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Teacher Use of Computer-Assisted Instruction for Young Inattentive Students: Implications for Implementation and Teacher Preparation

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Abstract

Teacher preparation and training appear limited in the area of computer-assisted instruction (CAI) as well as more general instruction and management for students with disabilities including those with attention problems. Research suggests that CAI is a promising intervention for young inattentive students, with several inherent advantages; however, there are a number of implementation challenges that may interfere with more extensive and effective use in the classroom. Lessons learned from a recent randomized controlled trial of a CAI intervention highlight some of these challenges and suggest strategies for addressing them. Implications for instruction are discussed with regard to selection of appropriate CAI programs, integration into the classroom, and strengthening teachers' more general management skills for inattentive students. Recommendations for pre-service training and professional development in CAI are provided.

Keywords: computer-assisted instruction, inattention, implementation, teacher preparation

1. Introduction

Current federal education policies mandate evidence-based teaching practices for all students, including those with disabilities who may require more specialized instructional methods within the regular education setting (Smith, Robb, West, & Tyler, 2010). In order to prepare teachers to do this, research findings must be translated into teacher preparation curricula with regard to both the content of specific instructional practices as well as the implementation methods needed to utilize these practices effectively in the classroom. Unfortunately, only 63% of new teachers report that they have received education or professional development in using research-based findings to improve their teaching practices [National Comprehensive Center for Teacher Quality and Public Agenda (NCCTQ), 2008]. Perhaps more concerning is that less than half believe that their teacher preparation and training has adequately equipped them to teach students with special needs (NCCTQ, 2008).

One specific area where teacher preparation and practices appear to fall short is in the use of computer assisted instruction (CAI) for young students with attention problems who are at-risk for special education.Effective teacher education in this area is important given that up to 16% of elementary students display frequent inattention and/or poor concentration (Wolraich, Hannah, Baumgaertel, & Feurer, 1998) and that the ability to attend to instructional activities underlies academic functioning across multiple content areas. Indeed, attention problems compromise achievement (Merrell & Tymms 2001; Rabiner, Murray, Schmid, & Malone, 2004), predict the onset of reading difficulties (Rabiner, Coie, & CPPRG, 2000), and undermine traditional academic interventions such as tutoring (Rabiner, Malone, & CPPRG, 2004). Among students who meet criteria for Attention Deficit Hyperactivity Disorder (ADHD), up to 80% experience academic performance problems and 30-40% may be placed in special education (Barkley, Fischer, Smallish, & Fletcher, 2006).

This paper will examinecurrent practices in the use of CAI for this population and discuss implementation challenges within the context of a randomized controlled trial (Rabiner, Murray, Skinner, & Malone, 2010) of CAI and Computerized Attention Training (CAT) funded by the Institute of Educational Sciences (IES). Limitations of current teacher education in this area as well as in more general instructional management approaches for inattentive students are reviewed, and recommendations for pre-service and in-service training are made. Given the potential cost-savings

and dissemination advantages of computerized interventions in combination with the need for greater teacher education in this area, this is a timely and relevant topic.

1.1 CAI for Attention Problems

CAI appears to be a promising intervention for young students with attention problems or those who have identified disabilities such as ADHD. Data support the use of CAI for students with learning difficulties (Hall, Hughes, & Filbert, 2000; Mayes, Calhoun, & Cromwell, 2000) and there is evidence that it may decrease rates of off-task behavior in older students (Din, 1996). Young students have also been observed to be more actively engaged in learning when using software products as compared to more traditional instructional approaches (Dynarski et al., 2007). The National Reading Panel has noted that CAI can increase the amount of instructional time provided to at-risk readers in early elementary school (NICHD, 2000),many of whomalso experience attention problems (Merrell & Tymms 2001; Rabiner et al., 2000; Rabiner et al., 2004). And two small case studies identified academic and attentional benefits of CAI for elementary students with ADHD compared to traditional instruction (Clarfield & Stoner, 2005; Mautone, DuPaul, & Jitendra, 2005). More recently, a randomized controlled trial evaluating the efficacy of CAI for first graders with attention problemsand low cognitive functioning showed significant improvement in teacher-rated attention in addition to increased academic performance and reading fluency (Rabiner et al., 2010). Although overall intervention effects were not maintained into the next school year, there was sustained benefit for those students with the most severe attention problems. This study also evaluated a computerized attention-training program which was found to have less robust effects.

