; however, the number of moderate to high users was too small to result in a significant reading gain.

In contrast to grades 1 and 3, enough students in grade 2 had moderate to high use to show significant benefits of the Lexia programs. In particular, students with moderate to high use produced significantly greater gains in word decoding than students with weak use (see Figure 3). These significant gains in word decoding were expected given that the Lexia programs were designed to provide structured exercises for enhancing phonics skills. These findings are consistent with others showing that practice with phonics-based computer programs can benefit word decoding (Wise et al., 2000). However, significant gains were not found on the word knowledge or comprehension subtests for the second-grade students. It is possible that gains in these areas surface at a later point in development once decoding skills become automatic. The trend toward reading comprehension gains for third-grade students with moderate to high use is consistent with this possibility.

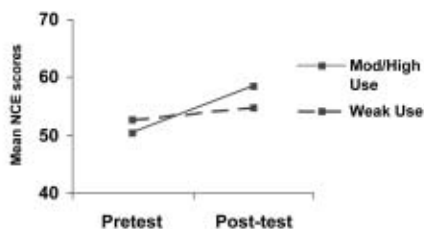


Figure 3. A comparison of pre- and post-test reading scores for students with moderate/high use and students with weak use.

To investigate the issue of weak use patterns in the Macaruso et al. (2006b) study, the second-grade teachers who participated in the study completed an implementation survey, in which they were asked to identify factors contributing to variations in use across classes. The one factor identified most often was lack of availability of the computer laboratory. Careful scheduling is required to assure that all students attend laboratory for a sufficient number of sessions per week. The number of classes requesting computer time slots often was close to the number of slots available during the school day. Poor class scheduling and

### *... low-performing students eligible for Title I services showed particular benefits.*

ineffective monitoring of individual student's schedules may have contributed to teachers reporting that the laboratory was not always available for their students. Two factors identified most often as contributing to variations in sessions completed by individual students within classes were absenteeism and attending out-of-class services (e.g., occupational therapy). According to a school administrator, lengthy absences were commonplace and often due to students visiting relatives out of state.

**Improving use patterns.** The fact that Macaruso et al. (2006b) was conducted on a larger scale than the initial study (Macaruso et al., 2006a) poses greater challenges for implementation. A large-scale implementation requires a greater degree of oversight to ensure that administrators, teachers, and support staff are all on board to get the programs running and available to students in a timely fashion. Priorities and extent of commitment may shift from year to year. In addition, it is much more challenging to monitor student use in the context of a large-scale compared to a small-scale implementation. In the earlier study, a member of the research team made weekly to biweekly school visits to check on student use and to question staff members when there

were signs of limited use. The follow-up study was conducted after Lexia use was established in the schools, and the research team did not consider it necessary to provide the same degree of monitoring as in the initial study. However, our results indicate that it is necessary to monitor program use carefully, even after a school demonstrates successful implementation of the software. Without the benefit of oversight from a research team, the responsibility for monitoring is likely to fall on the shoulders of school administrators. Likely candidates to oversee implementation and monitoring of computer use would be members of the curriculum staff who have instituted the computer programs as part of instruction.

In addition to ensuring that consistent monitoring and support from administration are in place, district- and school-level personnel could introduce further modifications to increase the number of computer sessions students are able to attend during the school year. First, every effort should be made to reduce unnecessary absences, such as requiring parents of students with poor attendance to meet with the school principal. Schedules should also be properly modified so that time allotted for computer use does not conflict with out-of-class services. To address the problem of lack of availability of the computer laboratory, additional funds might be needed to construct more laboratory space (equipped with more computers) or to provide extended day access to existing laboratories.

Another viable option is to equip classrooms with more computers so that students can access the software both in the laboratory and in the classroom. The latter option also addresses the problem of individual students missing computer sessions due to issues, such as absences and scheduling conflicts, as discussed above. It is often difficult to make up a missed session because it requires the student to leave the classroom and find an available computer in the laboratory, a highly unlikely possibility given so many constraints on schedules. As a means to increase use, students could be encouraged to spend more time in class engaged in computer-based activities. In addition, teachers could provide incentives for completing extra sessions within

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the class. It is important to keep in mind, though, that if students use more than one computer, it is much easier to ensure that they progress through the activities in a consistent manner if the computers are networked and share a central database. Having computers in the classroom is especially beneficial because it allows teachers to monitor computer use. Better supervision is possible with fewer students using the computers at any given time.

In the initial study, low performers with high use patterns made strong gains. This finding supports the current view that when developing intervention programs the intensity of instruction should be sensitive to the student's level of need and responsiveness to different types of instruction (Torgesen, 2004). Access to intensive program use for students with the greatest needs might occur more easily in the classroom than in a laboratory. In a classroom, the teacher has better control over how many times per week each student has access to a computer. Considering a differentiated instruction model that has learning centers within the classroom (Ribas, Deane, & Seider, 2005), computer activities could easily be included as one of the learning centers. At each center, students work on an activity either independently or in small groups while the teacher provides direct instruction to the other students. The automatic branching based on student performance that is characteristic of many software programs allows students to work independently at their own level and own rate. Students with the greatest needs may be assigned to groups that have frequent opportunities to visit the computer center each day. Further, these students may be encouraged to take part in extra computer sessions after school hours, at school and at home. The school-home connection can be further facilitated by making computer programs available via the Internet.

In conclusion, computer-assisted instruction has played and will continue to play an increasingly important role in

providing enhancement to instruction. It is critical, however, to be aware of the difficulties involved in appropriately implementing these programs, particularly on a large scale (insufficient administrative and technical support, lack of integration into the curriculum, and weak use), so educators can take proactive measures to ensure the best possible use of the software to obtain the best possible outcomes.

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