

**The Implications of Computer-Assisted Instruction on
Attention Deficit Hyperactive Disorder (ADHD):
A Review, Critique and Synthesis
of the Literature**

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Introduction

This article reviews some of the research that has been conducted regarding the use of Computer-Assisted Instruction (CAI) with students who have Attention Deficit Hyperactivity Disorder (ADHD). I have recognized the challenges faced by students with ADHD on both a personal and professional level. My brother has ADHD and this caused him a great deal of difficulty, which contributed to him eventually dropping out of school. As a teacher I frequently encounter students and teachers who are trying to work through the struggles faced with ADHD. It is from these experiences that I have gained an interest in the research surrounding ADHD. In this paper I will conduct a literature review that is organized into three parts. Firstly, I will give reasons for conducting the research. Next I will review, summarize, and critique the literature. Lastly, I will discuss possible solutions that could help students with ADHD and suggest where further research is needed.

Attention Deficit Hyperactivity Disorder (ADHD) is a neurodevelopmental disorder which characteristics include the inability to stay focused and hyperactivity (Xu, Reid, & Steckelberg, 2002). It is estimated that ADHD affects roughly 3 to 5 percent of school-aged children, with boys being affected more often than girls by a ratio of 2:1 to 5:1 (Xu, et al., 2002). As a result, considerable attention has been dedicated to developing teaching methods and strategies to combat the serious challenges faced with ADHD. Technology has been seen as a new pedagogical tool that could potentially offer assistance to those students with ADHD. Coupled with the proliferation of computers

within the school system, educators have an opportunity to use these tools in assisting students with learning disabilities such as ADHD. The computer offers instant feedback with its graphics, sound, animation, colour, and ability to present real world situations. Thus, the computer could be an ideal instructional tool for students with ADHD. Much can be gained by looking at a selection of literature that specifically analyzes CAI and its effects on students with ADHD.

Review of the Literature

Clarfield and Stoner's 2005 article investigated whether or not a computer program (Headsprout Reading Basics) was effective in improving students with ADHD's reading and fluency. The researchers created a multiple-baseline design across participants and their main goal was to identify the effects of computer assisted instruction (CAI) on attention, oral fluency, and task engagement (Clarfield & Stoner, 2005). The participants of the study were three Caucasian boys from both a kindergarten and grade one classroom with ADHD from a rural elementary school in Massachusetts. The participants exhibited reading difficulties, and were prescribed with different doses of methylphenidate (e.g. Ritalin) medication.

Students in the study were observed twice per week (using BOSS – Behaviour Observation of Students in Schools) during the baseline condition to determine the frequency that each student exhibited off-task behaviour. During the baseline condition, students were observed for approximately 10 minutes during either independent seatwork or small group reading instruction. Student behaviour was

classified as displaying, active engagement, passive engagement, or off-task behaviour (Clarfield & Stoner, 2005). After three weeks, during the experimental condition using CAI in the computer lab, the observation of participants was reduced to once every two weeks. On most occasions, each student finished one lesson per session (Clarfield & Stoner, 2005).

Clarfield and Stoner determined that CAI benefitted all three students. All three participants displayed a decrease in off-task behaviour and an increase in oral reading fluency (Clarfield & Stoner, 2005). Furthermore, they found Headsprout to be highly engaging and able to provide the students with reinforcement and individualized teaching (Clarfield & Stoner, 2005).

While I find Clarfield and Stoner's study to be well thought out, I believe that it has some limitations. Firstly, although a qualitative study, I believe it was detrimental that they used only three students of such a young age (kindergarten and grade one). Furthermore, the participants were each prescribed different doses and types of medication including one student who changed their prescription in the middle of the study (Clarfield & Stoner, 2005). In addition, I have reservations regarding the use of the program Headsprout in this study because its effectiveness has not been determined with students without ADHD. Furthermore, I feel that the in class observation period was flawed and its validity threatened because students could have been aware they were being observed (Clarfiend and Stoner, 2005). Finally, the intervention portion of

the study happened outside of the classroom, which I feel may have skewed the results of the study.

Mautone, DuPaul, and Jitendra examined the effects of CAI instruction on the performance in mathematics and classroom behaviour on three children (first through fourth grade) with ADHD (Mautone, DuPaul, & Jitendra, 2005). Math Blaster, which focuses on basic mathematical skills, was used in the study (Mautone et al., 2005). None of the participants in Mautone et al. were taking psychotropic medications at the time of the study (Mautone, et al., 2005). Comparisons were made between participants' academic achievement and behaviour using CAI and participants doing independent seatwork in the classroom environment. The study concluded that the use of CAI was effective in improving math skills (fluency) and on-task behaviour of students with ADHD (Mautone et. al., 2005).

Although I believe that Mautone and his colleagues have conducted a comprehensive study, I observed some potential problems within the study. I believe the sample size could have been larger as only three students were included in the study. In addition, I feel that it was detrimental to observe students using CAI in a separate room from where they observed for their baseline observation. The absence of a follow-up, in my opinion, also hurt the study, as we don't know if the improvement gains made by the students were maintained. My final concern with this study concerns the absenteeism of one of the participants. As a result of this particular student being absent from school, some data was missing (Mautone, et al., 2005).

Kotwal, Burns and Montgomery investigated whether or not a cognitive training computer program could treat a 13-year-old student with ADHD (Kotwal, Burns, & Montgomery, 1996). The study was conducted over a period of three months and included 35 sessions using Captain's Log software to develop the student's attention, memory, concentration, and problem solving skills (Kotwal, et al., 1996).