Computerized interventions have a number of inherent advantages relative to traditional instructional methods for young inattentive students, some of which are not unique to that population. First, they are able to immediately adjust to students' specific instructional levels and provide immediate and specific feedback such that the rate of learning is maximized. Second, instructional features (e.g., animation, interactive features) that are engaging to young children may improve time on task which enhances learning. For students with disabilities who have Individualized Educational Plans, or for those who are referred to pre-referral intervention teams, CAI may be considered an evidence-based educational intervention when it is well-matched to student need. As such, it may reduce the need for special education in later grades, which is significant given the chronic shortage of fully certified special education teachers (Boe & Cook, 2006) and the current fiscal environment of our public education system. Although software interventions do require some resources [average of $100 per student per school year not including needed upgrades to hardware, software, or operating systems (Dynarski et al., 2007)], CAI is actually less costly than the time required for certified teachers to provide small group instruction (considered the best-practice standard for struggling early readers).

1.2 Teacher CAI Practices

Unfortunately, teachers' use of CAI for young students appears limited and may not be utilized in ways that are of maximal benefit for at-risk learners. For example, a national study of first grade teachers across 43 schools and 11 districts showed that teachers randomly assigned to use designated reading software products averaged only 30 hours of use across a school year (approximately 11% of total instructional time) while control teachers averaged 10 hours of use of other products of their choice (Dynarski et al., 2007). This may not be sufficient for the at-risk inattentive student who fails to listen to teacher-led instruction and may benefit more from computerized instruction than traditional instruction. Such students may benefit from a higher proportion of time with computerized instruction or when it is provided as a supplement rather than replacing existing instruction. There is also indication that teachers' use of CAI may be limited to drill and practice games which are not of the same level of quality as some of the more recent software programs developed (Strudler, McKinney & Jones, 1999).

There are also a number of training and implementation challenges for teachers that must be considered if CAI is to be effectively incorporated into the classroom. Many teachers report a lack of confidence in integrating technology into their instruction (Teclehaimanot, Mentzer, & Hickman, 2011) and report that finding the extra planning time required to do so is a challenge (Bauer & Kenton, 2005). In addition to limitations in technical skills and/or available technical support, research suggests that teachers' attitudes towards computer technology may negatively impact their use (Lambert, Gong & Cuper, 2008). Perhaps more importantly, teachers may lack understanding of how to select specific software programs that meet individual students' learning needs, how to facilitate use by individual students within the larger classroom, and how to integrate CAI instruction with traditional instructional methods in a complimentary way. Unfortunately, teacher education does not appear to be adequately preparing teachers in the area of technology integration (Bauer & Kenton, 2005; Wozney, Venkatesh & Abrami, 2006).

2. Implementation of CAI within a Recent RCT

Project CLASS ("Children Learning Academic Success Skills") evaluated Destination Reading and Math (Riverdeep©) for 27 first graders across 5 schools in an afterschool program run by project staff twice per week for 14 weeks. Each

session lasted about 75 minutes with 50-60 minutes spent on computer exercises. This CAI programwas selected based on its consistency with guidelines from the Committee on the Prevention of Reading Difficulties (Snow, Burns, & Griffin, 1998) and the National Reading Panel (NICHD, 2000), evidence of effectiveness (DeLong-Cotty & Levenson, 2004; Riverdeep, 2003), and widespread use in schools. The sample was predominantly low-income and minority, with below average estimated cognitive abilities and stable teacher-rated attention problems (see Rabiner et al., 2010 for additional details).

In order to provide adequate technical and instructional assistance for a group of inattentive and cognitively low functioning young children, many of whom also exhibited disruptive and oppositional behavior,a very low student to counselor ratio (approximately 1:3) was utilized, with an average of 4-6 students per group. This level of supervision was considered necessary after our experience piloting the interventionwith groups of up to 9 students and a higher student to counselor ratio. School staff was included as counselors when possible to increase student comfort and connection with the program. After the pilot year, we also enhanced our behavior management and incentive systems to increase structure and reinforce appropriate learning behaviors. As a result of these implementation modifications, student engagement was enhanced and behavior challenges decreased, maximizing the potential impact of the CAI.

3. Implications for Instruction

3.1 Selection of Specific CAI Programs

Selection of a specific software product should be informed by existing research; however, identifying specific evidence-based programs and matching them to student needs may be challenging for educators given the wide range of programs that are commercially available and the increasing number of studies that may appear conflicting or are difficult to interpret. For example, although the What Works Clearinghouse (Department of Education, 2009) has identified two computerized reading programs for early learners with positive or potentially positive effects (Lexia Reading Program and *Earobics*®), a recent large-scale randomized trial of 7 different reading software programs conducted by the National Center for Education Evaluation (NCEE; Dynarski et al., 2007) did not find any significant achievement effects for first graders on standardized test scores. With regard to students with disabilities including attention problems, it is important to note that the NCEE study did not examine effects for at-risk (or inattentive) students who might be expected to experience greater benefits. This is an important point related to educators' abilities to interpret research findings that we will revisit shortly.

Some of the critical factors teachers need to consider in interpreting the extant literature are: how similar their students and classroom settings are to the study populations, how feasible and costly the intervention may be to implement in their setting, and how rigorous the study design was which will affect the degree of confidence that similar results might be obtained to those that are published. In order to select an appropriate CAI program, educators must also consider the diverse learning needs of students within the context of particular classroom environments. For example, some products have greater efficacy in specific areas such as reading fluency versus comprehension, thus selection or utilization may be fine-tuned to specific skills. Some products require greater operational support from teachers and students are less able to work independently, which may be less useful in some classrooms or with certain student populations. Thus, product selection involves knowledge of research and the ability to apply it to practice, an area that a majority of new teachers believe they have not been adequately prepared in (Melnick & Meister, 2008). This reflects the need for teacher preparation in effective use of CAI to be based in general evidence-based practice models so they can become educated purveyors of research and capable of going beyond simple identification of "evidence-based interventions" on the What Works Clearinghouse web site maintained by the Institute of Educational Science.

3.2 Integration into the Classroom

In the study reviewed above, the interventions were implemented by trained research assistants during an afterschool program created specifically for the project. Although this implementation structure had the advantage of avoiding any conflicts with regular school-day activities and thereby served as supplemental instructional time, replication outside of a research studywould require planning and resources beyond an individual teacher's classroom. Additionally, there was a low student-teacher ratio which has beenassociated with increased effectiveness of software reading products in first grade (Dynarski et al., 2007), suggesting that teacher availability to facilitate CAI is important. Administration by regular or special education teachers to small groups within the regular instructional day may avoid some of the implementation demands of our study, particularly if teachers build it into their small group schedule and target those students who do not work well independently. However, this may reduce students' time spent in other instructional activities, which may not be ideal.

One important classroom implementationissue is how teachers will monitor and support students' use of software programs, particularly when such programs are typically not available to all students at one time. Despite the potential for increased engagement of at-risk students, even carefully selected software programs will require some level of adult

assistance or reinforcement to ensure that students understand the directions and work effectively on them. For example, in our study, group and individual reinforcers were utilized to promote cooperation and motivation to work on the computer tasks and were considered critical to maintain the engagement of young inattentive students on more challenging work. At a minimum, best practice would suggest that CAI should be reinforced by proven teaching principles such as active engagement, immediate and consistent feedback, and connections to real-world contexts (Roschelle et al., 2000). Supervision and reinforcement could be provided by a teacher assistant in the younger grades or perhaps a parent volunteer, although this would require school-wide planning for efficient implementation for targeted students.Teacher facilitation nonetheless appears to be a critical factor in the effectiveness of CAI for young students with disabilities (Lau, Higgins, Gelfer, Hong, & Miller, 2005; Powell, Aeby, & Carpenter-Aeby, 2002), and should therefore be carefully considered in planning for effective implementation.

Finally, there are also inherent technical demands with any software program that some teachers may find challenging and that may require on-site technical support, particularly with outdated hardware which is not uncommon in many schools (Bauer & Kenton, 2005).However, a recent large-scale effectiveness trial of a wide range of products across grades and content areas suggests that most technical difficulties encountered are relatively minor and easily corrected or worked around (Dynarski et al., 2007). In the study described above, considerable time was spent during a pilot year gaining familiarity with the technical aspects of the software programs and identifying specific activities that were appropriate for the sample that targeted the areas of need. This is a luxury that many schools may not have when they make a decision to initiate a new CAI program, and as noted, teachers have limited time for additional instructional preparation time. Realistically then, incorporating CAI into existing practice in a way that is beneficial for both teachers and students is likely to require adequate Instructional Technology (IT) and administrative support as well as professional development.