The study concluded that the participant exhibited an improvement in behaviour and academic success (Kotwal, et. al., 1996). The participant showed an increase in on-task behaviour and a decrease in disruptive behaviour, as well as a decrease in hyperactive behaviour at home (Kotwal, et. al., 1996). The Conners Teacher Rating Scale, however, indicated both an improvement and deterioration in behaviour (Kotwal et al., 1996). A follow-up to this study, 7 months later, revealed that the student deteriorated slightly after treatment, but most of what was gained continued.

Due to some limitations in this study, I feel the author's findings should be observed with some caution. One of my concerns is the fact that only one subject was used in the study and he had discontinued his medication use (Ritalin) 15 days prior to the study (Kotwal et al., 1996). Discontinuation of prescribed medication so close to the study may have affected the outcome of the research. Also, the authors bolster their conclusion with informal verbal reports and data from teachers and mothers. This is concerning as studies have shown that ratings generally improve from first to second assessment from parents and teachers (Xu, et al., 2002).

A similar study by Slate, Meyer, Burns, and Montgomery investigated the effects of a computer software package (Captains Log) on the academic fluency and behaviour of four, severely emotionally disturbed students between the ages of 7 and 11 with ADHD (Slate, Meyer, Burns, & Montgomery, 1998). The study took 16 weeks and consisted of 64 training sessions (30 minutes each) and treatment success was determined by observing behavioural points on a tracking system, pre and post measures and computer advancement (Slate et. al., 1998).

The study determined that 2 of the participants showed improvement in controlling their hyperactive behaviour, 3 of the children showed improvement in mathematical accuracy and speed and vocabulary knowledge, but only one student demonstrated a significant difference in behaviour based on the Conners Rating Scale (Slate et. al., 1998). The authors concluded that the computer program for cognitive training, Captain's Log, could be an effective tool for treating ADHD when teamed with conventional treatment measures.

I believe that this study contains some concerns that should be acknowledged. Firstly, all of the participants at the time of the computerized cognitive training (CCT) were also receiving other forms of medication and behavioural modification techniques. Due to this, it is difficult to determine if the CAI or the behavioural modification techniques were instrumental in altering the behaviour. In addition, I believe it is difficult to determine if ADHD is causing the students' behaviour, as they are also

severely emotionally disturbed and some of the participants were either sexually or physically abused (Slate et al., 1998).

The purpose of Fenstermacher, Olympia, and Sheridan's study was to determine the effects a social skills computer program had on children with ADHD. The study included four boys between the ages of 10 and 13 from two school districts (Fenstermacher, Olympia, & Sheridan, 2006). Three of the participants were Caucasian, while the fourth student was biracial (Fenstermacher et. a., 2006). Developed by Fenstermacher, the software used for this study was created to develop student's social skills (Fenstermacher, 2006). The students participated in the study for 6 weeks, two times per week for one hour in a clinic location (Fenstermacher et al., 2006). During the baseline treatment, the participants' problem solving behaviour was observed by trained facilitators during a role-playing game with peers. Next, the students participated in CAI, which was administered by a videotaped actor (Fenstermacher et al., 2006). The study revealed that students who suffered from ADHD demonstrated improved behaviour as well as problem-solving skills as a result of using the computer program.

Fenstermacher and his colleagues have conducted a rigorous and complete study but there is some apprehension on my part for several reasons. Firstly, only one of the students was using stimulant medication. I believe for consistency purposes the participants should either all be on medication or not. I am also concerned as the study was being conducted in a clinic setting as opposed to a school. Students were taken out

of their school environment and as a result, behaviours could have been altered as a result.

Synthesis and Conclusion

The common theme that emerged in each of these studies is that technology (computer hardware/software) is a positive tool that educators could implement in reducing the negative problems associated with ADHD. There were some gains in student behaviour and academic achievement that should not go unnoticed. However, there needs to be caution in the findings and how this technology is implemented. In each of the studies, the authors extolled the virtues of the computer in combating ADHD even though, in some cases, improvements were either minimal or not maintained over a long period of time. Furthermore, in each of the studies there were other behaviour modification treatments or overlapping emotional problems mixed in with CAI. For example, except for the Mautone et al. study, almost all of the students were being medicated to help with their ADHD. In addition, the small sample size for each of the studies, even though they were qualitative, may have been detrimental to the findings. It may have been prudent, especially for the Kotwal et al. study to use a larger sample size.

There were some commonalities within each of these five studies as well. In two of the studies the same software (Captain's Log) was used in their studies. In all of the studies, a form of the ADHD rating scale was used for the purposes of selecting their participants. Two of the studies used the Conners teaching rating scale and Wechsler

Intelligence Scale for Children. In addition, for each case, students, although they may have been observed within the classroom, were taken out of their classroom into a different environment for CAI. Thus, placing the students into a different environment may have affected the outcome of the study. It would have been interesting to see if the findings would have been different had the students been observed in the same environment during CAI. Finally, all of the participants in each of the studies met the criteria for ADHD based on the ADHD rating scale (such as Rating Scale-IV, DSM-III or DSM-IV).

It is apparent that further research is required in looking at the effectiveness of computer technology in aiding students with ADHD. There is a need for computer hardware and software to meet the needs of students with ADHD. As well, teachers need to be better trained to best implement this technology. Although, computer technology shows promise for students with ADHD for the future, many questions still need to be answered: How can teachers better incorporate the computer into the classroom? How can teachers use the technology to achieve behaviour gains and academic success? How will educators know which types of software and hardware to use with students with ADHD? Will students with ADHD maintain their gains achieved from using CAI? How can we determine the most effective software and hardware for helping those students with ADHD? Do teachers notice a difference in their students' academic success and behaviour after using CAI? As well, does the computer software packages that were tested on students with ADHD have a favourable impact on students

who are not designated with ADHD? In the future it is my hope that some of these questions will be answered.

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