3.3 Instructional Management of Inattentive Students

Effective use of CAI for inattentive students should also be considered in the broader context of a teacher's general instructional management – in particular, how well teachers are able to keep young students actively engaged in learning activities. Research provides strong evidence that instructional and management strategies, including those that might be employed to maintain students' focus on more challenging CAI tasks, increase on-task behavior (Cameron, Connor & Morrison, 2005; Pianta, LaParo, Payne, Cox, & Bradley, 2002) and may influence the success of inclusive practices for students with disabilities. Behavior management is also highly relevant for inattentive students because so many of them also demonstrate significant disruptive behaviors, as was seen in our study. Unfortunately, such strategies have typically been overlooked in elementary teacher education programs (Oliver & Reschly, 2010). This reflects the broader neglect of classroom organization and management in teachers' pre-service training and professional development, along with limited preparation in modifying instruction for students with disabilities (Holdheid & Reschly, 2008).

Although teachers' abilities to meet students' diverse learning needs is widely recognized as important by educators, new teachers report a lack of both confidence and skills in providing a positive and productive classroom environment (Melnick & Meister, 2008) which is necessary to maximize academic learning time for children with attention problems. In addition, teacher practices withinattentive students appear to be variable and not well-aligned with best practices. For example, a sample of first grade teachers did not use instructional modifications with inattentive students any more often than with comparison students, unless they had also been referred to a school-based committee for academic concerns (Murray, Rabiner, & Hardy, 2010). This findingis consistent with a larger body of literature on classroom management strategies for students with disruptive behavior and emotional behavioral difficulties (Oliver & Reschley, 2010), highlighting the need for improved teacher education in this area.

Not surprisingly, teacher preparation programs provide limited time and emphasis on classroom management skills and working with students with disabilities.Even within special education programs, only 27% have one course specific to classroom management (Oliver & Reschley, 2010). Moreover, examination of course syllabi reflect a lack of attention to proactive management strategies and comprehensive management approaches which are considered best practice. Similarly, less than one-fourth of elementary teachers report having received adequate training in working with students with emotional disturbance (Wagner, Friend et al., 2006), many of whom present with attention problems.Clearly, both regular and special education teachers need better preparation to address the management challenges of the young inattentive student. Strengthening teachers' more general instructional and management skills will also enhance their effective use of CAI.

4. Implications for Teacher Preparation and Professional Development

4.1 Pre-service Training Recommendations

Several years ago the Office of Technology Assessment (OTA) reported numerous limitations in teachers' education in

technology including faculty's failure to model technology use, the lack of field experience modeling the use of technology, and the isolation of technology from the main curriculum and pedagogy (OTA, 1995). Despite the fact that a majority of teacher education programs now provide an education technology course of 1 to 4 credits (Kleiner, Thomas, & Lewis, 2007), pre-service and in-service teachers continue to report a lack of confidence in their ability to integrate technology into their curriculum (Bauer & Kenton, 2005; Wozney, Venkatesh & Abrami, 2006). This likely reflects some of the challenges to effective CAI use highlighted above, including selecting appropriate software to address specific student needs, monitoring and facilitating student use within the larger classroom, aligning with teachers' pedagogical orientation, and embedding CAI use within evidence-based instructional management.

In order to better prepare teachers to use CAI in the classroom, actual and virtual learning environments where technology is integral to the teacher development process are needed (Wedman & Diggs, 2001). This will require adoption of a new framework for faculty development that addresses a number of areas such as context, attitude, and organization which go beyond traditional faculty development approaches focused solely on knowledge and skills. A broad, systemic instructional improvement approach such as the performance support model proposed by Wedman & Graham (1998)may be useful in enhancing teacher development in this area.

In order for teachers to more effectively integrate technology into classroom instruction, it has been recommended that technology skills be integrated throughout the teacher education curriculum in connection with specific subject matter content and pedagogy (Kay, 2006) as well as in field experiences (Ottenbreit-Leftwich et al., 2010). A recent qualitative summary of 19 studies identified several content and delivery methods that provide a useful model for designing pre-service technology training (Tondeur et al., 2012). Some of these critical methods include linking conceptual information to practices that promote teachers' understanding of the reasons behind using technology for teaching specific content to targeted groups of students, e.g., students with attention problems.Providing good role models for technology integration and receiving feedback from experts is considered especially beneficial.Field placements with teachers who can model use of CAI along with a set of strong management skills would also be highly valuable. At the institutional level, technology planning and leadership, training staff, and access to resources are important for increasing the learning experience of pre-service teachers. Moreover, teacher educators may need their own staff development to enable them to teach and model technology integration effectively (Goktas, Yildirim & Yildirim, 2009).

In addition, teacher pre-service training may need to address teachers' attitudes related to CAI utilization as well as their technical skills. This is indicated by research showing that teachers' perceived value of computer technology predicts its use (Lambert et al., 2008) and that classroom integration is predicted most strongly by teachers' personal use of computers outside of the classroom (Wozney, et al., 2006). Negative attitudes towards CAI use may be difficult to change, although there is indication that pre-service coursework may have a positive impact (Lambert et al., 2008). Providing a supportive environment in which teachers can participate in discussion groups to reflect upon their attitudes about the role of technology in student learning and how it fits with their core visions of teaching is thought to be particularly helpful (Jang, 2008).

4.2 In-service Training Recommendations

Ongoing professional development and planning around technology integration and application to students with disabilities is also needed for in-service teachers. As we learned in our study and as washighlighted in a national study of reading software for 1st graders, one day of training with a specific software product is insufficient for teachers to feel adequately prepared to implement CAI, even with access to IT support (Dynarski et al., 2007). This is consistent with the broader professional development literature indicating that effective training in any evidence-based practice requires more than the typical one-time didactic in-service learning opportunity (Yoon, Duncan, Lee, Scarloss, & Shapley, 2007). Ideally, ongoing professional development would be provided within professional learning communities or perhaps grade-level teams, an approach that could provide a non-threatening learning environment to plan and problem-solve a range of issues related to effective use of CAI. Access to a technology coordinator who can provide assistance with planning lessons incorporating CAI to meet specific educational needs for particular students would also be helpful.Other areas that should be addressed during in-service training are how CAI can be designed to complement other instructional activities and to better meet the needs of individual students, including those with attention problems. With more knowledgeable staff, CAI would likely be incorporated more systematically into pre-referral intervention plans and even Individualized Educational Plans, if indicated.

With regard to more general classroom management strategies for young students with attention problems and related disabilities, the specific content knowledge, practice and support that are needed for in-service teachers has not been well studied. As noted, however, new teachers in particular are likely to lack skills in this area and those who do not develop such skills may be more likely to leave the teaching profession. Moreover, given that most young students with attention problems are not placed in special education classrooms, a focus on training for general education elementary

teachers appears indicated. There are existing comprehensive training programs such as the Incredible Years Teacher Classroom Management Program (Webster-Stratton, 1999) that have been demonstrated to change teacher management practices and increase use of proactive discipline.In addition, coaching in classroom management through the Classroom Check-Up model has proven effective in changing practice through multiple observations in the classroom, feedback, and modeling (Reinke, Lewis-Palmer & Merrell, 2008). Although the availability of specific evidence-based training and coaching programs in the field may be limited, the key elements for improving teachers' classroom management skills will likely include initial active and collaborative training with follow-up coaching to support teachers with classroom implementation. Incorporating such an approach into ongoing professional development in classroom management would likely benefit those students with or at risk for attentional and behavioral disabilities in particular, and increasethe effective use of CAI.

5. Summary and Conclusions

As discussed, effective use of CAI holds potential for improving young students' attention and academic performance. The evidence-base supporting this intervention is growing, although additional work on its efficacy for young students with disabilities is clearly needed. As is true for many educational interventions, field use sometimes precedes research. Although many would consider this problematic, an advantage is that implementation issues or concerns are identified and can be problem-solved. Given that CAI is an instructional approach that will continue to be utilized in schools, likely at increasing rates as technology advances, itseems prudent to thoughtfully consider teacher education issues in this area.

In sum, CAI currently appears under-utilized for young at-risk students; this islikely related to a number of implementation challenges and limitations in pre-service and in-service trainingin integrating technology into classroom instruction. In particular, teachers may lack knowledge of how to select specific CAI software programs to meet individual students' learning needs (particularly those with disabilities), how to address technical demands of the programs, how to integrate CAI use into their overall instructional approach, and how to facilitate student use within their larger classroom. Teachers may also hold attitudes or beliefs that limit their effective use of CAI.

In order to improve teacher education in this area, systematic faculty development, increased technology planning and leadership, and access to resources will be needed at an institutional level. Critical components of pre-service training to enhance the effective use of CAI appear to be the integration of technology skills throughout the course curriculum and in field placements, and linking the use of CAI to conceptual models of its role in targeting specific student instructional needs. Teacher reflection in the context of peer groups where ongoing professional development and collaborative instructional planning can occur also appear important for addressing attitude and belief barriers. Finally, improved training in proactive classroom management strategies to support effective CAI implementation is needed. Although this may appear to be a tall agenda for teacher educators, it is one that warrants serious consideration if we are to maximize effective use of CAI for young students with attention difficulties.

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